AN INVESTIGATION OF THE SOCIOECONOMIC GRADIENT OF PHYSICAL CAPABILITY AMONG OLDER ADULTS USING THE CANADIAN LONGITUDINAL STUDY ON AGING (CLSA)

by

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Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

To Mom and Dad.

Thank you for everything.

TABLE OF CONTENTS

LIST OF TABLES vi
LIST OF FIGURES viii
ABSTRACT ix
LIST OF ABBREVIATIONS USED x
ACKNOWLEDGEMENTS xi

CHAPTER 1: INTRODUCTION 1
CHAPTER 2: OBJECTIVES 3
CHAPTER 3: BACKGROUND 4
3.1. The Socioeconomic Gradient of Health 4
3.2. Self-Rated Health (SRH) 6
3.3. Physical Capability Measures 7
3.3.1. Measuring Chair Rises 8
3.3.2. Determinants of Chair Rises 9
3.3.3. Future Health Outcomes 10
3.3.4. Issues to Consider When Using the Chair Rise Test in Health Inequality Research 11
3.4. Gaps in the Literature 14
CHAPTER 4: METHODS 16
4.1. Study Population 16
4.2. Variables and Measures 17
4.2.1. Chair Rise Test 17
4.2.2. Chair Rise Test Ability 21
4.2.3. Health Variables 21
4.2.4. Frailty Index 22
4.2.5. Socioeconomic, Demographic, and Health Behaviour Factors 22
4.3. Analysis 23
4.4. Data Access and Ethics 25
4.5. Stakeholder Engagement 25

CHAPTER 5: RESULTS 27
5.1. Descriptive Characteristics (Results corresponding to the analysis for Objective 1) 27
5.2. Dimensions of Health and the Chair Rise Test (Results corresponding to the analysis for Objective 2) 41
5.2.1. Chair Rise Test Time 41
5.2.2.Age- and sex-stratified analysis for the dimensions of health and the chair rise test (Results corresponding to the analysis for Objective 4) 47
5.2.3. Chair Rise Test Ability) 47
5.3. Socioeconomic Status and the Chair Rise Test (Results corresponding to the analysis for Objective 3) 52
5.3.1. Chair Rise Test Time 52
5.3.2. Age- and sex-stratified analysis for socioeconomic status and the chair rise test (Results corresponding to the analysis for Objective 4) 62
5.3.3. Chair Rise Test Ability 62
CHAPTER 6: DISCUSSION 69
6.1. General Discussion 69
6.2. Stakeholder Engagement 75
6.3. End-of-Project Knowledge Translation 77
6.4. Strengths and Limitations 78
6 5. Policy Implications and Future Directions 79
CHAPTER 7: CONCLUSION 81
REFERENCES 82
APPENDIX 1: Missing Analysis 89
APPENDIX 2: CLSA Chair Rise Test Standard Operating Procedure 91
APPENDIX 3: Frailty Index 95
APPENDIX 4: Socioeconomic Status Variables 98
APPENDIX 5: Activities of Daily Living Variables 100
APPENDIX 6: Determinants of The Chair Rise Test 102
APPENDIX 7: Unweighted Descriptive Characteristics 107
APPENDIX 8: Chi-Square Tests of Independence 113

APPENDIX 9: Extended Tables for Objective 2 114
APPENDIX 10: Extended Tables for Objective 3 118
APPENDIX 11: Sex-Stratified Analyses – Dimensions of Health and the Chair Rise Test 127
APPENDIX 12: Age-Stratified Analyses – Dimensions of Health and the Chair Rise Test 134
APPENDIX 13: Sex-Stratified Analyses – Socioeconomic Status and the Chair Rise Test 143
APPENDIX 14: Age-Stratified Analyses – Socioeconomic Status and the Chair Rise Test 149

LIST OF TABLES

Table 1. Sample Characteristics (weighted) 28
Table 2. Unweighted Pearson Correlation of Continuous Chair Rise Test Time and Dimensions of Health 41
Table 3. Unweighted Spearman Correlation of Continuous Chair Rise Test Time and Dimensions of Health 42
Table 4. Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Activities of Daily Living (ADL) Difficulties 43
Table 5. Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Instrumental Activities Of Daily Living (IADL) Difficulties.....44
Table 6. Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Self-Rated Health (SRH) 45
Table 7. Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Frailty Index.....46
Table 8. Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Number Of Chronic Conditions 47
Table 9. Unweighted Spearman Correlation of Binary Chair Rise Ability and Dimensions of Health.....48
Table 10. Weighted Logistic Regression Model for Chair Rise Test Ability and ADL Difficulties 49
Table 11. Weighted Logistic Regression Model for Chair Rise Test Ability and IADL Difficulties 50
Table 12. Weighted Logistic Regression Model for Chair Rise Test Ability and Self-Rated Health.....50
Table 13. Weighted Logistic Regression Model for Chair Rise Test Ability and the Frailty Index.....51
Table 14. Weighted Logistic Regression Model for Chair Rise Test Ability and Number of Chronic Conditions.....52
Table 15. Unweighted Spearman Correlation of Income and Wealth Variables.....52
Table 16. Weighted OLS Regression for Chair Rise Test Time and Income.....53

Table 17. Weighted OLS Regression for the Chair Rise Test Time and Objective Wealth 56
Table 18. Weighted OLS Regression for the Chair Rise Test Time and Subjective Wealth 59
Table 19. Weighted Logistic Regression Model for Chair Rise Test Ability and Income. 63
Table 20. Weighted Logistic Regression Model for Chair Rise Test Ability and Objective Wealth.....65
Table 21. Weighted Logistic Regression Model for Chair Rise Test Ability and Subjective Wealth.....67

LIST OF FIGURES

Figure 1. Trajectories of Healthy Ageing 12
Figure 2. The Chair Rise Test Illustrated.....18
Figure 3. Distributions of the Chair Rise Test Times and Abilities 19
Figure 4. Distributions of the Chair Rise Test and the Log-Transformed Chair Rise Test 20
Figure 5. The Distribution of the Chair Rise Test Time and Ability by Sex.....34
Figure 6. The Distribution of the Chair Rise Test Time and Ability by Age 36
Figure 7. The Distribution of the Chair Rise Test Time and Ability by Income 38
Figure 8. Distributions of the Chair Rise Test Time by Sex, Age, and Income 40

ABSTRACT

Background: Understanding health inequalities among older adults is important as Canada's population ages. Health outcomes and health inequalities deteriorate with age, with income-related heath inequalities in Canada worsening in recent decades. Individuals in the lowest socioeconomic positions have the poorest health outcomes, and health outcomes improve in a stepwise fashion among those with higher socioeconomic positions – this is known as the socioeconomic gradient of health. Objective measures of health, including physical capability measures such as the chair rise test, which correlates with future health outcomes and other health measures, may be a vital addition in studies of aging and health inequality in older populations.

Objectives: The overall goal of this project is to explore the use of the chair rise test as a measure of intrinsic capacity (i.e., all physical and mental capacities of an individual without supportive environments) in health inequality studies among older adults. The specific objectives of this project are to: (1) explore differences in the chair rise test across demographic, behavioural and socioeconomic factors, (2) assess associations between the chair rise test and other measures of health, (3) investigate the presence of a socioeconomic gradient in the chair rise test, (4) if the socioeconomic gradient exists in the chair rise test, investigate how it differs by age and sex.

Methods: We used the most recently available, first follow-up data from the Canadian Longitudinal Study on Aging (CSLA) Comprehensive Cohort. Our sample included 24,685 observations (52.6% female, average age 65.1 years, Standard Deviation (SD) = 9.9) who completed both computer-assisted interviews and clinical and physical examinations, including physical capability tests. We created two dependent variables for the chair rise test: chair rise test time and chair rise test ability. We conducted a series of ordinary least squares regression models to assess associations between the chair rise test and other health measures, and socioeconomic (income, education, and wealth), demographic, and health behaviour variables. Additionally, we ran a series of logistic regression models to determine if there was any association between chair rise test ability and the dimensions of health and socioeconomic status variables. We arranged a series of stakeholder consultations with older adults and healthcare workers, and they provided insight into the usefulness of this measure and input on knowledge translation strategies.

Results: 1,288 (5.2%) of the participants in the analytical sample were unable to complete the chair rise test. Of the 23,397 (94.8%) participants who were able to complete the chair rise test, the average time was 12.53 seconds (SD = 3.5). The chair rise test was statistically and clinically, in a predicted manner, associated with all measures of health we assessed. There was a statistically significant and clinically meaningful difference in chair rise test times between the highest and the lowest income groups.

Policy Implications: The chair rise test is an easy to assess, important movement for day-to-day activities, making it a promising objective measure for future research, clinical practices, and population-based studies.

LIST OF ABBREVIATIONS USED

ADL	Activities of Daily Living
IADL	Instrumental Activities of Daily Living
SRH	Self-rated health
CLSA	Canadian Longitudinal Study on Ageing
CDSH	Commission on Social Determinants of Health
CIHR	Canadian Institutes of Health Research
SPOR	Strategy for Patient-Oriented Research
MSSU	Maritime SPOR Support Unit
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

By the year 2030, Canadians aged 65 years and above will make up 23% of the total population – an increase of 7.4% since 2014 (Employment and Social Development Canada, 2014). It is important to understand the overall health of older adults as well as health inequalities among them as this age demographic grows. One well-documented example of health inequality is income-related health inequality. In Canada, inequalities in health related to income level persist and have only worsened over the past few decades (CIHI, 2015). Moreover, these health inequalities form a socioeconomic gradient of health, wherein individuals in low socioeconomic positions have poorer health outcomes than individuals in higher socioeconomic positions (Marmot & Bell, 2016; PHAC, 2018). The same is true among older adult populations. A study from Hajizadeh and colleagues (2016) found that in addition to the well-established trend that shows health outcomes on average generally worsening with age, the socioeconomic gradient of health also widens with age in Canada, thus leaving older adults in low socioeconomic positions at even higher risk for poor health outcomes than younger adults in low socioeconomic positions.

In order to address the socioeconomic gradient of health in older adults, we must pay attention to the choice of appropriate measures of health, which can be either subjective or objective. Subjective health measures are based on individual experience or awareness, and objective health measures are based on observable or measurable assessments (e.g., individual pain is subjective, whereas blood pressure is objective). One measure with which to begin this inquiry is self-rated health. Self-rated health is a frequently used measure of health in the study of the socioeconomic gradient of health. Self-rated health is a predictor of mortality and a variety of future health outcomes, and it correlates with a variety of other health measures (Marmot et al., 1991; Idler & Benyamini, 1997; Moreno et al., 2014). It is a broad measure that is easy to obtain in population-based studies. Self-rated health is a subjective measure of health, and previous research found differences across socioeconomic groups and by age in how people report health, conditional upon their health status (Huisman et al., 2007).

Recent studies have investigated objective health measures, including physical capability measures, to assess the socioeconomic gradient of health. These measures have been used extensively in clinical settings and are gaining popularity in population health studies as well (Bohannon, 2002; Cooper et al., 2010). Physical capability measures, including hand grip strength, walking speed, standing balance, and the chair rise test, are good predictors of future health outcomes and mortality (Cooper, Kuh, et al., 2011). They are also often associated with independent living (Guralnik et al., 1994). The chair rise test is particularly meaningful in terms of independent living. Even so, it has not been investigated as thoroughly as other physical capability measures. Many older people use the chair rise motion (as captured by the chair rise test) many times each day, to stand up from a chair, rise from the toilet, or while exercising. The large sample size and a broad age range of study participants captured by the Canadian Longitudinal Study of Aging (CLSA) gives us an opportunity to explore the chair rise test in the context of health inequality research. Furthermore, the recently published World Health Organization (WHO) Decade of Healthy Ageing Report (2021) offers a rich conceptual foundation for the exploration of physical capability measures in population aging studies. The report makes the distinction between intrinsic capacity (all physical and mental capacities that one can access) and functional ability (one's ability to meet basic needs using their intrinsic capacity with the help of a supportive environment; *Decade of Healthy Ageing: Baseline Report. Summary*, 2021). This distinction between intrinsic capacity and functional ability provides us with an opportunity to clarify what the chair rise test is measuring and the rationale for using it as a measure of intrinsic capacity. Physical capability measures such as the chair rise test, which is correlated with future health outcomes and other health measures, may be an important addition in studies of the socioeconomic gradient of health and health inequality in older adults.

CHAPTER 2: OBJECTIVES

The overall objective of this project was to investigate health inequality among older adults, using the chair rise test as an objective measure of intrinsic capacity. The specific objectives of this project were to: (1) explore differences in chair rise test performance across demographic, behavioural and socioeconomic factors, (2) assess associations between the chair rise test and other measures of health, (3) investigate the presence of a socioeconomic gradient in chair rise test performance, (4) if the socioeconomic gradient exists in chair rise test performance, investigate how it differs by age and sex.

CHAPTER 3: BACKGROUND

3.1. The Socioeconomic Gradient of Health

Most mortality and morbidity measures exhibit a socioeconomic gradient, wherein those in low socioeconomic positions have poorer health and shorter lives than those in high socioeconomic positions, and these health outcomes improve in a stepwise fashion as socioeconomic position improves (Marmot & Bell, 2016). At the individual level, income influences health outcomes through individual access to material opportunities and resources and psychosocial factors including work stress and social capital (Solar & Irwin, 2010; Frolich et al., 2006). Income also influences health behaviours – those in lower socioeconomic positions are more likely to smoke, have a poor diet, and be physically inactive, which increases one's risk of a negative health outcome (Shankar et al., 2010). The socioeconomic gradient in health has been documented for decades, across different countries, and using various measures of health (both objective and subjective; Hakeberg & Wide Boman, 2018). Despite general improvements in overall population health, the socioeconomic gradient of health persists in Canada and has even widened over the past 40 years (Hajizadeh et al., 2016). This gradient is reflected in the presence of chronic conditions, obesity, diabetes, infectious diseases and lung cancer among Canadian adults (Hajizadeh et al., 2016). This widespread example of health inequality is a concern amongst researchers and policy makers from a variety of disciplines from epidemiology to economics, sociology, and philosophy (Marmot & Bell, 2016).

As I write this thesis, in the midst of the COVID-19 pandemic, examples of the socioeconomic gradient of health are endless. Work and working conditions during COVID-19 present an example of the socioeconomic gradient of health in action. A study from Aromí and colleagues (2021) found that since the beginning of the COVID-19 pandemic, individuals in higher socioeconomic positions experienced an intense reduction in mobility (i.e., short bouts of travel for work, leisure, shopping, etcetera) compared to those in lower socioeconomic positions. This implies that those in higher socioeconomic positions may be able to "work-from-home", compared to those in lower socioeconomic positions that may not have the privilege to stay home, thus reducing

potential exposures to COVID-19 among those in higher socioeconomic positions. Similarly, adverse working conditions disproportionately experienced by those in lower socioeconomic positions are associated with a higher risk of certain chronic conditions and risk factors for COVID-19, and with the unequal distribution of the disease burden (Bambra et al., 2020). The presence of a socioeconomic gradient of health during the COVID-19 pandemic is one of many examples of how socioeconomic inequalities inform health outcomes.

The abundance of examples of empirical evidence of the socioeconomic gradient of health is supported by numerous conceptual and theoretical frameworks which centre socioeconomic status – typically measured by social class, income, education, and/or occupation – as a key determinant of health. These traditional measures have been criticized for not fully capturing one's socioeconomic position; for instance, wealth (i.e., accumulated assets and debts) appears to be a more sensitive and representative measure of socioeconomic status than income alone in population health studies (Allin et al., 2009). This is especially relevant in health studies of older adults, as retired persons may no longer have a steady income, making wealth a more important factor than income or occupation (Allin et al., 2009). Studies of older adults call for further investigation into non-traditional measures of socioeconomic position, like wealth.

The Commission on Social Determinants of Health (CDSH) was led by the World Health Organization (WHO) to investigate the complex social interactions that affect population health (Solar & Irwin, 2010). Solar and Irwin (2010) developed a conceptual framework of the social determinants of health for the CDSH, and in it, socioeconomic status is considered a *structural determinant* of health (or a social determinant of health inequality). In this framework, structural determinants refer to the complex relationship between social stratification/hierarchy and the socio-political context, and one's ensuing socioeconomic position. Other structural determinants of health include social class, gender, racism, education, occupation and income, as well as the aforementioned socio-political context (i.e., governance, macroeconomic policies, social policies, public policies, and culture and societal values; Solar & Irwin, 2010). Emerging from these structural determinants of health are the *intermediary determinants* of health (i.e.,

material circumstances, behavioural, biological and psychosocial factors, and the health system) which determine both health risks and access to health resources.

Overall, Solar and Irwin's framework depicts how structural determinants (such as socioeconomic position) inform intermediary determinants, which then inform health (in)equality. Socioeconomic position shapes health through a variety of complex pathways, making the socioeconomic gradient of health an important topic in health inequality research. However, in order to properly study the socioeconomic gradient of health and make informed policy changes, we need to ensure appropriate measures of health are being used. Moreover, in the context of the current research, those measures need to adequately capture the socioeconomic gradient of health in older adults specifically. Self-rated health (SRH) is one example of a subjective health measure that is often used in studies of health in the general population, but further investigation is needed in the use of SRH in studies of health in older adults. It is important to consider both subjective and objective measures of health. Physical capability measures, such as the chair rise test, are examples of objective measures of health that are commonly used in clinical settings and population health studies of older adults.

3.2. Self-Rated Health (SRH)

One frequently used measure of health in the study of the socioeconomic gradient of health is self-rated health (SRH), however, a number of studies show variations in SRH by age and socioeconomic position (Layes et al., 2012; Humphries & van Doorslaer, 2000; Idler & Benyamini, 1997). Clear socioeconomic gradients of SRH have been demonstrated across different measures of socioeconomic position (Hakeberg & Wide Boman, 2018). SRH is subjective, simple, accessible, and does not require any equipment to administer it – the individual is simply asked to rate their overall health on a Likert scale (e.g., "In general, would you say your health is excellent, very good, good, fair or poor ?"). The subjectivity of SRH is beneficial because the measure may capture nuances that certain clinical health measures may otherwise miss. However, subjective health measures like SRH can be problematic, as outlined below. Consequently, there is an increasing interest in investigating objective health measures that address the socioeconomic gradient of health, while still emphasizing the importance of the patient's subjective experiences that are captured by SRH.

Associations between SRH and mortality are apparent in epidemiologic and clinical research, yet little is known about the mechanism(s) behind the association (Jylhä, 2009). One's reported SRH typically changes over time and is influenced by an individual's knowledge about their own health, social and cultural expectations, and adaptability to changes in health and illness (Layes et al., 2012; Jylhä, 2009). Furthermore, there is variation in SRH reporting by age and socioeconomic position (Layes et al., 2012). Individuals in higher socioeconomic positions tend to be more negative about their perceived health status, compared to those in lower socioeconomic positions; similarly, those with the most formal education are more negative about their perceived health status than those with less education (Layes et al., 2012; Dowd & Zajacova, 2010). As for variations in SRH by age, numerous studies found that SRH improves with age, thus reducing the ability of SRH to predict mortality as age increases (van Doorslaer & Gerdtham, 2003; Layes et al., 2012). These variations in age and socioeconomic position warrant investigation into additional alternative health measures in the study of the socioeconomic gradient of health in older adults.

3.3. Physical Capability Measures

Grip strength, walking speed, standing balance, and the chair rise test are easy to obtain, objective measures of physical capability, often used in geriatric or clinical studies of health in older adults (Cooper et al., 2010; Kuh et al., 2005). A number of systematic reviews showed associations between the aforementioned measures and mortality and morbidity in older, community dwelling adults (Cooper et al., 2010; Cooper, Kuh, et al., 2011).

These objective measures of physical capability may provide an opportunity to address issues of reporting variability in SRH, and physical capability measures are becoming increasingly common health measures in the study of the socioeconomic gradient of health in older adults. Hurst and colleagues (2013) found clear gradients in both childhood and adult socioeconomic positions across physical capabilities (grip strength, chair rise time, standing balance time, and timed get-up-and-go) in community-dwelling older adults in the United Kingdom. Similarly, in a study of community-dwelling older adults in England, Steptoe and Zaninotto (2020) found graded associations between socioeconomic status and physical capability measures (grip strength, gait speed,

chair stand failure, and the physical activity index) in their cross-sectional analysis. The researchers also found graded associations with socioeconomic position and decline in physical capability performance (grip strength, gait speed, and the physical activity index) over eight years in their longitudinal analysis, with greater declines occurring in less wealthy individuals. However, a recent study of grip strength, arguably the most studied of the physical capability measures, shows that SRH and grip strength, after adjustment for age, sex, and body size are poor predictors of each other and that grip strength does not demonstrate the expected socioeconomic gradient of health (Asada et al., 2020).

Further exploration into additional physical capability measures, such as the chair rise test, may provide additional insight into appropriate measures to use in the study of the socioeconomic gradient of health in older adults. Despite being an important aspect of daily living for many individuals, the chair rise test has not been studied to the same degree as other physical capability measures. Rising from a chair requires lower body function, strength, power, coordination and balance (Tiihonen et al., 2017; Hardy et al., 2010). Due to the simplicity of assessment and the implications for independent living of the chair rise test, the present study aims to investigate this measure further in the context of the socioeconomic gradient of health.

3.3.1. Measuring Chair Rises

The chair rise motion is used by many on a daily basis to complete a number of tasks, including getting out of bed and rising from the toilet. The chair rise test (also called the sit-to-stand test) is a relatively easy to assess measure of physical capability, that only requires a chair and a stopwatch and does not require any special training to administer. In their systematic review of the optimal chair rise test, Mehmet and colleagues (2020) found that although there is substantial variation in the measure, the most common protocol for the chair rise test consists of an individual performing five chair rises as quickly as possible, measured in seconds, beginning in a seated position and ending in a standing position after the fifth repetition. Moreover, the chair rise test is to be completed without any assistance. The reliability and validity of the chair rise test has been assessed in a number of different settings. In a study of physical performance measures among older adults with dementia, the chair rise test showed good relative reliability (intraclass

correlation coefficient (ICC) = 0.84, 95%CI: 0.73-0.90) while absolute reliability differed based on cognitive impairment (Blankevoort et al., 2013). Additionally, Özkeskin and colleagues (2022) found that the 30-second chair rise test (which the researchers found was strongly correlated with the five-times chair rise test; Spearman correlation coefficient = -0.87) was both reliable and valid when the re-test was conducted one-hour following the initial test in persons with multiple sclerosis (ICC = 0.97, 95%CI: 0.95-0.98).

A recent sub-study of the CLSA from Hao and colleagues (2023) assessed the test-retest reliability of various commonly used physical capability measures and variations of those measures, including how study participants were instructed to perform the chair rise test. In the CLSA, the chair rise test must be completed with the participant's arms crossed over their chest; the variation of the test allowed participants the option to use their arms. The researchers suggested that when administering the chair rise test, participants should be given the option to use their arms to stand as the alternative chair rise test (option to use arms; ICC = 0.79, 95%CI: 0.66-0.86) showed potentially better reliability than the traditional chair rise test (with arms crossed; ICC = 0.64, 95%CI: 0.45-0.77) in the overall sample. Moreover, the researchers found that the reliability of the chair rise test did not differ by age (chair rise with arms crossed: $ICC_{50\text{-}64\ years}$ = 0.55, 95%CI: 0.26, 0.74; $ICC_{65\text{-}74\ years}$ = 0.70, 95%CI: 0.38, 0.85; $ICC_{75+\ years}$ = 0.67, 95%CI: 0.47, 0.80; chair rise test with option to use arms: $ICC_{50\text{-}64\ years}$ = 0.72, 95%CI: 0.44, 0.85; $ICC_{65\text{-}74\ years}$ = 0.82, 95%CI: 0.63, 0.91; $ICC_{75+\ years}$ = 0.75, 95%CI: 0.59, 0.85).

3.3.2. Determinants of Chair Rises

Several characteristics determine whether or not one will be able to rise from a chair and the speed with which a chair rise can be completed. One such determinant is age: physical capability levels decline with age and the time it takes to complete the chair rise test increases as age increases in older, community-dwelling adult populations (Cooper, Hardy, et al., 2011). The ability to complete other physical capability tests (grip strength, walking speed, and standing balance) also declines with age (Cooper, Hardy, et al., 2011). Additionally, in a meta-analysis of physical capability measures in older adults, sex was a determinant of most physical capability measures, including the chair rise test: men were faster at completing the chair rise test than women (Cooper, Hardy, et al.,

2011). Kuh and colleagues (2005) also found that among those still alive of the British adults in the 1946 national birth cohort study, women had significantly slower chair rise times (by 6%) than men when assessed at age 53 years.

Socioeconomic factors also act as determinants of chair rise performance, with individuals in manual labour social classes (based on current or most recent occupation if retired) having slower chair rise test times than those in non-manual labour social classes, among men and women assessed at age 53 years of age from the 1946 British cohort study (Kuh et al., 2005). Lifelong socioeconomic position (encompassing childhood and adulthood socioeconomic position) is positively correlated with chair rise performance assessed at age 53 years, demonstrating a lifelong socioeconomic gradient of chair rises (Strand et al., 2011). Furthermore, in a systematic review and meta-analysis of mostly older populations, Birnie and colleagues (2011) found that upon adjusting for adult socioeconomic position, adverse childhood socioeconomic position was associated with poorer chair rise test performance assessed at a median age of 69 years. Finally, in a study of chair rise performance in older home-care clients over 75 years of age, Tiihonen and colleagues (2017) found that older home care clients who could not complete the chair rise test (50.6% of participants) typically had fewer years of education than participants who could complete the test.

3.3.3. Future Health Outcomes

The chair rise test is a good predictor of future health outcomes including mortality, fall risk, and fracture risk, among others. Numerous studies have found that slower chair rise test time (or the inability to complete the chair rise test) is associated with mortality in 2 to 10 years in community dwelling older adults tested at 53 to over 80 years of age (Guralnik et al., 1994; Cesari et al., 2008; 2009; Cooper et al., 2010; 2014; Kuh et al., 2014). In a study of older adults aged 80 and above, Cesari and colleagues (2008) used the 4-metre walking speed test and a Short Physical Performance Battery (SPPB, including 4-metre walking speed, balance, and chair rise tests) as physical performance measures to predict mortality. The researchers found that the SPPB was the best predictor of mortality during the 24-month follow-up period among the measures used and that performance on the chair rise test alone was able to predict mortality comparably to the whole SPPB. Conversely, Rolland and colleagues (2006) found that the chair rise test

was not a significant predictor of mortality during the average follow-up period of 3.8 years in community-dwelling French women aged 75 years or older.

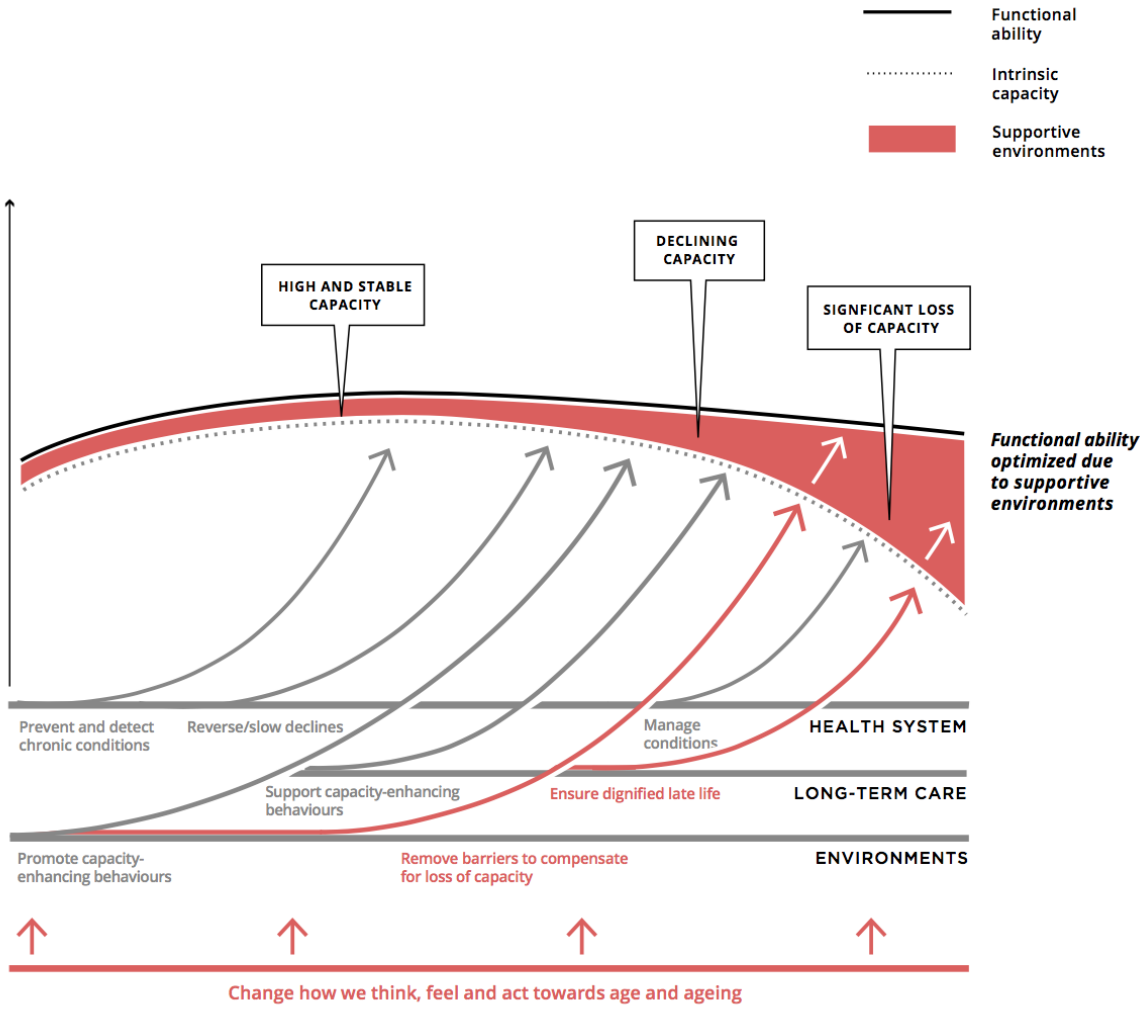
A systematic review of physical capability measures found that slow chair rise test time is associated with other future health outcomes in older adults (ranging in age from 31 to 107 years old, with follow-up times ranging from 1 to 24.4 years), including increased risk of fracture and increased risk of stroke (Cooper, Kuh, et al., 2011). The same study found that after adjusting for age and sex there were no associations between slow chair rise test time and cognitive decline in 5.9 years or hospitalization in 1 year. Additionally, the chair rise test is considered as a measure of muscle strength, lower extremity functioning, and leg extensor power in older adults (Bohannon, 2002; Tiihonen et al., 2017; Hardy et al., 2010). Relatedly, a systematic review and meta-analysis from Muñoz-Bermejo and colleagues (2021) found that the chair rise test is an effective measure of lower limb strength, balance, and mobility in adults aged 21 to 94 years with or without adjustment for existing chronic conditions. The researchers also found that slow chair rise time was a predictor of fall risk in older adults. The majority of studies in the published literature suggest that the chair rise test is a good predictor of mortality and other future health outcomes, but more research is needed to investigate some of the differences found across studies, as well as some future health outcomes that have not yet been investigated in the context of the chair rise test.

3.3.4. Issues to Consider When Using the Chair Rise Test in Health Inequality Research

The World Health Organization (WHO) declared the years 2021-2030 as the "Decade of Healthy Ageing". This call to action seeks to improve functional ability of older adults and ensure that the needs of older adults are being met by communities and health care providers (*Decade of Healthy Ageing: Baseline Report. Summary*, 2021). The WHO defines functional ability as one's ability to meet basic needs, make decisions, be mobile, have relationships, and contribute to society. Functional ability encompasses both intrinsic capacity, defined as "all physical and mental capacities that an individual can access", and the supportive environment in which the individual lives, including home, community, society, technologies, equipment, supports, and services, as shown in Figure 1 (*Decade of Healthy Ageing: Baseline Report. Summary*, 2021).

Figure 1

Trajectories of Healthy Ageing



Note. Trajectories of healthy ageing, optimizing functional ability (*Decade of Healthy Ageing: Baseline Report. Summary*, 2021). This figure depicts the trajectories of healthy aging, with functional ability (shown as a solid black line) optimized through supportive environments (shown in pink). Intrinsic capacity is represented by the dotted black line.

Using this framework to guide my research, I consider a few potential issues when using the chair rise test as a measure of health in the assessment of the socioeconomic gradient of health. Notably, the construct validity of the chair rise test must be clarified. Construct validity refers to how well a test or assessment actually measures what it is

attempting to measure (Smith, 2005). For instance, does the chair rise test measure *intrinsic capacity* or *functional ability*? Someone who uses crutches on a daily basis may not be able to complete the chair rise test without the assistance of their crutches, but if otherwise generally healthy, would rate their health as very good. Many physical capability measures, including the chair rise test, specify that the test must be completed without assistive devices, therefore this person would fail the chair rise test and thus their intrinsic capacity would be categorized as poor. They may not have the intrinsic capacity to complete this test, but with the help of their environment, specifically technology and equipment, they could have the functional ability to complete this test, and more importantly, the associated day to day activities that it is meant to represent.

As our definition of *health* shifts from "simply the absence of illness or disability" (p. 70S) to a more holistic and multidimensional understanding of health, our measures must also shift (Becker, 2006). Historically, traditional measures of health have inadvertently measured intrinsic capacity alone, rather than functional ability. These measures automatically exclude people with disabilities from being considered to be in good health, because the questions or tests do not allow for any accommodations or assistance (Andresen & Meyers, 2000). Health measures that address the intersection of environment and intrinsic capacity, rather than strictly intrinsic capacity, actually allow for the possibility of individuals with disabilities and older adults to be included in the "healthy" category, rather than being unfairly excluded.

With this example in mind, a certain amount of reconceptualization of our current health measures (including physical capability measures) is necessary. In a study of the assessment of health states, Asada (2005) discusses the distinctions between medical technologies, human assistance, nonhuman aids, and accommodating environmental factors, concluding that medical technologies (i.e., a pacemaker) and nonhuman aids (i.e., a prosthetic limb) should be included in health assessment measures. A question still remains as to whether health states with medical technologies and nonhuman aids should be considered as intrinsic capacity within the WHO terminology.

At the least, researchers should engage in discussions regarding what – intrinsic capacity or functional ability – they are measuring, and, if appropriate, consider the inclusion of non-human aids (e.g., canes) based on what is relevant to their study

questions. For instance, a researcher who is interested in assessing lower limb strength might wish to measure the chair rise test in the context of intrinsic capacity, while a researcher who is interested in assessing activities of daily living might want to measure the chair rise test in the context of functional ability. The latter of these two researchers might consider allowing for the measurement to be completed with aids and accommodations that are used by many on a daily basis, moving towards the goal of measuring functional ability.

For ongoing population-based health and aging studies, including the current study, we must take care to note who is being left out on the basis of not having access to aids one would use on a daily basis. Not everyone can participate in the chair rise test, so can we reliably use it to measure the socioeconomic gradient of health? Traditionally, many population-based studies of health and aging use un-assisted physical capability measures to assess overall health in older adults, including the Canadian Longitudinal Study on Aging (CLSA), the dataset that was used in this research. By implicitly excluding and not assessing certain individuals, we are measuring intrinsic capacity rather than functional ability or health. By investigating intrinsic capacity using the chair rise test with the WHO Decade of Healthy Ageing framework in mind, the present study identifies some areas of improvement in using physical capability measures in studies of health, namely, ensuring that existing health studies and surveys are accurately identifying what they are studying (i.e., intrinsic capacity or functional ability?). Furthermore, we included those who were unable to perform the chair rise test in our analysis as having no/minimal intrinsic capacity, rather than automatically treating them as missing data. One of the requirements of the Decade of Healthy Ageing is "more innovation in collecting, analysing and using information", and this research aims to reassess those areas in respect to the chair rise test (*Decade of Healthy Ageing: Baseline Report. Summary*, 2021, p. 13).

3.4. Gaps in the Literature

The current research aimed to address the following three gaps in the existing literature. First, compared to other physical capability measures, the chair rise test has not been studied as thoroughly. Although relatively under-studied, the chair rise test has implications for independent living – the chair rise motion is used daily by many of us (i.e., standing up from the dinner table, getting out of your seat on the bus, etc.). This

study aims to address this gap in the physical capability and socioeconomic gradient of health literature that has yet to be addressed using the chair rise test.

Second, we attempted to make important connections between the empirical research on physical capability measures, and conceptual frameworks of healthy aging and disability measurement. The WHO Decade of Healthy Ageing framework allows us to assess the construct validity of the chair rise test (i.e., are we measuring *intrinsic capability* or *functional ability*?). In the current literature, this question is often not considered, and I addressed this gap by using chair rises as a measure of intrinsic capacity and including those who could not complete the chair rise test in my analysis. Including participants who could not complete the chair rise test allowed us to assess participants who did not have the intrinsic capacity to complete the chair rise test, instead of considering them to be missing values. Finally, the wide age range of participants in the CLSA allows us to assess the chair rise test in adult age groups starting as young as age 45 rather than focusing only on much older adults.

CHAPTER 4: METHODS

4.1. Study Population

This study was a secondary analysis of the first follow-up data from the Canadian Longitudinal Study on Aging (CLSA), which includes 51,338 adults between the ages of 45 and 85 at recruitment (Raina et al., 2019). The overall objective of the CLSA is to better understand the aging process and the dynamic changes that older adults undergo (Raina et al., 2009). The sampling frames for the CLSA Comprehensive include provincial health registry mail-outs, random digit dialing, targeted sampling to try to improve the under-representation of participants with lower levels of education, and the Quebec Longitudinal Study on Nutrition and Aging (NuAge; *CLSA Technical Document*, 2017). The CLSA used the selection criteria from the Canadian Community Health Survey on Healthy Aging (CCHS-HA) to recruit participants. Based on the eligibility criteria of the CCHS-HA, the following groups were also excluded from the CLSA recruitment: residents of the Canadian territories, residents of certain remote regions, persons institutionalized at baseline, persons residing on Federal First Nations reserves and other provincial First Nations settlements, and full-time Canadian Armed Forces members. Moreover, participants had to be able to physically and cognitively participate in data collection independently at baseline and complete the interviews in either French or English (Raina et al., 2019).

The current project used the CLSA Comprehensive, a subset of 30,097 CLSA participants who reside within a 25-50 km radius of one of 11 data collection sites (DCS) across seven provinces in Canada. The DCSs were located in small urban/rural areas, medium urban areas, and large cities; as such, the CLSA Comprehensive is representative of only those DCS regions (Raina et al., 2019). Participants in the Comprehensive cohort completed both in-person at home computer-assisted interviews and additional questionnaires, tests, physical measurements/assessments, and biological (blood and urine) specimens at the DCS (Raina et al., 2019). The variables cultural/racial background, sex and education are only available at baseline, thus, these variables will be obtained from the baseline data, not the follow-up data.

The first follow-up of the CLSA Comprehensive consisted of 27,765 observations. We excluded a total of 3,077 observations due to missing data, resulting in a final

analytical sample of 24,685 observations. We removed all observations that were missing both of the outcome variables: the chair rise test time and chair rise test ability (n=1,536). We also removed observations that were missing an independent variable that had less than 5% missing in the original sample (n=1,541). When variables had greater than or equal to 5% missing in the original sample we created a missing category (e.g., income, objective wealth, arthritis) or added the missing observations to an existing category. In the cultural/racial background variable missing observations were added to the category called "Other racial/cultural origin(s) or racial/cultural origin(s) not reported" and in the chronic conditions variable missing observations were added to the category called "No condition(s) or no response". Overall, participants with missing data whose observations were the deleted were generally older, less educated, in lower socioeconomic positions, and in poorer general health compared to the analytical sample; Appendix 1 includes further information about the missing analysis and the missing sample.

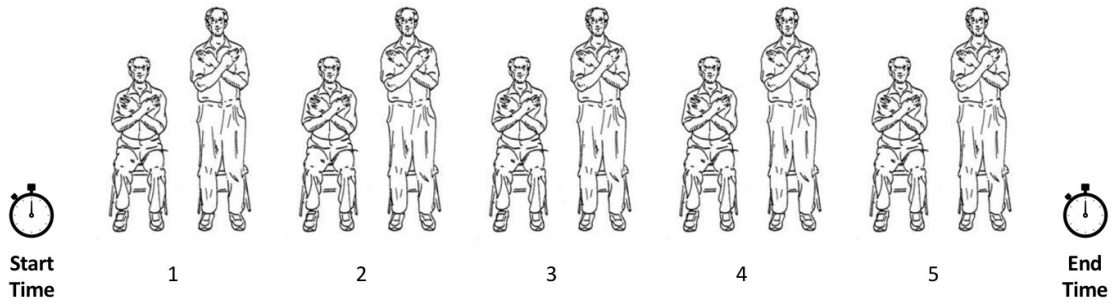
4.2. Variables and Measures

4.2.1. Chair Rise Test

The main outcome of interest was the time of the chair rise test. Chair rise test time is a continuous variable measured in seconds. The chair rise test is a physical assessment conducted at one of the 11 DCS across the country, requiring only a chair without arm rests and a validated stopwatch. From the CLSA chair rise test standard operating procedure (Appendix 2), participants are asked to sit with their feet on the floor hip width apart, sitting as far back in the chair as is possible, with their knees bent at a right angle, and with their arms crossed over their chest (Moss, 2014). After one practice trial, they are asked to go from a sitting to standing position (standing completely upright), repeating this motion five times. The time begins while the participant is in the sitting position and ends when the participant is fully standing after the fifth repetition; the practice trial is not included in the final time (Figure 2; Moss, 2014).

Figure 2

The Chair Rise Test Illustrated

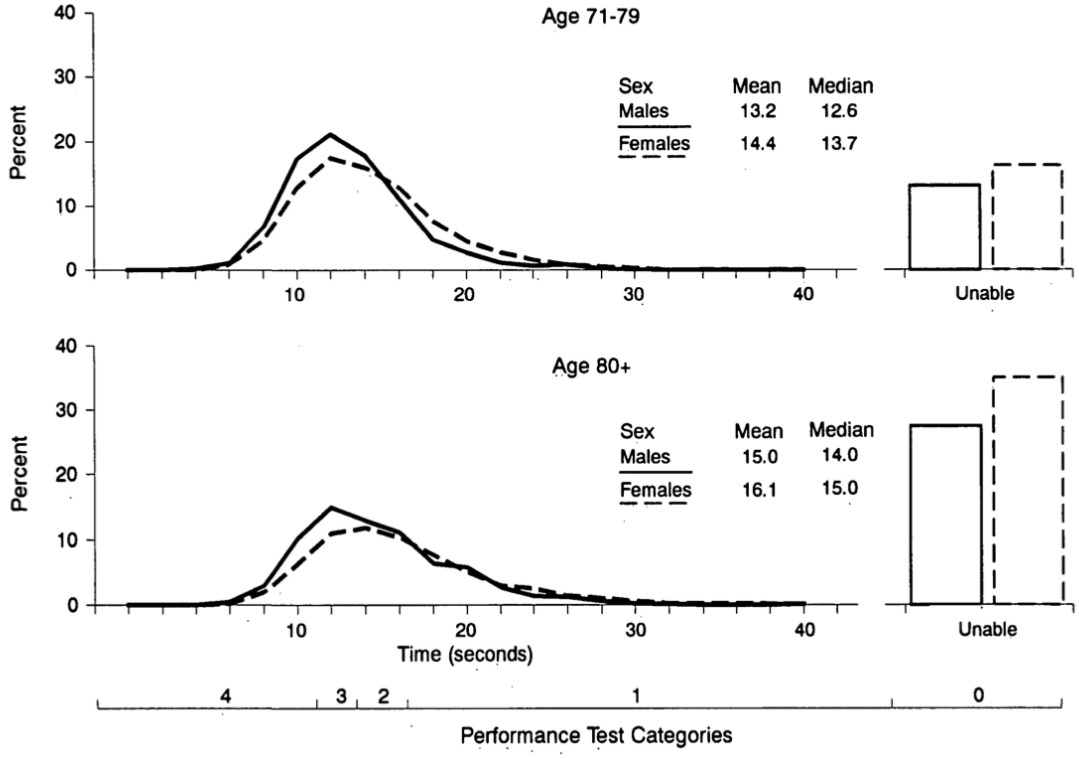


Note. Illustration of the timed chair rise test, from start to finish. Adapted from the CLSA chair rise test standard operating procedure (Moss, 2014; Appendix 2).

Figure 3 shows the distribution of the chair rise test times according to age and sex as collected and analysed by Guralnik and colleagues (1994). They conducted a short battery of physical performance tests (including the chair rise test) in older adults aged 65 and older at baseline, and followed-up once annually for 6 years. The outcomes of interest in this study were mortality and nursing home admission. The distribution of the chair rise test times was right-skewed, with a mean chair rise test time for adult men aged 71-79 being 13.2 seconds and for women aged 71-79 the mean was 14.4 seconds, and for men aged 80 and above the mean was 15.0 seconds and for women aged 80 and above the mean was 16.1 seconds (Guralnik et al., 1994).

Figure 3

Distributions of the Chair Rise Test Times and Abilities

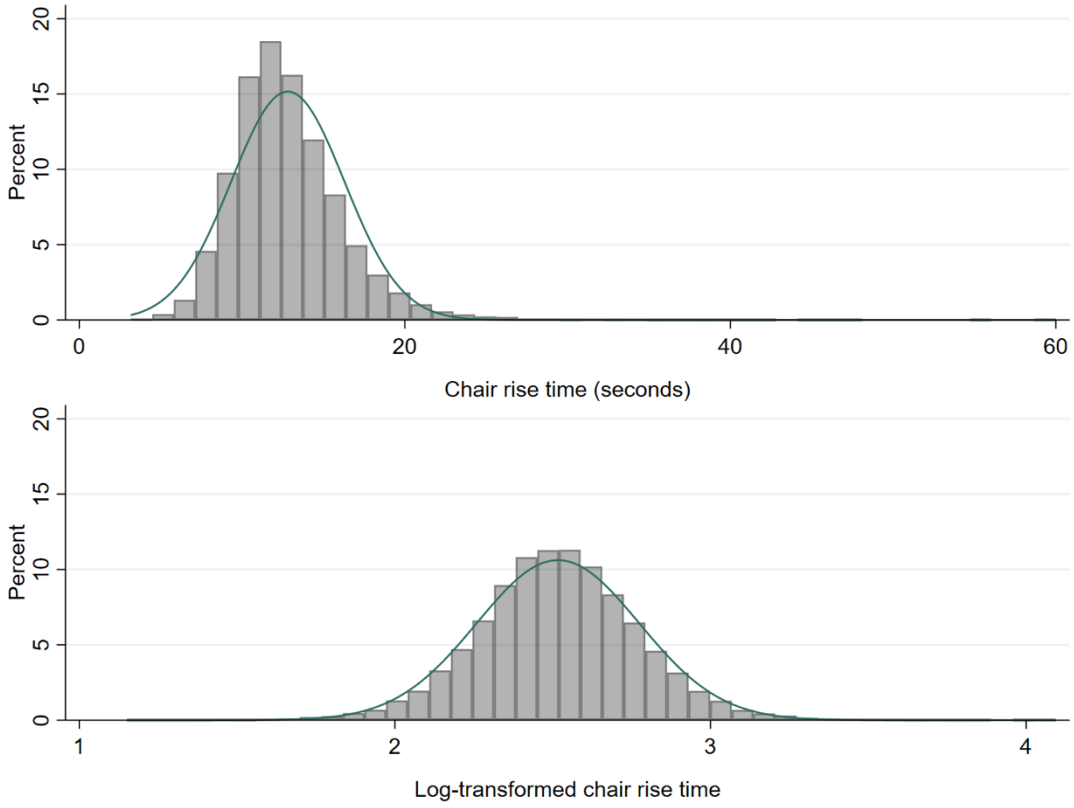


Note. The distributions of the chair rise test times and abilities by age group and sex, reproduced directly from Guralnik et al. (1994).

As shown in Figure 4 (top half), the raw chair rise test time for our sample distribution was similarly very right skewed. To meet the assumption of normality required by ordinary least squares (OLS) regression models, we log-transformed the continuous chair rise test time variable. The log-transformed chair rise test time variable is normally distributed (shown in Figure 4, lower half), and we used this version for our OLS regressions models, which are described in section *4.3. Analysis*.

Figure 4

Distributions of the Chair Rise Test and the Log-Transformed Chair Rise Test



Note. The untransformed continuous chair rise test time distribution is shown on the top and the log-transformed continuous chair rise test time distribution is shown on the bottom.

In the absence of well-established clinically meaningful differences for the chair rise test, I defined "clinical meaningfulness" to refer to how a difference in chair rise test performance is reflected in ten year increases in age. For example, I have found that for every ten year increase in age after 45 years, chair rise test times increase by approximately 1.0 second on average. However, this change is not linear, meaning that the overall difference in chair rise test time between 45 years of age to 55 years of age is on average shorter than the overall difference in chair rise test time between 75 years of age and 85 years of age. Thus, I have taken the approximate average difference in chair rise test time across age groups, rounded to the nearest second for ease of use, to arrive at

the one second change in chair rise test time to be defined as a clinically meaningful difference.

4.2.2. Chair Rise Test Ability

The additional outcome of interest in this study was chair rise test ability, which was a binary variable, categorized as "able" or "unable" to complete the chair rise test. We defined "able" as having a chair rise test time and having completed the full chair rise test (i.e., completed all five repetitions). We defined "unable" as not having completed the full chair rise test (i.e., completed less than five repetitions) or having been unable to participate in the chair rise test due to contraindications or lack of accommodations.

4.2.3. Health Variables

We also assessed to what extent the chair rise test is correlated with the following health variables: self-rated health, Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), chronic conditions, and a frailty index.

Self-rated health (SRH) was measured in the CLSA by asking participants to rate their general health on a five-point Likert scale (excellent, very good, good, fair, poor) via questionnaire. (I)ADLs are examples of functional activities measured by the CLSA using a questionnaire from the Older American Resources and Services (OARS) list. The OARS questionnaire includes questions regarding taking care of appearance, getting out of bed, incontinence, and household characteristics. We created a categorical variable based on the counts of (I)ADLs with two responses: no difficulty with (I)ADLs or some difficulty/no ability to conduct one or more ADL (Appendix 5).

Chronic condition measures include stroke or cardiovascular accident, diabetes, chronic asthma/chronic obstructive pulmonary disease (COPD), cardiovascular disease, high blood pressure, clinical depression, arthritis of the hip or knee, cancer, and Alzheimer's and Parkinson's diseases. These chronic conditions were all measured by a self-report questionnaire and selected based on previous literature suggesting their associations with the chair rise test (Tiihonen et al., 2017) and physical function (Cooper, 2010; 2011; Groll et al., 2005). We created categorical variables for the count of chronic conditions that one has (i.e., no conditions or no response, 1 condition, 2 conditions, 3 or more conditions).

4.2.4. Frailty Index

Following previous investigations of physical capability measures using the CLSA (Radford, 2021), we created a frailty index to measure frailty. The frailty index refers to the accumulation of deficits and potential deficits in an individual, which allows frailty – a relatively broad term – to be investigated in absolute terms, while emphasizing the complex nature of frailty (Rockwood & Mitnitski, 2011). In the current research, the frailty index was composed of the 38 variables outlined in Appendix 3. We categorized frailty using 0.1 unit increments (i.e., ≤0.1, >0.1 & ≤0.2, >0.2 & ≤0.3, >0.3 & ≤0.4, >0.4 & ≤0.5, and >0.5).

4.2.5. Socioeconomic, Demographic, and Health Behaviour Factors

Independent variables of primary interest were socioeconomic status measured by income, education, and wealth (Appendix 4). Income was measured by respondent's total household income via questionnaire with five levels (less than $20,000; $20,000 or more, but less than $50,000; $50,000 or more, but less than $100,000; $100,000 or more, but less than $150,000; $150,000 or more). Education was measured by respondent's highest level of education with the following condensed levels (less than secondary school graduation, secondary school graduation, some post-secondary, and post-secondary degree or diploma).

Moreover, we measured socioeconomic status by wealth, as it has been suggested that wealth is a more appropriate indicator of socioeconomic status in older adults than income (Allin et al., 2009). We used two wealth variables, one objective measure of wealth and one subjective measure of wealth. The objective measure of wealth was assessed by the approximate total of the respondent's savings and investments (referring to an account at a bank, credit union or elsewhere, Registered Retirement Savings Plan (RRSPs), and financial investments outside of RRSPs) with four levels (less than $50,000; $50,000 to less than $100,000; $100,000 to less than $1 million; $1 million or more). Subjective wealth was assessed by the question, "which of these phrases best describes how you (and your spouse/partner) are getting along financially these days?" Response categories were: manage very well; manage quite well; get by alright; don't manage very well/have some or severe financial difficulties.

As independent variables, we also included factors that are shown to be or suspected to be associated with the chair rise test: demographic factors (age, sex, weight, height, cultural/racial background, geographical location), and health behaviour variables (physical activity, social supports, smoking status, alcohol consumption, nutrition; Appendix 6). Age was measured in years via questionnaire and is a continuous variable. We also created categorical variables for age with the following levels: 45 to 54, 55 to 64, 65 to 74, 75+ years of age. Sex was measured as a binary variable via questionnaire as either male or female. Weight and height were both continuous variables, measured in kilograms and centimetres, respectively. Cultural/racial background was measured via questionnaire, and collapsed into variables with guidance from the Ontario Anti-Racism Directorate (Appendix 6; *Anti-Racism Directorate | Ontario.ca*, n.d.; Meng & D'Arcy, 2016). Geographical location was measured by province and urban or rural classification of dwelling.

As for health behaviour variables, we included physical activity, social supports, smoking status, alcohol consumption, and nutrition (Appendix 6). Smoking status was measured by current smoking status (never, former, current). Alcohol consumption was measured by how often the respondent consumed alcohol during the past 12 months (regular drinker (at least once per month), occasional drinker, did not drink in the last 12 months). Nutrition was measured by how many servings of fruits and vegetables the respondent reported consuming per day (fewer than 2 servings; 2-4 servings; 5-7 servings; more than 7 servings).

4.3. Analysis

To explore differences in the chair rise test across demographic and socioeconomic factors (Objective 1), we conducted descriptive statistical analyses (mean and standard deviation) of the chair rise test by the following socioeconomic, demographic, and health characteristics: income, education, wealth (subjective and objective), age, sex, height, weight, cultural/racial background, geographic location, SRH, (I)ADLs, chronic conditions, social supports, physical activity, eyesight, hearing, arthritis, smoking status, alcohol consumption, and nutrition.

In order to assess associations between the chair rise test and other measures of health (Objective 2), we ran separate ordinary least squares (OLS) regression models with self-

rated health, Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), chronic conditions, and the frailty index as independent variables, and the log-transformed chair rise test as a continuous dependent variable. In order to interpret the regression coefficients produced using the log-transformed continuous chair rise test time outcome variable in this OLS regression model, we computed estimated marginal means. Calculating the estimated marginal means allowed us to interpret the regression results in the original scale of seconds, rather than a logarithmic scale. Additionally, in order to assess associations between chair rise test ability and other measures of health, we conducted separate logistic regression models with self-rated health, ADLs, IADLs, chronic conditions, and the frailty index as independent variables, and the binary chair rise ability variable as the dependent variable.

We investigated the correlations between income and subjective and objective wealth using the Spearman Correlation Coefficient. To investigate the presence of a socioeconomic gradient in the chair rise test (Objective 3), we ran three separate OLS regression models with different combinations of socioeconomic variables: (1) education and income; (2) education and subjective wealth; and (3) education and objective wealth. All of these three models also included other independent variables, demographic factors (age, sex, height, weight, cultural/racial background, geographic location), and health behaviour variables (physical activity, smoking status, alcohol consumption, social supports, nutrition), with the log-transformed chair rise test again as the dependent variable. As conducted in objective two, we computed estimated marginal means in order to interpret the regression coefficients produced using the log-transformed continuous chair rise test time outcome variable in this OLS regression model. Additionally, in order to assess associations between socioeconomic status and chair rise test ability, we conducted three separate logistic regression models with the above combinations of socioeconomic variables, and demographic and health behaviour factors as independent variables, with the binary chair rise ability variable as the dependent variable.

To explore whether the socioeconomic gradient differed by age and sex (Objective 4), we conducted age- and sex-stratified analyses for the OLS regression models in objectives two and three.

We evaluated the model fit by obtaining the R-squared for each OLS regression model. We ran the above analyses with the sample weights from the CLSA Comprehensive data in order to adjust for unequal probabilities and to make an appropriate population estimate. We used the Taylor Linearization method to estimate standard errors, addressing the complex survey design of the CLSA (Lohr et al., 2009). Given the large sample size, we considered $p<0.01$ as statistically significant and estimated 99% confidence intervals for regression coefficients. We used Stata 15.1 for all analyses (StataCorp, 2017).

4.4. Data Access and Ethics

Data access for the current research was granted by the CLSA data access committee (Application ID 2104018). This study was approved by the Dalhousie Research Ethics Board (REB # 2022-5956).

4.5. Stakeholder Engagement

Throughout this project, we learned from the experts involved, including older adults and healthcare workers, recognizing the expert knowledge gained from both clinical experience and lived experience. We followed the CIHR's Strategy for Patient Oriented Research (SPOR) which emphasizes the importance of patient-focussed, evidence-based healthcare (*MSSU Strategic Plan 2020-2026*, 2021). We conducted a series of stakeholder consultations with the aforementioned groups of experts by means of the networks of the supervisory committee, to explore the usefulness of the chair rise test in their practices and/or their day-to-day lives. The stakeholder consultations complemented the clinical and academic expertise of the supervisory committee, integrating knowledge translation throughout the project.

The stakeholder consultations consisted of four stakeholders (at last three stakeholders were present at each meeting) who were asked a few general discussion questions related to the research project. I conducted three stakeholder consultation meetings throughout the project, first following the defense of my thesis proposal, second during the data analysis stage with preliminary results, and third following the completion of my thesis research to discuss the results and implications of the research. Given the ongoing pandemic situation, all of these meetings to took place remotely via video call. The first two meetings mainly served to inform the analysis and writing

portion of my thesis, by better understanding how the chair rise test is used by stakeholders. The final meeting informed the way that the information was, and will continue to be, disseminated to stakeholders (those involved in the project and beyond).

CHAPTER 5: RESULTS

5.1. Descriptive Characteristics (Results corresponding to the analysis for Objective 1)

A total of 24,685 participants were included in the analytical sample after 3,077 observations were removed due to missing data (Appendix 1). The analytical sample (52.6% female; average age 65.1 years, standard deviation (SD) = 9.9) was mostly white (92.8%) and living in urban settings (94.8%; see Table 1 for additional demographic characteristics of the sample). Overall, the analytical sample was highly educated (64.8% had a post-secondary degree or diploma) and affluent (38.2% had an annual household income of over $100,000). Similarly, in terms of wealth, 40.3% of the sample reportedly "managed very well" financially and 51.6% of the sample had over $100,000 in savings and assets. Most participants did not report any difficulties with (Instrumental) Activities of Daily Living (87.0% had no difficulties with ADLs, 95.5% had no difficulties with IADLs, and 99.7% had no difficulty getting in/out of bed). Overall, most participants rated their general health as good (31.9%), very good (40.6%) or excellent (17.9%).

Table 1

Sample characteristics (weighted)

(N = 24,685)

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Demographic and anthropometric								
Age (categorical)				<0.001		<0.001		<0.001
45-54	4036	27.7	123	3.1	11.71	2.51	0.07	0.04
55-64	8378	34.8	309	3.7	12.25	3.25	0.11	0.07
65-74	7434	24.1	353	4.8	13.01	3.72	0.15	0.10
75+	4837	13.1	503	10.4	14.24	4.91	0.20	0.12
Sex				<0.001		0.7218		<0.001
Female	12,552	52.6	730	5.8	12.61	3.57	0.13	0.08
Male	12,133	47.4	558	4.6	12.45	3.38	0.11	0.09
Cultural/racial background				0.099		<0.001		0.003
White	23,366	92.8	1209	5.2	12.50	3.53	0.12	0.09
Black	160	1.0	15	9.4	12.77	2.68	0.12	0.07
East/Southeast Asian	285	1.7	10	3.5	12.95	2.52	0.10	0.06
South Asian	201	1.0	13	6.5	14.17	3.60	0.10	0.07
Multiple racial/cultural origins	372	1.8	24	6.5	12.91	3.16	0.12	0.08
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	301	1.8	17	5.7	12.29	2.53	0.11	0.06

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Rurality				0.003		0.1039		<0.001
Urban	22,672	94.8	1211	5.3	12.53	3.45	0.12	0.09
Rural	2013	5.2	77	3.8	12.43	3.89	0.11	0.10
Province				<0.001		<0.001		<0.001
Alberta	2510	11.0	127	5.1	11.78	3.31	0.11	0.08
British Columbia	5248	29.2	228	4.3	13.57	2.75	0.12	0.07
Manitoba	2530	7.0	97	3.8	12.89	4.16	0.12	0.10
Newfoundland and Labrador	1782	1.9	69	3.9	13.84	6.37	0.13	0.17
Nova Scotia	2100	3.1	146	7.0	11.44	4.94	0.11	0.14
Ontario	5474	17.1	265	4.8	13.13	4.27	0.13	0.11
Québec	5041	30.7	356	7.1	11.35	2.59	0.13	0.07
Height (cm) (mean (SD))		0.7070						
168.23 (9.86)								
Weight (kg) (mean(SD))		<0.001						
80.09 (18.37)								
Socioeconomic status								
Education				<0.001		<0.001		<0.001
Less than secondary school graduation	1131	14.8	114	10.1	13.66	2.02	0.17	0.06
Secondary school graduation, no post-secondary	2196	11.2	154	7.0	12.67	2.84	0.13	0.08
Some post-secondary	1756	9.1	123	7.0	12.63	3.47	0.13	0.08

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Post-secondary degree/diploma	19,602	64.8	897	4.6	12.25	3.73	0.11	0.09
Income				<0.001		<0.001		<0.001
< $20,000	1037	5.0	131	12.6	13.66	3.49	0.19	0.10
$20,000 to < $50,000	4807	19.6	383	8.0	13.15	3.71	0.16	0.09
$50,000 to <$100,000	8310	31.7	393	4.7	12.67	3.45	0.12	0.08
$100,000 to <$150,000	4818	20.3	155	3.2	12.13	3.26	0.10	0.06
$150,00 or more	4318	17.9	127	2.9	11.56	2.86	0.08	0.06
Missing	1395	5.5	99	7.1	13.53	4.48	0.15	0.10
Objective wealth				<0.001		<0.001		<0.001
Less than $50,000	4682	23.3	379	8.1	12.77	3.29	0.15	0.09
$50,000 to less than $100,000	3450	14.9	187	5.4	12.56	3.37	0.13	0.09
$100,000 to less than $1 million	11,492	42.9	437	3.8	12.30	3.32	0.11	0.08
$1 million or more	2542	8.7	97	3.8	12.27	3.33	0.10	0.08
Missing	2519	10.2	188	7.5	13.24	4.46	0.14	0.10
Subjective wealth				<0.001		<0.001		<0.001
Don’t manage very well/have some or severe financial difficulties	984	4.9	94	9.6	13.08	3.44	0.15	0.09
Get by alright	4329	21.1	272	6.3	12.73	3.01	0.13	0.09
Manage quite well	8322	33.8	424	5.1	12.52	3.44	0.12	0.09
Manage very well	11,050	40.3	498	4.5	12.37	3.76	0.12	0.09
Health variables								
Self-rated health				<0.001		<0.001		<0.001
Poor	360	1.4	89	24.7	15.56	5.54	0.28	0.12

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Fair	1959	8.2	266	13.6	13.91	3.94	0.20	0.10
Good	7204	31.9	455	6.3	12.91	3.63	0.15	0.08
Very good	10,460	40.6	340	3.3	12.28	3.15	0.10	0.07
Excellent	4702	17.9	138	2.9	11.72	3.18	0.08	0.06
ADL difficulties				<0.001		<0.001		<0.001
No difficulties or inability to complete	20,956	87.0	832	4.0	12.37	3.30	0.11	0.07
1 or more	3729	13.0	456	12.2	13.77	4.60	0.22	0.11
IADL difficulties				<0.001		<0.001		<0.001
No difficulties or inability to complete	23,336	95.5	884	3.8	12.44	3.38	0.11	0.08
1 or more	1349	4.5	404	29.9	15.56	5.37	0.28	0.13
Able to get in/out of bed				<0.001		<0.001		<0.001
Yes	24,610	99.7	1237	5.0	12.53	3.48	0.12	0.09
No	75	0.3	51	68.0	16.16	9.87	0.30	0.12
Number of chronic conditions				<0.001		<0.001		<0.001
No conditions or no response	6256	28.0	152	2.4	11.89	2.84	0.06	0.04
1 condition	7337	30.1	269	3.7	12.25	3.37	0.10	0.05
2 conditions	5602	21.2	321	5.7	12.85	3.67	0.14	0.07
3 or more conditions	5490	20.8	546	10.0	13.58	4.10	0.22	0.10
Health behaviour and other factors								
Eyesight				<0.001		<0.001		<0.001

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Poor or non-existent/blind	267	1.1	39	14.6	13.48	4.04	0.22	0.11
Fair	1790	8.3	128	7.2	13.10	3.45	0.17	0.10
Good	8517	37.3	431	5.1	12.58	3.23	0.12	0.08
Very good	9863	37.8	462	4.7	12.35	3.34	0.11	0.08
Excellent	4248	15.5	228	5.4	12.48	4.31	0.10	0.08
Hearing				<0.001		<0.001		<0.001
Poor	446	1.8	35	7.9	13.11	3.22	0.19	0.10
Fair	3051	13.0	195	6.4	13.05	4.05	0.16	0.09
Good	9809	39.4	435	4.4	12.58	3.47	0.13	0.09
Very good	8073	32.1	409	5.1	12.29	3.22	0.11	0.08
Excellent	3306	13.7	214	6.5	12.40	3.45	0.10	0.08
High social support availability				<0.001		<0.001		<0.001
Yes	21,447	87.5	993	4.6	12.41	3.41	0.12	0.08
No or no response	3238	12.5	295	9.1	13.45	3.90	0.16	0.10
Arthritis (hip or knee)				<0.001		<0.001		<0.001
No hip or knee arthritis	18,443	77.0	746	4.0	12.37	3.27	0.10	0.07
Has hip or knee arthritis	5720	20.4	482	8.4	13.12	3.98	0.19	0.11
Missing	522	2.6	60	11.5	13.02	5.04	0.15	0.09
Fruit and vegetable intake (daily)				<0.001		<0.001		<0.001
Fewer than 2 servings	5878	27.3	447	7.6	12.77	3.24	0.13	0.09
2 to 4 servings	8552	34.8	423	5.0	12.60	3.43	0.12	0.09
5 to 7 servings	7321	27.6	291	4.0	12.42	3.72	0.12	0.09

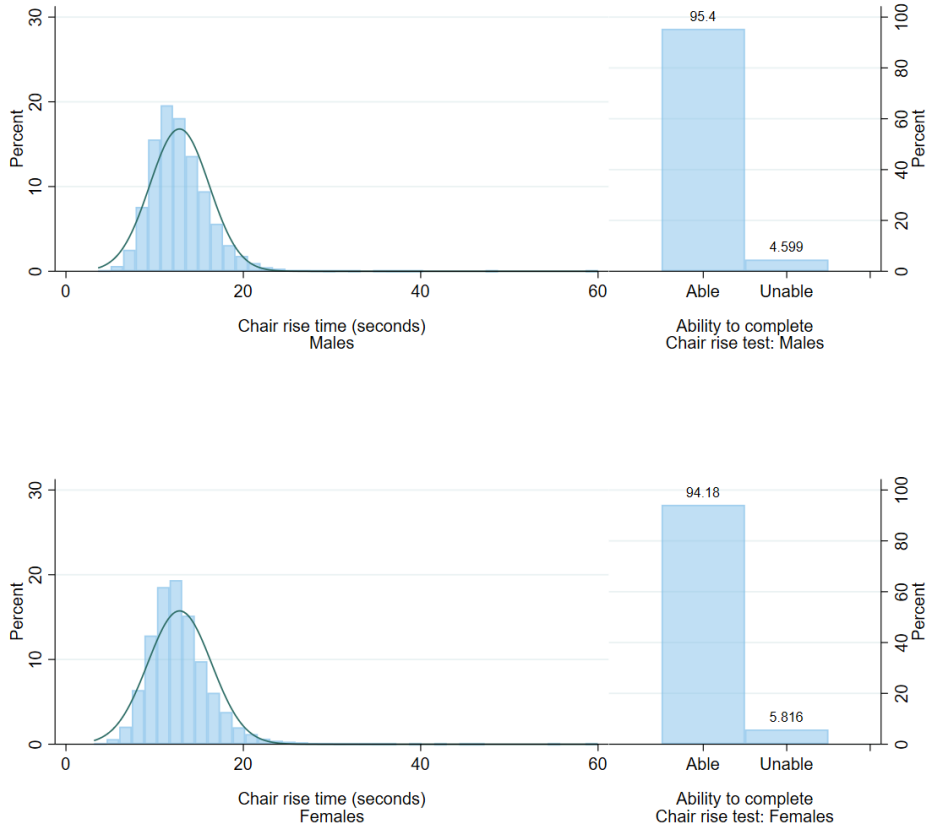
			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
More than 7 servings	2934	10.3	127	4.3	12.00	3.56	0.11	0.08
Physical activity (PASE)				<0.001		<0.001		<0.001
Normal level of physical activity	13,347	56.8	431	3.2	12.14	3.20	0.10	0.07
Low level of physical activity	11,338	43.2	857	7.6	13.08	3.81	0.15	0.10
Alcohol consumption				<0.001		<0.001		<0.001
Regular drinker (at least once a month)	18,940	74.9	822	4.3	12.34	3.44	0.11	0.08
Occasional drinker	2874	12.4	210	7.3	12.95	3.41	0.15	0.09
Did not drink in the last 12 months	2871	12.7	256	8.9	13.26	3.64	0.15	0.10
Smoking status				<0.001		<0.001		<0.001
Never	12,447	47.5	603	4.8	12.32	3.62	0.11	0.08
Former	10,476	43.1	546	5.2	12.70	3.42	0.13	0.09
Current	1762	9.4	139	7.9	12.89	3.02	0.14	0.08
Total	**24,685**	**100.0**	**1288**	**5.2**	**12.53**	**3.49**	**0.12**	**0.09**

Note. Counts (N) are unweighted. The chair rise ability percentage represents the percentage of those unable to complete the chair rise test in the given category, and not the overall sample (i.e., 123 participants ages 45-54 years were unable to complete the chair rise test, which is 3.1% of participants in the 45-54 years age group). Abbreviations used in this table: Standard Deviation (SD), Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Physical Activity Scale for the Elderly (PASE). P-values refer to the differences between categories within the variables.

Figure 5 shows the distributions of chair rise test time by sex as well as those unable to complete the chair rise test by sex. The average chair rise test time for males was 12.45 (SD = 3.38) seconds, and the average chair rise test time for females was 12.61 (SD = 3.57) seconds. There was a total of 1,288 participants who were unable to complete the chair rise test, 730 (56.7%) of those individuals were female and 558 (43.3%) of those individuals were male. Although the distributions of the continuous chair rise test time were very similar for males and females, there were differences in binary chair rise ability by sex, with more females unable to complete the chair rise test than males.

Figure 5

The Distribution of the Chair Rise Test Time and Ability by Sex

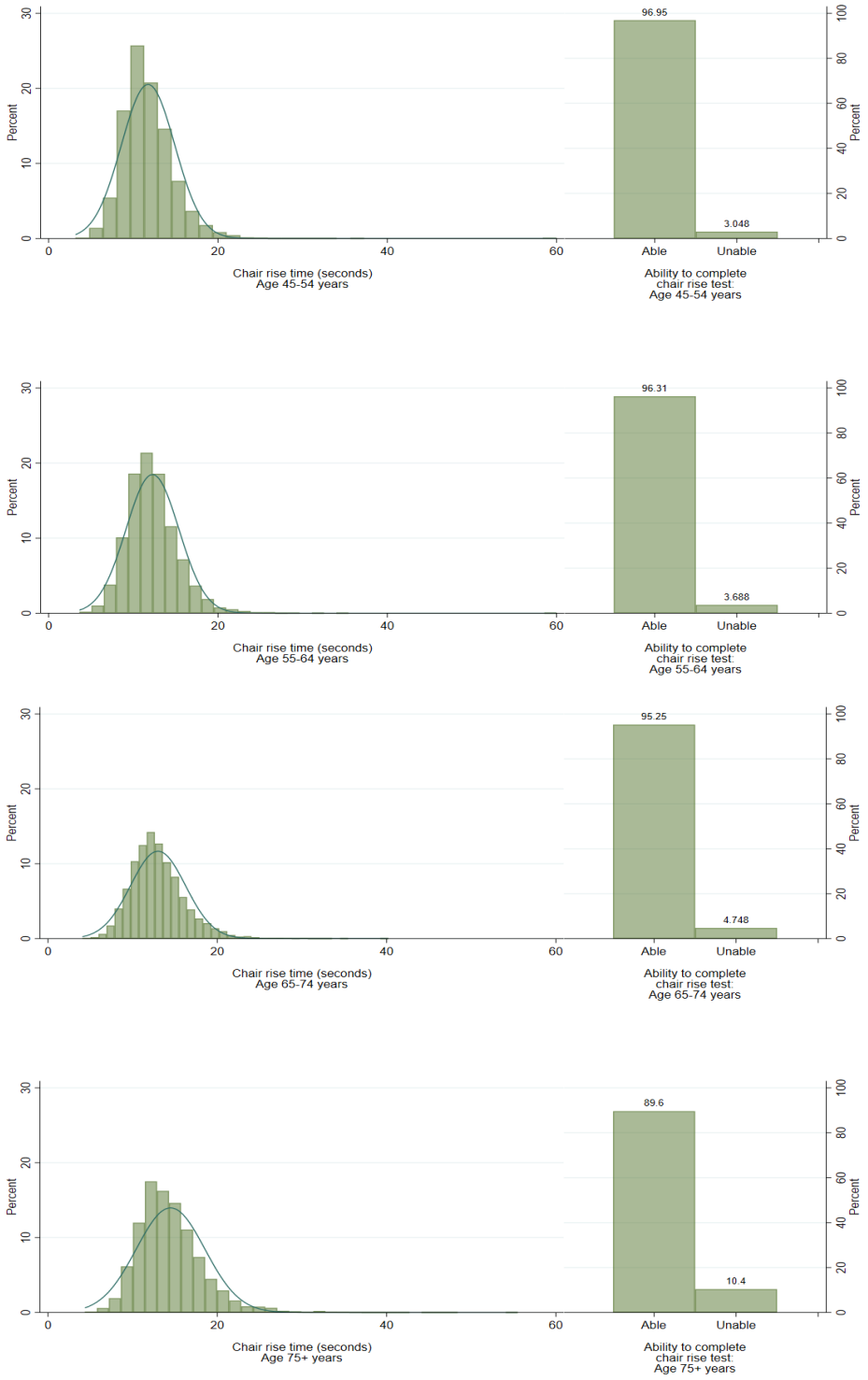


Note. The distribution of chair rise test times divided by sex. Those unable to complete the chair rise test are included alongside the chair rise test times distributions.

Figure 6 shows the distributions of chair rise test time by age category as well as those unable to complete the chair rise test by age category. As Table 1 shows, the older the age category was, the longer the average chair rise test time and greater the standard deviation was. Between the adjacent age categories, the difference in the average chair rise test time was approximately one second. Furthermore, the older the age category, the greater the proportion of participants who were unable to complete the chair rise test. Differences between the ages of 45 to 54 years and the ages of 55 to 64 years (9.5% unable versus 24.0% unable) and between the ages of 65 to 74 years and the ages 75 years and over (27.4% unable versus 39.1% unable) were particularly notable.

Figure 6

The Distribution of the Chair Rise Test Time and Ability by Age



Note. The distribution of chair rise test times divided by age. Those unable to complete the chair rise test are included alongside the chair rise test times distributions.

Figure 7 shows the distributions of chair rise test time by annual household income category as well as those unable to complete the chair rise test by income category. As Table 1 shows, the lower the income category was, the longer the average chair rise test time was. Between the adjacent income categories, the difference in the average chair rise test time was approximately half of a second. Furthermore, with the exception of the lowest income category, the higher the income category was, the lower the proportion of participants who were unable to complete the chair rise test was. Differences between the income categories of less than $20,000 annually and $20,000 to $50,000 annually (10.2% unable versus 29.7% unable) and between the income categories of $50,000 to $100,000 annually and $100,000 to $150,000 annually (30.5% unable versus 12.0% unable) were particularly notable.

Figure 7

The Distribution of the Chair Rise Test Time and Ability by Income

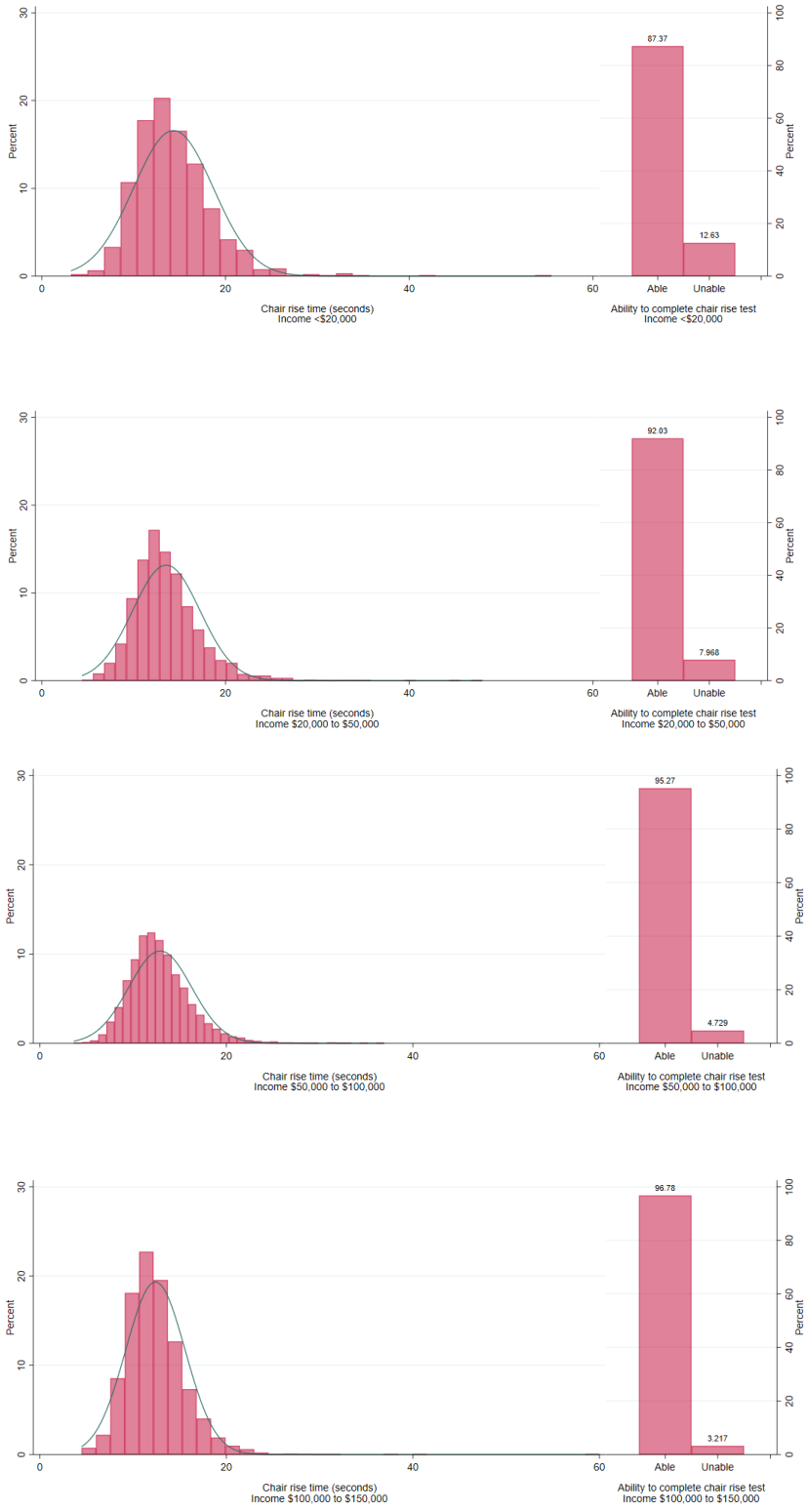
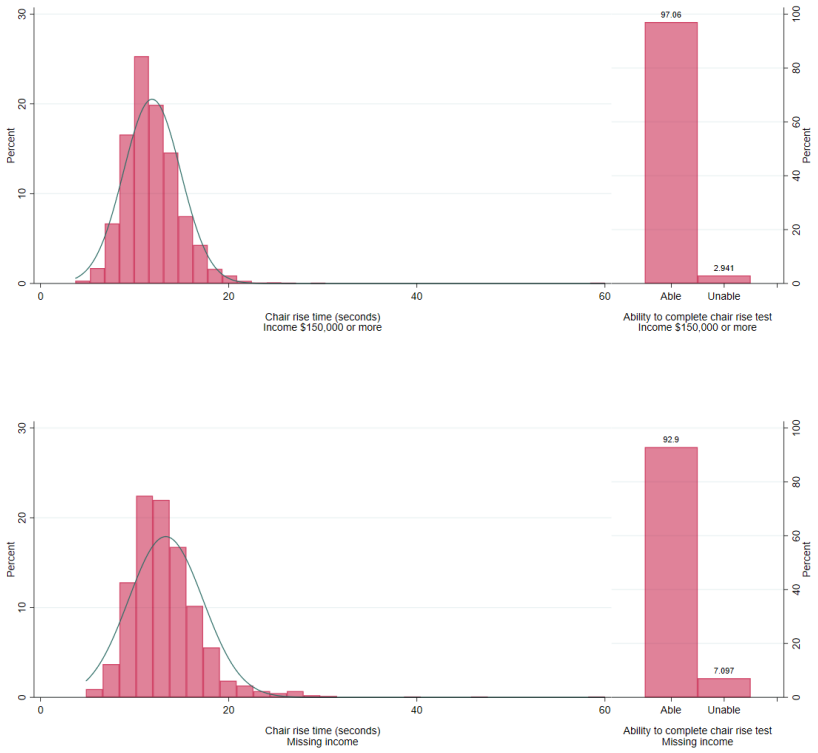


Figure 7 (continued)

The Distribution of the Chair Rise Test Time and Ability by Income

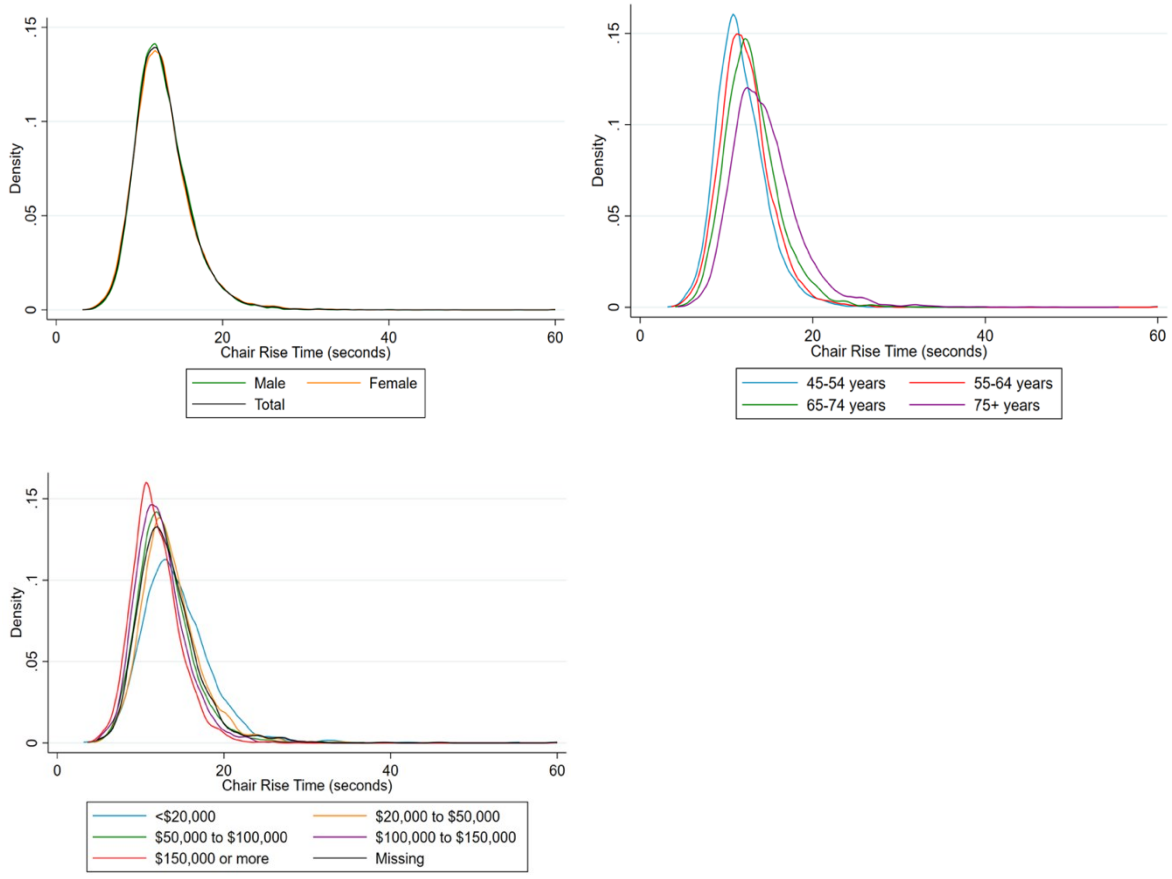


Note. The distribution of chair rise test times divided by income. Those unable to complete the chair rise test are included alongside the chair rise test times distributions.

The kernel density plots in Figure 8 show the distribution of the chair rise test time by sex, the distribution of chair rise test time by categorical age variables, and the distribution of the chair rise test time by income category. The distributions of the chair rise test time were similar by sex. The distribution of chair rise test time was graded by age, with younger age groups performing faster on the chair rise test compared to older age groups. The distribution of chair rise test time was graded by income categories, with lower income categories performing slower on the chair rise test than higher income categories.

Figure 8

Distributions of the Chair Rise Test Time by Sex, Age, and Income



Note. Distributions of chair rise test time by sex (top left), age (top right), and income category (lower left).

5.2. Dimensions of Health and the Chair Rise Test (Results corresponding to the analysis for Objective 2)

5.2.1. Chair Rise Test Time

The Pearson and Spearman correlation coefficients of the chair rise test time and each of the dimensions of health variables suggested they were very similar to each other (Table 2 and 3). Using the correlation coefficient (r) interpretation guidelines for gerontological research reported by Brydges (2019), I used cut-off points of $r = 0.12$, 0.20, and 0.32 to interpret weak, moderate, and strong relationships, respectively. The chair rise test was moderately positively correlated with the frailty index; the chair rise test was weakly positively correlated with the other dimensions of health: Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), chronic conditions, and self-rated health (SRH) variables. The frailty index was also moderately/strongly correlated with ADLs, IADLs, chronic conditions, and SRH variables. Of note, various ADL, IADL, and chronic conditions variables were used in the construction of the frailty index which may contribute to the strength of those correlations.

Table 2

Unweighted Pearson Correlation of Continuous Chair Rise Test Time and Dimensions of Health

	CRT	SRH	ADL	IADL	CC	FI
CRT	1.00					
SRH	0.19	1.00				
ADL	0.13	0.16	1.00			
IADL	0.16	0.22	0.15	1.00		
CC	0.18	0.32	0.16	0.15	1.00	
FI	0.31	0.45	0.40	0.32	0.65	1.00

Note. Acronyms used in this table: Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), chronic conditions (CC), self-rated health (SRH), chair rise test (CRT), and the frailty index (FI).

Table 3

Unweighted Spearman Correlation of Continuous Chair Rise Test Time and Dimensions of Health

	CRT	SRH	ADL	IADL	CC	FI
CRT	1.00					
SRH	0.17	1.00				
ADL	0.12	0.14	1.00			
IADL	0.14	0.16	0.15	1.00		
CC	0.18	0.30	0.16	0.14	1.00	
FI	0.28	0.41	0.36	0.25	0.67	1.00

Note. Acronyms used in this table: Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), chronic conditions (CC), self-rated health (SRH), chair rise test (CRT), and the frailty index (FI).

The weighted OLS regression model for the log-transformed chair rise test time and Activities of Daily Living (ADL) difficulties and estimated marginal means is shown in Table 4. Participants who reported difficulty or inability to complete one or more ADL(s) had a chair rise test time that was on average 13.41 seconds (99% CI: 13.10, 13.72), which is 1.00 second slower compared to those who reported no ADL difficulty (average time 12.41 seconds, 99% CI: 12.30, 12.52), while controlling for age. This finding was statistically significant (p-value <0.001). This finding was also clinically meaningful, given that we considered a 1.0 second difference in chair rise test time to be clinically meaningful based on differences in chair rise test speed for 10-year age increments.

Table 4

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Activities of Daily Living (ADL) Difficulties

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	4.85	<0.001	0.02	0.07			
65-74	0.10	0.01	10.84	<0.001	0.08	0.12			
75+	0.18	0.01	15.06	<0.001	0.15	0.21			
ADL difficulties									
No difficulties	Ref.						12.41	12.30	12.52
1 or more	0.08	0.01	8.14	<0.001	0.05	0.10	13.41	13.10	13.72
(Constant)	2.42	0.01	339.72	<0.001	2.40	2.44			

R-squared: 0.0634

Note. Adjusted for age (categorical). Acronyms used: standard error (SE), chair rise test (CRT), confidence interval (CI).

The weighted OLS regression model for the log-transformed chair rise test time and Instrumental Activities of Daily Living (IADL) difficulties is shown in Table 5, with the estimated marginal means for the model also included. Participants who reported difficulty or inability to complete one or more IADL(s) had a chair rise test time that was on average 14.82 seconds (99% CI: 14.23, 15.40), which is 2.36 seconds slower compared to those who reported no IADL difficulty (average time 12.46 seconds, 99% CI: 12.35, 12.56), while controlling for age. This finding was statistically significant (p-value <0.001) and clinically meaningful (a difference in chair rise test time that is greater than 1.0 second).

Table 5

Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Instrumental Activities Of Daily Living (IADL) Difficulties

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	4.87	<0.001	0.02	0.07			
65-74	0.10	0.01	11.31	<0.001	0.08	0.13			
75+	0.18	0.01	14.99	<0.001	0.15	0.21			
IADL difficulties									
No difficulties	Ref.						12.46	12.35	12.56
1 or more	0.17	0.02	11.06	<0.001	0.13	0.21	14.82	14.23	15.40
(Constant)	2.43	0.01	335.83	<0.001	2.41	2.44			

R-squared: 0.0670

Note. Adjusted for age. Acronyms used: standard error (SE), chair rise test (CRT), confidence interval (CI).

The weighted OLS regression model for the log-transformed chair rise test time and self-rated health (SRH) is shown in Table 6, with the estimated marginal means for this model included in the table. Participants who reported their general SRH as poor, had an average chair rise test time of 15.28 seconds (99% CI: 14.22, 16.34) while those who rated their general SRH as excellent had an average chair rise test time of 11.73 seconds (99% CI: 11.51, 11.95). On average, people with poor SRH performed 3.54 seconds slower than people with excellent SRH on the chair rise test. This finding was clinically meaningful (a difference in chair rise test time that is greater than 1.0 second). There was a graded relationship between SRH categories and chair rise test time, with statistically significant differences between each level of SRH and the reference category. Moreover, there were clinically meaningful differences in chair rise test time between good, fair, and poor levels of SRH.

Table 6

Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Self-Rated Health (SRH)

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal meals (CRT, sec.)	
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	5.02	<0.001	0.02	0.07			
65-74	0.11	0.01	11.82	<0.001	0.08	0.13			
75+	0.19	0.01	16.17	<0.001	0.16	0.22			
Self-rated health									
Excellent	Ref.						11.73	11.51	11.95
Very good	0.05	0.01	5.58	<0.001	0.03	0.07	12.32	12.18	12.47
Good	0.09	0.01	9.70	<0.001	0.07	0.12	12.88	12.67	13.08
Fair	0.16	0.01	11.58	<0.001	0.13	0.20	13.83	13.40	14.26
Poor	0.26	0.03	9.47	<0.001	0.19	0.34	15.28	14.22	16.34
(Constant)	2.36	0.01	247.60	<0.001	2.34	2.39			

R-squared: 0.0870

Note. Adjusted for age. Acronyms used: standard error (SE), chair rise test (CRT), confidence interval (CI).

The weighted OLS regression model for the log-transformed chair rise test time and the frailty index with the estimated marginal means for this model is shown in Table 7. Participants with a high frailty index score (over 0.5) had an average chair rise test time of 22.21 seconds (99% CI: 16.58, 27.84), while those with a low frailty index score (less than or equal to 0.1) had an average chair rise test time of 11.96 seconds (99% CI: 11.81, 12.11). On average, people with high frailty index scores performed 10.25 seconds slower than people with low frailty index scores on the chair rise test. This finding is clinically meaningful (a difference in chair rise test time that is greater than 1.0 second). There was a graded relationship between frailty index categories and chair rise test time, with statistically significant differences between each level of the frailty index and the reference category. There are clinically meaningful differences in chair rise test time between the frailty index categories >0.2 & ≤0.3 and >0.3 & ≤0.4 of 1.08 seconds, and between >0.4 & ≤0.5 and >0.5 of 6.76 seconds.

Table 7

Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Frailty Index

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Age (categorical)									
45-54	Ref.								
55-64	0.03	0.01	2.98	0.003	0.00	0.05			
65-74	0.06	0.01	6.10	<0.001	0.04	0.09			
75+	0.11	0.01	8.32	<0.001	0.08	0.15			
Frailty index									
≤0.1	Ref.						11.96	11.81	12.11
>0.1 & ≤0.2	0.06	0.01	7.44	<0.001	0.04	0.08	12.69	12.51	12.88
>0.2 & ≤0.3	0.13	0.01	12.01	<0.001	0.10	0.16	13.67	13.34	14.00
>0.3 & ≤0.4	0.21	0.02	11.57	<0.001	0.16	0.26	14.75	14.11	15.39
>0.4 & ≤0.5	0.25	0.04	6.64	<0.001	0.16	0.35	15.43	13.93	16.93
>0.5	0.62	0.10	6.28	<0.001	0.37	0.87	22.21	16.58	27.84
(Constant)	2.41	0.01	336.72	<0.001	2.39	0.43			

R-squared: 0.0901

Note. Adjusted for age. Acronyms used: standard error (SE), chair rise test (CRT), confidence interval (CI).

The weighted OLS regression model for the log-transformed chair rise test time and chronic conditions is shown in Table 8, with the estimated marginal means for this model included in the table. Participants with three or more chronic conditions had an average chair rise test time of 13.25 seconds (99% CI: 13.01, 13.49), compared to those with no chronic conditions/no response who had an average chair rise test time of 12.14 seconds (99% CI: 11.97, 12.32). On average, people with three or more chronic conditions performed 1.10 seconds slower than people with no chronic conditions on the chair rise test. This finding is clinically meaningful (a difference in chair rise test time that is greater than 1.0 second). There were statistically significant differences in chair rise test time between the reference category and following categories: two conditions and 3 conditions or more.

Table 8

Weighted OLS Regression for the Log-Transformed Chair Rise Test Time and Number Of Chronic Conditions

Variable	Coef.	SE	t	P-value	99%CI		Marginal means (CRT, sec.)	99%CI for marginal means (CRT, seconds)	
Age (categorical)									
45-54	Ref.								
55-64	0.03	0.01	3.84	<0.001	0.01	0.06			
65-74	0.09	0.01	9.22	<0.001	0.06	0.11			
75+	0.17	0.01	13.58	<0.001	0.13	0.20			
Number of chronic conditions									
No conditions/ no response	Ref.						12.15	11.97	12.32
1 condition	0.01	0.01	1.51	0.131	-0.01	0.03	12.30	12.11	12.50
2 conditions	0.04	0.01	4.57	<0.001	0.02	0.07	12.70	12.44	12.94
3 conditions or more	0.09	0.01	9.58	<0.001	0.06	0.11	13.25	13.01	13.49
(Constant)	2.41	0.01	300.86	<0.001	2.39	2.43			

R-squared: 0.0680

Note. Adjusted for age. Acronyms used: standard error (SE), chair rise test (CRT), confidence interval (CI).

5.2.2. Age- and sex-stratified analysis for the dimensions of health and the chair rise test (Results corresponding to the analysis for Objective 4)

The age-stratified analysis for the chair rise test and other dimensions of health is included in Appendix 12. The age-stratified analyses showed a general graded relationship in the chair rise test for each of the dimensions of health categories (ADLs, IADLs, SRH, the frailty index, and chronic conditions). Sex was not statistically significant or clinically meaningful in the models, however I still conducted a sex-stratified analysis for the chair rise test time and other dimensions of health which are included in Appendix 11. The sex-stratified analysis confirmed that there were very few sex differences in the chair rise test for each of the dimensions of health.

5.2.3. Chair rise test ability

The Spearman correlation between the binary chair rise ability variable and the dimensions of health is shown in Table 9. The binary chair rise ability variable is

moderately correlated with IADLs, compared to the other dimensions of health variables. Similar to the continuous chair rise test time correlations, the frailty index is moderately/strongly correlated with SRH, ADLs, and IADLs, and strongly correlated with chronic conditions. SRH and chronic conditions are also moderately correlated.

Table 9

Unweighted Spearman Correlation of Binary Chair Rise Ability and Dimensions of Health

	CRA	SRH	ADL	IADL	CC	FI
CRA	1.00					
SRH	0.13	1.00				
ADL	0.13	0.16	1.00			
IADL	0.27	0.20	0.22	1.00		
CC	0.12	0.31	0.17	0.18	1.00	
FI	0.18	0.43	0.39	0.30	0.68	1.00

Note. Acronyms used in this table: Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), chronic conditions (CC), self-rated health (SRH), chair rise ability (CRA), and the frailty index (FI).

I ran a series of Chi-square tests of independence to determine if there was any association between chair rise test ability and the following variables: frailty index, self-rated health, sex, and age (Appendix 8). The relationship between chair rise test ability and the frailty index was statistically significant ($p < 0.001$); people with the highest frailty scores were more likely to be unable to complete the chair rise test compared to people with lower frailty scores. The relationship between chair rise test ability and self-rated health was also significant ($p < 0.001$); people with poor self-rated health were more likely to be unable to complete the chair rise test compared to people with better (fair to excellent) self-rated health. The relationship between chair rise test ability and sex was also statistically significant ($p < 0.001$); women were more likely to be unable to complete the chair rise test than men. Finally, the relationship between chair rise test ability and age was significant ($p < 0.001$); people above the age of 75 years were more likely to be unable to complete the chair rise test than the younger age groups.

Table 10 shows the age-adjusted weighted logistic regression model for binary chair rise test ability and ADL difficulties. Individuals with reported difficulties performing one or more ADL(s) have odds of being unable to perform the chair rise test that are 2.96 times those of individuals with no reported ADL difficulties. This finding was statistically significant.

Table 10

Weighted Logistic Regression Model for Chair Rise Test Ability and ADL Difficulties

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.34	0.23	1.74	0.082	0.87	2.08
65 to 74	1.51	0.27	2.36	0.018	0.96	2.38
75+	2.58	0.42	5.39	<0.001	1.71	3.92
ADL difficulties						
No difficulties	Ref.					
1 or more	2.96	0.36	8.91	<0.001	2.16	4.06
(Constant)	0.04	0.00	-25.08	<0.001	0.03	0.05

Note. Acronyms used: confidence interval (CI).

Table 11 shows the age-adjusted weighted logistic regression model for binary chair rise test ability and IADL difficulties. Individuals with reported difficulties performing one or more IADL(s) have odds of being unable to perform the chair rise test that are 9.14 times those of individuals with no reported IADL difficulties. This finding was statistically significant.

Table 11

Weighted Logistic Regression Model for Chair Rise Test Ability and IADL Difficulties

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.27	0.22	1.40	0.163	0.82	1.98
65 to 74	1.47	0.26	2.23	0.026	0.94	2.30
75+	2.00	0.33	4.20	<0.001	1.31	3.05
IADL difficulties						
No difficulties	Ref.					
1 or more	9.14	1.27	15.99	<0.001	6.40	13.06
(Constant)	0.04	0.01	-24.09	<0.001	0.03	0.06

Note. Acronyms used: confidence interval (CI).

Table 12 shows the age-adjusted weighted logistic regression model for binary chair rise test ability and self-rated health. Compared to individuals with excellent self-rated health, individuals with poor, fair, and good self-rated health had, respectively, 17.32 times, 4.25 times, and 2.42 times greater odds of being unable to perform the chair rise test. These findings were all statistically significant. The difference in odds of being unable to perform the chair rise test between those with very good self-rated health and excellent self-rated health was not statistically significant.

Table 12

Weighted Logistic Regression Model for Chair Rise Test Ability and Self-rated Health

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.34	0.22	1.75	0.080	0.87	2.06
65 to 74	1.70	0.30	3.00	0.003	1.08	2.67
75+	3.05	0.49	7.00	<0.001	2.02	4.60
Self-rated health						
Excellent	Ref.					
Very good	1.38	0.24	1.90	0.057	0.89	2.15
Good	2.42	0.41	5.18	<0.001	1.56	3.76
Fair	4.25	0.85	7.24	<0.001	2.54	7.11
Poor	17.32	5.12	9.65	<0.001	8.09	37.07
(Constant)	0.02	0.00	-20.28	<0.001	0.01	0.04

Note. Acronyms used: confidence interval (CI).

Table 13 shows the age-adjusted weighted logistic regression model for binary chair rise test ability and the frailty index. Compared to individuals with the lowest frailty index scores (≤0.1), individuals with frailty index scores of over 0.5, over 0.4 and less than or equal to 0.5, over 0.3 and less than or equal to 0.4, over 0.2 and less than or equal to 0.3, and over 0.1 and less than or equal to 0.2 units had, respectively, 52.89 times, 26.37 times, 9.50 times, 3.38 times, and 1.71 times greater odds of being unable to perform the chair rise test. These findings were all statistically significant.

Table 13

Weighted Logistic Regression Model for Chair Rise Test Ability and the Frailty Index

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.06	0.18	0.33	0.741	0.68	1.63
65 to 74	0.93	0.18	-0.35	0.727	0.56	1.54
75+	1.13	0.22	0.63	0.526	0.68	1.89
Frailty index						
≤0.1	Ref.					
>0.1 & ≤0.2	1.72	0.25	3.65	<0.001	1.17	2.51
>0.2 & ≤0.3	3.38	0.68	6.05	<0.001	2.01	5.69
>0.3 & ≤0.4	9.50	2.13	10.03	<0.001	5.33	16.94
>0.4 & ≤0.5	25.09	7.72	10.48	<0.001	11.36	55.41
>0.5	52.28	30.95	6.68	<0.001	11.38	240.24
(Constant)	0.04	0.00	-24.26	<0.001	0.02	0.05

Note. Acronyms used: confidence interval (CI).

Table 14 shows the age-adjusted weighted logistic regression model for binary chair rise test ability and number of chronic conditions. Compared to individuals with no chronic conditions or no response, individuals with three or more chronic conditions and two chronic conditions had, respectively, 3.16 times and 2.03 times greater odds of being unable to perform the chair rise test. These findings were both statistically significant. There was no statistically significant difference in the odds of being unable to complete the chair rise test in individuals with one chronic conditions compared to individuals with no conditions/no response.

Table 14

Weighted Logistic Regression Model for Chair Rise Test Ability and Number of Chronic Conditions

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.18	0.20	1.02	0.308	0.77	1.82
65 to 74	1.29	0.23	1.44	0.151	0.82	2.04
75+	2.17	0.36	4.72	<0.001	1.42	3.31
Number of chronic conditions						
No conditions/ no response	Ref.					
1 condition	1.29	0.22	1.51	0.132	0.83	2.01
2 conditions	2.03	0.36	4.03	<0.001	1.29	3.18
3 conditions or more	3.16	0.54	6.68	<0.001	2.03	4.92
(Constant)	0.03	0.01	-20.42	<0.001	0.02	0.05

Note. Acronyms used: confidence interval (CI).

5.3. Socioeconomic Status and the Chair Rise Test (Results corresponding to the analysis for Objective 3)

5.3.1. Chair Rise Test Time

The Spearman correlation between the categorical income variable and the subjective and objective wealth variables is shown in Table 15. Subjective wealth and income have a moderate correlation, while objective wealth and income, and objective wealth and subjective wealth are both strongly correlated.

Table 15

Unweighted Spearman Correlation of Income and Wealth Variables

	INC	SW	OW
INC	1.00		
SW	0.24	1.00	
OW	0.33	0.32	1.00

Note. Acronyms used in this table: income (INC), subjective wealth (SW), and objective wealth (OW).

Table 16 shows the income coefficients and marginal means of the chair rise test. The differences between the two highest income categories ($150,000 or more and between $100,000 and $150,000 in annual household income) and the reference category (less than $20,000 in annual household income) were both statistically significant. The differences in average chair rise test time between the other income categories and the reference category (less than $20,000 in annual household income) were not statistically significant. There was a clinically meaningful difference in chair rise test time between the highest income category (more than $150,000 in annual household income) and the lowest income category (less than $20,000 in annual household income); the lowest income category had an average chair rise test time of 13.05 seconds (99% CI: 12.54, 13.53) which was 1.03 seconds slower than the highest income category at 12.02 seconds (99% CI: 11.83, 12.22). There were statistically significant differences between all levels of education (post-secondary degree/diploma, some post-secondary education, and secondary school graduation) and the reference category (less than secondary school graduation). However, none of these differences in average chair rise test time across education categories were clinically meaningful differences.

Table 16

Weighted OLS Regression for Chair Rise Test Time and Income

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
Age									
45 to 54	Ref.						11.94	11.71	12.16
55 to 64	0.03	0.01	4.04	<0.001	0.01	0.05	12.33	12.18	12.48
65 to 74	0.08	0.01	8.74	<0.001	0.06	0.11	12.84	12.66	13.03
75+	0.17	0.01	13.66	<0.001	0.13	0.20	13.75	13.44	14.05
Sex									
Female	Ref.						12.52	12.37	12.67
Male	-0.05	0.01	-6.11	<0.001	-0.08	-0.03	12.54	12.40	12.68
Income									
< $20,000	Ref.						13.05	12.54	13.54
$20,000 to < $50,000	-0.02	0.02	-1.16	0.246	-0.06	0.02	12.78	12.52	13.04
$50,000 to <$100,000	-0.03	0.02	-1.90	0.057	-0.08	0.01	12.65	12.47	12.84

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
$100,000 to <$150,000	-0.06	0.02	-3.44	0.001	-0.10	-0.02	12.32	12.11	12.53
$150,00 or more	-0.08	0.02	-4.82	<0.001	-0.13	-0.04	12.02	11.83	12.22
Missing	-0.01	0.02	-0.38	0.703	-0.06	0.04	12.94	12.51	13.38
Education									
Less than secondary school graduation	Ref.						13.05	12.61	13.50
Secondary school graduation, no post-secondary	-0.04	0.02	-2.70	0.007	-0.08	0.00	12.48	12.22	12.73
Some post-secondary	-0.05	0.02	-3.00	0.003	-0.09	-0.01	12.42	12.12	12.71
Post-secondary degree/diploma	-0.05	0.01	-3.27	0.001	-0.08	-0.01	12.44	12.33	12.54
Cultural/racial background									
White	Ref.						12.50	12.39	12.61
Black	0.08	0.03	2.43	0.015	0.00	0.16	13.65	12.48	14.82
East/Southeast Asian	0.05	0.02	2.66	0.008	0.00	0.10	12.64	12.03	13.24
South Asian	0.12	0.04	3.28	0.001	0.02	0.21	13.59	12.31	14.87
Multiple racial/cultural origins	0.02	0.02	0.78	0.435	-0.04	0.07	12.66	12.00	13.32
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	0.02	0.02	0.94	0.346	-0.04	0.08	12.61	11.92	13.31
Weight (kg)	0.00	0.00	9.84	<0.01	0.00	0.00			
Height (cm)	0.00	0.00	3.51	<0.01	0.00	0.00			
Smoking									
Never	Ref.						12.36	12.22	12.49
Former	0.02	0.01	3.02	0.003	0.00	0.03	12.63	12.47	12.78
Current	0.06	0.01	4.92	0.000	0.03	0.09	13.01	12.63	13.38
Alcohol consumption									
Did not drink in the last 12 months	Ref.						12.46	12.34	12.58
Occasional drinker	-0.01	0.01	-0.68	0.494	-0.04	0.02	12.71	12.44	12.99

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
At least once a month	-0.02	0.01	-2.24	0.025	-0.05	0.00	12.76	12.45	13.07
Fruit and vegetable consumption									
>7 servings	Ref.						12.57	12.36	12.78
5-7 servings	0.03	0.01	3.09	0.002	0.01	0.06	12.70	12.55	12.86
2-4 servings	0.05	0.01	5.12	<0.001	0.02	0.07	12.45	12.27	12.64
<2 servings	0.04	0.01	3.61	<0.001	0.01	0.06	12.06	11.78	12.33
Physical activity									
Normal level of physical activity	Ref.						12.38	12.24	12.51
Low level of physical activity	0.03	0.01	4.27	<0.001	0.01	0.04	12.73	12.57	12.90
High social support availability									
Yes	Ref.						12.96	12.66	13.26
No	0.04	0.01	4.42	<0.01	0.02	0.07	12.47	12.36	12.58
Rural/Urban									
Urban	Ref.						12.63	12.32	12.93
Rural	0.01	0.01	1.05	0.292	-0.01	0.03	12.53	12.42	12.63
Province									
Alberta	Ref.						12.01	11.77	12.24
British Columbia	0.13	0.01	15.12	<0.01	0.11	0.16	13.69	13.51	13.88
Manitoba	0.06	0.01	6.28	<0.01	0.04	0.09	12.81	12.58	13.03
Newfoundland and Labrador	0.15	0.01	13.38	<0.01	0.12	0.18	13.93	13.62	14.24
Nova Scotia	-0.04	0.01	-4.43	<0.01	-0.07	-0.02	11.45	11.24	11.66
Ontario	0.09	0.01	10.53	<0.01	0.07	0.12	13.17	12.98	13.35
Québec	-0.06	0.01	-5.86	<0.01	-0.09	-0.03	11.15	10.94	11.36
Constant	2.01	0.08	25.72	<0.01	1.81	2.21			

R-squared: 0.2072

Note. OLS regression for the log-transformed chair rise test time and income, with the calculated marginal means and their confidence intervals. Acronyms used in this table: standard error (SE), chair rise test (CRT), and confidence interval (CI).

Table 17 shows the objective wealth coefficients and marginal means of the chair rise test. The differences between the highest two objective wealth categories ($100,000 to $1 million and $1 million or more in savings or investments) and the reference category (less than $50,000 in savings or investments) were statistically significant. These differences were not clinically meaningful. The differences in average chair rise test time between the other objective wealth categories and the reference category were not statistically significant. There were statistically significant differences between all levels of education (post-secondary degree/diploma, some post-secondary education, and secondary school graduation) and the reference category (less than secondary school graduation). But none of these differences in average chair rise test time across education categories were clinically meaningful.

Table 17

Weighted OLS Regression for the Chair Rise Test Time and Objective Wealth

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
Age									
45 to 54	Ref.						11.84	11.62	12.05
55 to 64	0.04	0.01	4.87	<0.001	0.02	0.06	12.30	12.15	12.46
65 to 74	0.10	0.01	11.05	<0.001	0.08	0.12	12.96	12.77	13.14
75+	0.18	0.01	15.90	<0.001	0.15	0.21	13.86	13.57	14.15
Sex									
Female	Ref.						12.54	12.40	12.69
Male	-0.05	0.01	-6.14	<0.001	-0.08	-0.03	12.52	12.37	12.66
Education									
Less than secondary school graduation	Ref.						13.08	12.64	13.52
Secondary school graduation, no post-secondary	-0.04	0.02	-2.77	0.006	-0.08	0.00	12.51	12.26	12.76
Some post-secondary	-0.05	0.02	-3.14	0.002	-0.09	-0.01	12.44	12.14	12.74
Post-secondary degree/diploma	-0.05	0.01	-3.69	<0.001	-0.09	-0.02	12.42	12.32	12.53
Objective wealth (savings and investments)									

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
Less than $50,000	Ref.						12.82	12.58	13.06
$50,000 to less than $100,000	-0.01	0.01	-0.60	0.548	-0.04	0.02	12.72	12.44	13.00
$100,000 to less than $1 million	-0.04	0.01	-4.09	<0.001	-0.06	-0.01	12.34	12.20	12.48
$1 million or more	-0.06	0.01	-5.24	<0.001	-0.08	-0.03	12.08	11.82	12.33
Missing	0.01	0.01	0.65	0.519	-0.02	0.04	12.85	12.52	13.18
Cultural/racial background									
White	Ref.						12.50	12.39	12.61
Black	0.08	0.03	2.46	0.014	0.00	0.16	13.65	12.49	14.81
East/Southeast Asian	0.05	0.02	2.64	0.008	0.00	0.10	12.64	12.04	13.24
South Asian	0.11	0.04	3.19	0.001	0.02	0.21	13.55	12.27	14.84
Multiple racial/cultural origins	0.01	0.02	0.71	0.473	-0.04	0.07	12.65	11.98	13.32
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	0.02	0.02	0.91	0.364	-0.04	0.08	12.60	11.90	13.30
Weight (kg)	0.00	0.00	9.58	<0.001	0.00	0.00			
Height (cm)	0.00	0.00	3.48	0.001	0.00	0.00			
Smoking									
Never	Ref.						12.35	12.22	12.49
Current	0.06	0.01	5.12	<0.001	0.03	0.09	12.63	12.47	12.78
Former	0.02	0.01	3.12	0.002	0.01	0.03	13.02	12.65	13.40
Alcohol consumption									
Did not drink in the last 12 months	Ref.						12.46	12.34	12.58
Occasional drinker	-0.01	0.01	-0.67	0.504	-0.04	0.00	12.73	12.45	13.01
At least once a month	-0.02	0.01	-2.53	0.012	-0.05	0.02	12.78	12.47	13.09
Fruit and vegetable consumption									
>7 servings	Ref.						12.57	12.36	12.78
5-7 servings	0.03	0.01	3.05	0.002	0.00	0.06	12.71	12.55	12.87
2-4 servings	0.05	0.01	5.20	<0.001	0.02	0.07	12.45	12.26	12.63

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
<2 servings	0.04	0.01	3.66	<0.001	0.01	0.07	12.06	11.78	12.33
Physical activity									
Normal level of physical activity	Ref.						12.37	12.23	12.50
Low level of physical activity	0.03	0.01	4.53	<0.001	0.01	0.05	12.75	12.58	12.92
High social support availability									
Yes	Ref.						13.02	12.72	13.31
No	0.05	0.01	5.10	<0.001	0.02	0.07	12.46	12.35	12.57
Rural/Urban									
Urban	Ref.						12.64	12.32	12.95
Rural	0.01	0.01	1.08	0.282	-0.01	0.04	12.53	12.42	12.63
Province									
Alberta	Ref.						12.01	11.78	12.25
British Columbia	0.14	0.01	15.67	<0.001	0.12	0.16	13.75	13.56	13.94
Manitoba	0.06	0.01	6.38	<0.001	0.04	0.09	12.81	12.59	13.04
Newfoundland and Labrador	0.15	0.01	12.79	<0.001	0.12	0.17	13.86	13.55	14.17
Nova Scotia	-0.05	0.01	-4.54	<0.001	-0.07	-0.02	11.43	11.22	11.64
Ontario	0.09	0.01	10.28	<0.001	0.07	0.12	13.15	12.96	13.33
Québec	-0.06	0.01	-6.02	<0.001	-0.09	-0.04	11.12	10.91	11.32
Constant	1.99	0.08	25.42	<0.001	1.78	2.19			

R-squared: 0.2051

Note. OLS regression for the log-transformed chair rise test time and objective wealth, with the calculated marginal means and their confidence intervals. Acronyms used in this table: standard error (SE), chair rise test (CRT), and confidence interval (CI).

Table 18 shows the subjective wealth coefficients and marginal means of the chair rise test. The difference between the mean chair rise test time of the highest subjective wealth category (manage very well) and the reference category (don't manage well/have some or severe financial difficulties) was statistically significant but not clinically meaningful. The differences in average chair rise test time between the other levels of subjective wealth and the reference category were not statistically significant. There were statistically significant differences in average chair rise test time between all levels of education (post-secondary degree/diploma, some post-secondary education, and

secondary school graduation) and the reference category (less than secondary school graduation). However, these differences in average chair rise test time across education categories were not clinically meaningful.

Table 18

Weighted OLS Regression for the Chair Rise Test Time and Subjective Wealth

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
Age									
45 to 54	Ref.						11.82	11.60	12.04
55 to 64	0.04	0.01	4.80	<0.001	0.02	0.06	12.29	12.14	12.44
65 to 74	0.10	0.01	11.10	<0.001	0.08	0.12	12.96	12.78	13.14
75+	0.19	0.01	16.31	<0.001	0.16	0.22	13.93	13.64	14.23
Sex									
Female	Ref.						12.57	12.43	12.71
Male	-0.06	0.01	-6.33	<0.001	-0.08	-0.03	12.49	12.35	12.64
Education									
Less than secondary school graduation	Ref.						13.16	12.72	13.60
Secondary school graduation, no post-secondary	-0.05	0.02	-3.03	0.002	-0.08	-0.01	12.54	12.28	12.79
Some post-secondary	-0.06	0.02	-3.59	<0.001	-0.10	-0.02	12.42	12.13	12.72
Post-secondary degree/diploma	-0.06	0.01	-4.26	<0.001	-0.09	-0.02	12.40	12.30	12.51
Subjective Wealth									
Don't manage very well/have some or severe difficulties	Ref.						13.09	12.63	13.56
Get by alright	-0.03	0.01	-1.88	0.061	-0.07	0.01	12.71	12.50	12.91
Manage quite well	-0.03	0.01	-2.37	0.018	-0.07	0.00	12.60	12.44	12.77
Manage very well	-0.05	0.01	-3.72	<0.001	-0.09	-0.02	12.32	12.16	12.48
Cultural/racial background									
White	Ref.						12.50	12.39	12.61
Black	0.08	0.03	2.53	0.011	0.00	0.16	13.65	12.49	14.80

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
East/Southeast Asian	0.05	0.02	2.64	0.008	0.00	0.10	12.63	12.05	13.22
South Asian	0.12	0.04	3.33	0.001	0.03	0.21	13.64	12.35	14.92
Multiple racial/cultural origins	0.01	0.02	0.70	0.483	-0.04	0.07	12.65	11.97	13.33
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	0.02	0.02	1.13	0.259	-0.03	0.08	12.66	11.95	13.37
Weight (kg)	0.00	0.00	9.53	<0.001	0.00	0.00			
Height (cm)	0.00	0.00	3.19	0.001	0.00	0.00			
Smoking									
Never	Ref.						12.35	12.22	12.49
Former	0.02	0.01	3.15	0.002	0.00	0.03	12.63	12.47	12.78
Current	0.06	0.01	5.07	<0.001	0.03	0.09	13.02	12.64	13.39
Alcohol consumption									
At least once a month	-0.03	0.01	-2.83	0.005	-0.05	-0.00	12.45	12.33	12.57
Occasional drinker	-0.01	0.01	-0.78	0.433	-0.04	0.02	12.74	12.46	13.02
Did not drink in the last 12 months	Ref.						12.81	12.50	13.12
Fruit and vegetable consumption									
<2 servings	0.04	0.01	3.93	<0.001	0.01	0.07	12.59	12.38	12.80
2-4 servings	0.05	0.01	5.27	<0.001	0.03	0.07	12.70	12.54	12.86
5-7 servings	0.03	0.01	3.13	0.002	0.01	0.06	12.44	12.26	12.63
>7 servings	Ref.						12.04	11.77	12.31
Physical activity									
Normal level of physical activity	Ref.						12.36	12.23	12.50
Low level of physical activity	0.03	0.01	4.63	<0.001	0.01	0.05	12.75	12.59	12.92
High social support availability									
Yes	Ref.						12.46	12.35	12.57

Variable	Coef.	SE	t	P-value	99% CI		Marginal means (CRT, seconds)	99% CI for marginal means (CRT, seconds)	
No	0.05	0.01	5.00	<0.001	0.02	0.07	13.01	12.71	13.31
Rural/Urban									
Urban	Ref.						12.53	12.42	12.63
Rural	0.01	0.01	1.04	0.298	-0.01	0.03	12.63	12.32	12.94
Province									
Alberta	Ref.						11.94	11.71	12.17
British Columbia	0.14	0.01	15.96	<0.001	0.12	0.16	13.69	13.51	13.88
Manitoba	0.07	0.01	6.92	<0.001	0.04	0.09	12.80	12.58	13.03
Newfoundland and Labrador	0.16	0.01	13.96	<0.001	0.13	0.18	13.93	13.62	14.24
Nova Scotia	-0.04	0.01	-3.66	<0.001	-0.06	-0.01	11.47	11.27	11.68
Ontario	0.10	0.01	10.78	<0.001	0.07	0.12	13.13	12.95	13.32
Québec	-0.05	0.01	-5.06	<0.001	-0.09	-0.03	11.18	10.98	11.39
Constant	2.03	0.08	25.88	<0.001	1.83	2.23			

R-squared: 0.2026

Note. OLS regression for the log-transformed chair rise test time and subjective wealth, with the calculated marginal means and their confidence intervals. Acronyms used in this table: standard error (SE), chair rise test (CRT), and confidence interval (CI).

In all three models of socioeconomic status and chair rise test time, current and former smokers performed slower on the chair rise test compared to those who had never smoked; this finding was statistically significant but not clinically meaningful. Participants who reported eating more than seven servings of fruit and vegetables each day performed faster than those who ate less than seven servings; this finding was statistically significant but not clinically meaningful in all three models. Regular drinkers performed faster on the chair rise test compared to people who did not drink in the previous 12 months; this finding was statistically significant but not clinically meaningful in all three models. People with normal levels of physical activity performed faster on average on the chair rise test than those with low levels of physical activity in all three models; this finding was statistically significant but not clinically meaningful. Individuals with high social support availability on average performed faster on the chair rise test than those who did not have high social support availability in all three models; this finding was statistically significant but not clinically meaningful.

The demographic and anthropomorphic variables that we controlled for showed notable differences in age, cultural/racial background, and geographic location at baseline. In all three models, White people performed on average over one second faster on the chair rise test than South Asian people, a finding that was statistically significant and clinically meaningful. White people performed on average over one second faster on the chair rise test than Black people, a finding that was statistically significant and clinically meaningful in both wealth models but not the income model. Finally, there were statistically significant differences in average chair rise test time across individuals in all provinces compared to individuals in the reference province (Alberta) in all three socioeconomic status models. There were clinically meaningful differences in chair rise test performance across three provinces, with individuals in British Colombia, Newfoundland and Labrador, and Ontario performing on average over one second slower on the chair rise test compared to individuals in the reference group, Alberta.

5.3.2. Age- and sex-stratified analysis for socioeconomic status and the chair rise test (Results corresponding to the analysis for Objective 4)

In all three models the youngest age groups performed faster on the chair rise test than the oldest age groups, with statistically significant and clinically meaningful differences between certain categories. The age-stratified analysis for socioeconomic status and the chair rise test is included in Appendix 14. Sex was not statistically significant or clinically meaningful in the models, however the sex-stratified analysis for socioeconomic status and the chair rise test is included in Appendix 13.

5.3.3. Chair Rise Test Ability

Table 19 shows the adjusted weighted logistic regression model for chair rise test ability and income. The difference in odds of being unable to perform the chair rise test between income and education categories and the reference category were not statistically significant in this model.

Table 19

Weighted Logistic Regression Model for Chair Rise Test Ability and Income

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.23	0.21	1.18	0.237	0.78	1.93
65 to 74	1.23	0.22	1.16	0.245	0.77	1.95
75+	2.33	0.45	4.39	<0.001	1.42	3.83
Sex						
Female	Ref.					
Male	0.57	0.10	-3.12	0.002	0.36	0.91
Education						
Less than secondary school graduation	Ref.					
Secondary school graduation, no post-secondary	0.92	0.20	-0.36	0.716	0.53	1.62
Some post-secondary	1.21	0.27	0.85	0.398	0.68	2.14
Post-secondary degree/diploma	0.95	0.18	-0.26	0.796	0.58	1.56
Income						
< $20,000	Ref.					
$20,000 to < $50,000	0.77	0.19	-1.06	0.288	0.41	1.45
$50,000 to <$100,000	0.59	0.16	-1.93	0.054	0.29	1.20
$100,000 to <$150,000	0.47	0.13	-2.71	0.007	0.23	0.96
$150,00 or more	0.50	0.15	-2.29	0.022	0.23	1.09
Missing	0.91	0.29	-0.30	0.761	0.40	2.07
Cultural/racial background						
White	Ref.					
Black	0.99	0.57	-0.01	0.992	0.23	4.34
East/Southeast Asian	0.74	0.49	-0.45	0.649	0.14	4.02
South Asian	0.46	0.20	-1.80	0.071	0.15	1.39
Multiple racial/cultural origins	0.88	0.31	-0.36	0.718	0.36	2.15
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	0.54	0.23	1.47	0.141	0.18	1.59
Weight (kg)	1.02	0.00	4.19	<0.001	1.01	1.03
Height (cm)	1.01	0.01	0.94	0.346	0.98	1.03
Smoking						
Never	Ref.					
Former	1.03	0.12	0.26	0.793	0.76	1.39
Current	1.67	0.30	2.87	0.004	1.05	2.65
Alcohol consumption						
At least once a month	0.70	0.11	-2.21	0.027	0.46	1.06
Occasional drinker	0.87	0.18	-0.67	0.503	0.51	1.49

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Did not drink in the last 12 months	Ref.					
Fruit and vegetable consumption						
<2 servings	1.63	0.29	2.75	0.006	1.03	2.57
2-4 servings	0.90	0.15	-0.62	0.535	0.59	1.39
5-7 servings	0.89	0.16	-0.65	0.513	0.56	1.41
>7 servings	Ref.					
Physical activity						
Normal level of physical activity	Ref.					
Low level of physical activity	1.52	0.18	3.52	<0.001	1.12	2.05
High social support availability						
Yes	Ref.					
No	1.28	0.22	1.41	0.159	0.82	2.00
Rural/Urban						
Urban	Ref.					
Rural	0.74	0.15	-1.51	0.132	0.44	1.24
Province						
Alberta	Ref.					
British Columbia	1.12	0.22	0.56	0.575	0.67	1.85
Manitoba	0.85	0.20	-0.70	0.485	0.46	1.55
Newfoundland and Labrador	0.83	0.18	-0.82	0.410	0.48	1.47
Nova Scotia	1.45	0.26	2.11	0.035	0.92	2.29
Ontario	1.08	0.18	0.45	0.650	0.70	1.68
Québec	2.55	0.43	5.52	<0.001	1.65	3.95
Constant	0.00	0.01	-3.77	<0.001	0.00	0.17

Note. Acronyms used in this table: confidence interval (CI).

Table 20 shows the adjusted weighted logistic regression model for chair rise test ability and objective wealth. For individuals with between $100,000 and $150,000 in savings and investments, the odds of being unable to complete the chair rise test decrease by 43.3% compared to individuals in the lowest objective wealth category (less than $50,000 in savings and investments); this finding was statistically significant. The difference in odds of being unable to perform the chair rise test between the other objective wealth categories and all education categories and the reference category were not statistically significant in this model.

Table 20

Weighted Logistic Regression Model for Chair Rise Test Ability and Objective Wealth

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.33	0.23	1.65	0.099	0.85	2.08
65 to 74	1.46	0.26	2.17	0.030	0.93	2.30
75+	2.83	0.53	5.58	<0.001	1.75	4.57
Sex						
Female	Ref.					
Male	0.57	0.10	-3.17	0.002	0.36	0.90
Education						
Less than secondary school graduation	Ref.					
Secondary school graduation, no post-secondary	0.93	0.20	-0.35	0.723	0.53	1.61
Some post-secondary	1.22	0.27	0.88	0.376	0.69	2.16
Post-secondary degree/diploma	0.93	0.17	-0.39	0.700	0.58	1.50
Objective Wealth						
Less than $50,000	Ref.					
$50,000 to less than $100,000	0.71	0.13	-1.83	0.067	0.43	1.15
$100,000 to less than $1 million	0.57	0.08	-4.05	<0.001	0.40	0.81
$1 million or more	0.52	0.11	-3.24	0.001	0.31	0.87
Missing	0.74	0.13	-1.70	0.089	0.46	1.17
Cultural/racial background						
White	Ref.					
Black	0.96	0.54	-0.08	0.936	0.22	4.08
East/Southeast Asian	0.73	0.49	-0.47	0.642	0.13	4.18
South Asian	0.46	0.20	-1.82	0.069	0.15	1.39
Multiple racial/cultural origins	0.86	0.30	-0.43	0.665	0.35	2.10
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	0.53	0.22	-1.55	0.121	0.19	1.52
Weight (kg)	1.01	0.00	3.93	<0.001	1.01	1.02
Height (cm)	1.01	0.01	1.11	0.269	0.99	1.03
Smoking						
Never	Ref.					
Former	1.02	0.12	0.15	0.880	0.75	1.37
Current	1.63	0.29	2.72	0.006	1.03	2.57
Alcohol consumption						
At least once a month	0.70	0.11	-2.25	0.024	0.47	1.05
Occasional drinker	0.87	0.18	-0.65	0.513	0.51	1.49

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Did not drink in the last 12 months	Ref.					
Fruit and vegetable consumption						
<2 servings	1.57	0.28	2.55	0.011	0.99	2.49
2-4 servings	0.88	0.15	-0.75	0.452	0.57	1.35
5-7 servings	0.87	0.15	-0.81	0.420	0.55	1.37
>7 servings	Ref.					
Physical activity						
Normal level of physical activity	Ref.					
Low level of physical activity	1.53	0.18	3.61	<0.001	1.13	2.08
High social support availability						
Yes	Ref.					
No	1.37	0.22	1.98	0.047	0.91	2.07
Rural/Urban						
Urban	Ref.					
Rural	0.74	0.14	-1.56	0.119	0.45	1.22
Province						
Alberta	Ref.					
British Columbia	1.09	0.21	0.44	0.662	0.67	1.77
Manitoba	0.82	0.19	-0.84	0.399	0.45	1.49
Newfoundland and Labrador	0.75	0.17	-1.29	0.198	0.43	1.33
Nova Scotia	1.37	0.24	1.81	0.070	0.87	2.16
Ontario	1.04	0.18	0.23	0.817	0.67	1.61
Québec	2.35	0.40	5.01	<0.001	1.51	3.64
Constant	0.00	0.00	-4.01	<0.001	0.00	0.12

Note. Acronyms used in this table: confidence interval (CI).

Table 21 shows the adjusted weighted logistic regression model for chair rise test ability and subjective wealth. The difference in odds of being unable to perform the chair rise test between subjective wealth and education categories and the reference category were not statistically significant in this model.

Table 21

Weighted Logistic Regression Model for Chair Rise Test Ability and Subjective Wealth

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Age						
45 to 54	Ref.					
55 to 64	1.29	0.22	1.51	0.132	0.83	2.01
65 to 74	1.42	0.25	2.01	0.044	0.91	2.23
75+	2.77	0.53	5.37	<0.001	1.70	4.52
Sex						
Female	Ref.					
Male	0.56	0.10	-3.26	0.001	0.35	0.88
Education						
Less than secondary school graduation	Ref.					
Secondary school graduation, no post-secondary	0.84	0.18	-0.80	0.424	0.48	1.47
Some post-secondary	1.09	0.24	0.37	0.712	0.61	1.93
Post-secondary degree/diploma	0.82	0.16	-1.04	0.300	0.51	1.34
Subjective Wealth						
Don't manage very well/have some or severe difficulties	Ref.					
Get by alright	0.64	0.15	-1.96	0.051	0.36	1.15
Manage quite well	0.59	0.13	-2.38	0.018	0.33	1.05
Manage very well	0.55	0.13	-2.48	0.013	0.299	1.02
Cultural/racial background						
White	Ref.					
Black	0.99	0.58	-0.01	0.990	0.22	4.48
East/Southeast Asian	0.74	0.50	-0.45	0.652	0.13	4.18
South Asian	0.48	0.20	-1.73	0.084	0.16	1.44
Multiple racial/cultural origins	0.88	0.30	-0.38	0.703	0.36	2.12
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	0.54	0.23	-1.45	0.147	0.18	1.61
Weight (kg)	1.02	0.00	4.07	<0.001	1.01	1.03
Height (cm)	1.01	0.01	0.84	0.403	0.98	1.03
Smoking						
Never	Ref.					
Former	1.03	0.12	0.26	0.798	0.76	1.39
Current	1.66	0.30	2.87	0.004	1.05	2.63
Alcohol consumption						
At least once a month	0.67	0.11	-2.55	0.011	0.44	1.00
Occasional drinker	0.85	0.18	-0.75	0.452	0.50	1.46

Variable	Odds ratios	Standard error	t	P-value	99% CI	
Did not drink in the last 12 months	Ref.					
Fruit and vegetable consumption						
<2 servings	1.66	0.29	2.85	0.004	1.05	2.62
2-4 servings	0.91	0.15	-0.59	0.553	0.59	1.39
5-7 servings	0.88	0.16	-0.70	0.484	0.56	1.39
>7 servings	Ref.					
Physical activity						
Normal level of physical activity	Ref.					
Low level of physical activity	1.53	0.18	3.58	<0.001	1.13	2.08
High social support availability						
Yes	Ref.					
No	1.35	0.22	1.83	0.067	0.89	2.04
Rural/Urban						
Urban	Ref.					
Rural	0.75	0.15	-1.48	0.139	0.45	1.24
Province						
Alberta	Ref.					
British Columbia	1.14	0.22	0.72	0.469	0.70	1.88
Manitoba	0.87	0.20	-0.61	0.540	0.47	1.58
Newfoundland and Labrador	0.86	0.19	-0.69	0.491	0.49	1.51
Nova Scotia	1.52	0.27	2.39	0.017	0.97	2.38
Ontario	1.09	0.18	0.53	0.596	0.71	1.69
Québec	2.69	0.45	5.87	<0.001	1.74	4.15
Constant	0.01	0.01	-3.59	<0.001	0.00	0.23

Note. Acronyms used in this table: confidence interval (CI).

CHAPTER 6: DISCUSSION

6.1. General Discussion

The purpose of this study using the first follow-up data from the Canadian Longitudinal Study on Aging (CLSA) was to investigate the socioeconomic gradient of health among older adults, using the chair rise test as an objective measure of intrinsic capacity. We found that the chair rise test was associated with other dimensions of health as expected. We found a statistically significant and clinically meaningful difference between the highest and the lowest income groups, and statistically significant, but not clinically meaningful, differences between the highest and lowest subjective and objective wealth groups, when controlling for a number of demographic, anthropomorphic, health behaviour, and geographic variables. Additionally, by including those who were unable to complete the chair rise test in our analyses, we gained valuable insight into the characteristics of who is typically left out of studies of physical capability due to a lack of intrinsic capacity and environmental supports.

Based on our descriptive analyses, we found that those who were older than 75, less educated, less affluent (based on income and both wealth variables), less generally healthy (based on SRH, chronic conditions, and ADLs), less socially supported, and less physically active have a greater proportion of people who are unable to complete the chair rise test, compared to their counterparts. Among Black people, Nova Scotians, and Quebecois people, a higher proportion of people were unable to complete the chair rise test, compared to other races and provinces. Finally, smokers, people with poorer nutrition, and people with knee and/or hip arthritis have a higher proportion of people unable to complete the chair rise test compared to their counterparts. Beyond the descriptive analyses, we also found statistically significant associations between chair rise ability and the frailty index, self-rated health, sex and age. Social and structural determinants of health, including racism, age, gender, education, wealth, income, and the socio-political context are known to determine health outcomes and ability (Solar & Irwin, 2010), as is demonstrated by the characteristics of the subset of participants who were unable to complete the chair rise test. Including people who were unable to complete the chair rise test in our analysis tells us valuable information about who is typically considered “missing” in studies of physical capability.

As mentioned, there was a higher proportion of people unable to complete the chair rise test in Nova Scotia and Quebec, compared to other provinces. However, Nova Scotians and Quebecois who could perform the chair rise test had on average the fastest chair rise test times compared to other provinces. If we had only analyzed those who could perform the chair rise test, we would have not known about those who lack the intrinsic capacity to complete the chair rise test. This further illustrates the importance of including people who lack the intrinsic capacity to complete physical capability measures in studies of health inequality.

Moreover, in the present study we found statistically significant, clinically meaningful racial/cultural differences in the chair rise test (Black and South Asian people completed the chair rise test over one second slower than White people) and racial/cultural differences in chair rise test ability (Black people had a higher proportion of people unable to complete the chair rise test than other racial/cultural groups). Similarly, a study from Sternfeld and colleagues (2020) found racial/ethnicity-related inequalities in physical performance among American women in mid-life, with African American, Chinese, and Hispanic women scoring lower than Caucasian and Japanese women on measures of grip strength, walking speed, and the chair rise test. These results were mediated by factors such as socioeconomic status, education, and financial strain. Sternfeld and colleagues (2020) found that these inequalities were likely due to the sociopolitical/cultural context of being a person of colour in America. Future population health studies of the chair rise test should further investigate reasons why racial/cultural differences in the chair rise test exist and make careful assessment as to whether these differences are inequitable.

Our logistic regression analyses of binary chair rise test ability and other dimensions of health show that individuals with poorer health, more functional impairments, and higher levels of frailty were more likely to be categorized as unable to complete the chair rise test. There are a number of potential reasons why one would be categorized as unable to complete the chair rise test, including not being able to use a necessary assistive device such as a cane or crutches, or even not being able to use one's arms to push up from a chair. Without access to aids and devices that we use on a daily basis, the chair rise test and other similar physical capability measures should be considered measures of intrinsic

capacity and not of functional ability (George et al., 2021). Future studies that wish to use physical capability measures as measures of functional ability rather than intrinsic capacity should allow for the use of environmental supports. Measures of intrinsic capacity and functional ability both have their place in the world of physical capability measures research, and it is important to engage in conversations about which of those two concepts we wish to assess in a given study. Future studies should make efforts to include the "unable" category as an outcome in their analyses of physical capability measures and other similar measure of health.

We found associations between the chair rise test and all of the other measures of health that we assessed (i.e., self-rated health (SRH), Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), number of chronic conditions, and the frailty index) while controlling for age. The chair rise test was strongly associated with SRH, a frequently used measure in the study of the socioeconomic gradient of health (Huisman et al., 2007). The associations with SRH and the chair rise test make this a promising physical capability measure to use along with SRH in future studies of health inequality in older adults; the objectivity of the chair rise test could be a complementary addition to the subjectivity of SRH.

The chair rise test also showed both statistically significant and clinically meaningful associations with function in (I)ADLs. The World Health Organization states that functional ability/the ability to meet basic needs can be sufficiently measured by only three items: the ability to get dressed, take medication, and manage money (*Decade of Healthy Ageing: Baseline Report. Summary*, 2021). These three items are included in our IADL and ADL variables. The strong associations with the chair rise test and ADLs and IADLs suggest that the chair rise test has the potential to be a good measure of functional ability. IADLs include complex tasks such as managing finances and preparing meals, while ADLs include the skills required to manage basic physical needs such as dressing and toileting. As such, IADL impairment often occurs before ADL impairment (Mlinac & Feng, 2016). Notably, we found that IADL impairment slowed chair rise test performance more than ADL impairment – individuals with IADL impairment completed the chair rise test in 14.82 seconds on average, while individuals with ADL impairment completed the chair rise test in 13.41 seconds on average – which was unexpected based

on the current literature in this area (Mlinac & Feng, 2016). One potential explanation for this finding is that ADL and IADL impairment is measured as a binary variable in the current study, wherein the response options are: no difficulties with (I)ADLs or one or more difficulties with (I)ADLs. Therefore someone with one (I)ADL impairment was categorized the same as someone with five (I)ADL impairments. Future research could consider using (I)ADL impairment subgroups to provide a more nuanced look at patterns of impairment, as demonstrated by Zhang and colleagues (2021).

We found expected associations between each level of the frailty index and chair rise test time; as frailty increases, so does the length of time required to complete the chair rise test. Perhaps the most poignant of the differences in chair rise test time was the 10.23 second increase in time from the least frail category to the most frail category. Participants in the most frail category took on average almost two times longer to complete the chair rise test than the average chair rise test time of the overall analytical sample. This finding, as well as the graded relationship between each of the frailty categories, is consistent with previous literature that shows other physical capability measures to be associated with frailty (Lam et al., 2016; Radford, 2021). Our findings suggest that the chair rise test might be an appropriate measure to use when the frailty index (which requires numerous variables, which may include biometric tests and measures) is inaccessible in studies of health inequality in older adults and clinical settings.

The age-stratified analysis revealed that the aforementioned associations between the chair rise test and other dimensions of health were present in all age categories. This finding suggests that the chair rise test is a health indicator starting as young as 45 years of age; this is noteworthy because most other studies of the chair rise test are assessed only at much older ages (i.e., Cesari et al., 2008; Rolland et al., 2006; Tiihonen et al., 2017). In our sex-stratified analyses of the chair rise test time and other dimensions of health variables, there were very few differences in chair rise test times by sex, with the exception of function in IADLs and the frailty index. Our analyses showed that males performed significantly slower on the chair rise test compared to females among those in the difficulty/inability to complete IADL(s) category and the highest frailty index category. This finding is in contrast with Cooper, Hardy, and colleagues (2011) and Kuh

and colleagues (2005) who found sex differences in the chair rise test and other physical capability measures, finding that males performed faster than females. It is important to note that we only analysed sex differences and not gender differences in the current study, thus not accounting for gender diverse and gender non-conforming individuals, as well as only considering the limited *biological* context of sex and not the *social* context of gender.

We found that there was a statistically significant and clinically meaningful difference between the highest and the lowest income groups, and statistically significant, but not clinically meaningful, differences between the highest and lowest subjective and objective wealth groups. This finding is similar to a recent study of associations between socioeconomic status (measured by education and subjective social status) and sarcopenia (measured by the chair rise test and/or grip strength) in community dwelling older adults aged 60 and over. The researchers found that sarcopenia was twice as prevalent among individuals in the lowest socioeconomic positions, compared to the highest socioeconomic positions (Swan et al., 2022). Our findings contribute to the growing body of research that shows socioeconomic inequalities in health among older adults, using physical capability measures to assess health.

Although there appeared to be a graded relationship between increasing levels of income and subjective and objective wealth and chair rise test performance, we did not find a statistically significant socioeconomic gradient in the chair rise test. The statistically significant, clinically meaningful difference was only between the lowest and highest income groups, and this may indicate that the chair rise test may not be a sensitive enough measure to capture a socioeconomic gradient. The lack of clear socioeconomic gradients in chair rise test we found in our study align with the findings of Jancova-Vseteckova and colleagues (2015). In their study of Czech adults ages 60 to 75 years, the researchers found that the chair rise test did not exhibit a socioeconomic gradient measured by self-reported material circumstances (i.e., money for food, clothes, and paying bills) despite finding a clear educational gradient in the chair rise test. An additional explanation for this finding may be that the CLSA is overall more educated and affluent than the general population, which may contribute to the lack of presence of

a socioeconomic gradient in the chair rise test. Perhaps a more socioeconomically representative sample would tell a different story.

We also included education in each of our analyses of socioeconomic status and the chair rise test. There were statistically significant differences in education in all three socioeconomic status models, however the relationship was not graded as we expected based on previous research (Jancova-Vseteckova et al., 2015). In each of the models, the lowest education level (less than secondary school graduation) performed approximately 0.57 – 0.76 seconds slower on the chair rise test than the other three education levels (secondary school graduation, some post-secondary education, and post-secondary degree/diploma) which all fell within a 0.06 – 0.14 second range of each other, depending on the model. Similarly, a study from Welmer and colleagues (2013) found associations between education and the chair rise test, but not a graded relationship. While there was not a graded relationship between all levels of education and the chair rise test in the current study, there was still a much larger difference in chair rise test time between those who have not completed secondary school and those who have, compared to the differences between other education categories. These differences were not clinically meaningful, but may warrant further investigation.

Our definition of clinical meaningfulness should be interpreted cautiously. In clinical settings the chair rise test is often one test included in the Short Physical Performance Battery (SPPB), a well-established tool often used in clinical settings to assess lower extremity physical performance status in older adults (Pavasini et al., 2016). Because the chair rise test is typically one aspect in a larger battery of tests, its clinical meaningfulness alone is scarcely reported. As such, I determined an ad hoc way to assess the clinical meaningfulness of the chair rise test: an increase in chair rise test time by approximately 1.0 seconds translates to an increase in age by 10 years. This biological gradient between age and chair rise test time led to our definition of clinical meaningfulness. As described by Andrew and Rockwood (2008) however, there are a number of other factors to consider when determining clinical meaningfulness including reproducibility between studies, convergence between different measures, and distinctions between what is clinically meaningful and what is clinically detectable. Even so, we found that the 1.0 second difference distinguished other clinically distinguishable

groups (e.g. those with ADL impairment, those with IADL impairment, and those with those with three or more chronic conditions); triangulating these observations provides further support for our definition of a one second time difference as being clinically meaningful. The definition of clinical meaningfulness of the chair rise test as used in the current study is an adequate starting point, however future research should investigate the validity and significance of this definition.

The current study found a statistically significant and clinically meaningful difference in the chair rise test between the highest and the lowest income groups, and that a number of health dimensions including self-rated health and the frailty index were statistically and clinically associated with the chair rise test. Chair rise test time was an indicator of health across all age groups starting as young as 45 years, based on our age-stratified analyses. While we did not find sex differences in chair rise test *time* in our age-adjusted sex-stratified analysis, we did find sex differences in chair rise test *ability* in our Chi-squared tests of independence, with women more likely to be unable to perform the chair rise test than men. We have identified a number of characteristics that show that the chair rise test is a promising measure of intrinsic capacity, with the potential to be used as a measure of functional ability when appropriate environmental supports are available in the health inequality research context.

6.2. Stakeholder Engagement

Throughout this project, we learned from experts during three separate stakeholder consultation meetings. The purpose of the first of the three meetings was to understand how the chair rise test is (or is not) relevant to stakeholders in their day-to-day lives or practices. The main questions used to guide discussions were as follows:

1. Do you think that the ability to rise from a chair is important in your (or your clients') day-to-day life?
2. Do you (or your clients) typically require assistance in rising from a chair?
3. Do you feel that your (or your clients') ability to rise from a chair is a meaningful way to judge your general health?

During the first meeting one of the stakeholders, a physiotherapist, made some important connections between the chair rise motion and our ability to be an active member in our communities. From sitting down at a bench in the mall, to a low pew at a church, or a

couch at a friend's house – when you lose the ability to rise up, or use your arms to push yourself up, you are often losing the ability to go certain places, they explained. This is where we see the importance of environmental supports, which can mean the difference between having no intrinsic capacity to do certain activities, to having the functional ability to be able to accomplish them. The responses to these questions helped me to shape the data analysis and interpretations of results in a way that aligns with the interests of the stakeholders.

The purpose of the second meeting was to share some of the preliminary results and discuss what the results mean to the implicated parties. This meeting helped to inform the writing of my results and discussion sections, and the implications of the findings. The stakeholder team provided useful insight into how they felt the preliminary findings related to their experiences with the chair rise test/motion, as healthcare workers and/or older adults. For example, one of the stakeholders present at the second meeting was a nurse specialising in fall risk. They emphasized just how important socioeconomic status is when it comes to functional ability, which we were discussing in the context of physical capability measures that they use daily in their clinical practice, including the chair rise test. They explained that among their patients, those in lower socioeconomic positions often struggle in a number of areas that contribute to their ability to meet certain needs, including finding transportation to attend health appointments, paying for their medications, or going to the gym to maintain or strengthen their physical capabilities. These barriers perpetuate a vicious cycle: a lack of wealth makes it hard to do health promoting activities, thus negatively impacting our health and well-being, making it even harder to do the aforementioned health promoting activities – and so forth. Another stakeholder, an older adult community member echoed this idea, saying that even thinking about doing those health promoting activities can require a luxurious amount of energy that many people cannot afford to expel.

Finally, the main purpose of the third meeting was to share ideas for effective knowledge dissemination. Some of the ideas that were raised during this meeting included creating a short video explaining the importance of the chair rise test as a measure of health to be used by clinicians, and sharing printed materials with community members both in clinical settings (i.e., a doctor's office waiting room, a physiotherapy

clinic, etc.) and community settings (i.e., a yoga studio, a recreation centre, etc.). I want to ensure that the results of this research are presented in a meaningful way, so I was grateful to gain guidance from the stakeholders in informing the non-academic dissemination of this project.

6.3. End-of-Project Knowledge Translation

In addition to the integrated knowledge translation steps described above, we wished to ensure effective knowledge translation upon completion of the project. The exchange of knowledge between researchers and implicated stakeholders should be collaborative (Graham et al., 2006), therefore we wanted to ensure that the research is effectively disseminated to community members, health providers, and policy makers. In order to translate research into practice, we followed Lavis and colleagues' framework for knowledge transfer, which suggests five questions be considered when designing a knowledge transfer strategy:

1. What should be transferred to decision makers?
2. To whom should research knowledge be transferred?
3. By whom should research knowledge be transferred?
4. How should research knowledge be transferred?
5. With what effect should research knowledge be transferred? (Lavis et al., 2003, p. 222).

With these five questions guiding our dissemination (both academically and non-academically), we designed a knowledge translation strategy that is both meaningful to stakeholders and has clear, concrete direction for policymakers. During my thesis research I presented at the following six conferences: Maritime Health Research Summit, Canadian Association on Gerontology Annual Scientific and Educational Conference, Community Health and Epidemiology Research Day (Dalhousie University), Faculty of Medicine Graduate Research Day (Dalhousie University), Annual Canadian Association for Health Services and Policy Research Conference, and Atlantic Health Exploration and Discovery: Collaborative Health Research Conference. Upon completion of my thesis, I will continue to present the findings at relevant conferences, and submit manuscripts for publication to aging journals. As for non-academic dissemination, I am compiling the findings into relevant materials that can be used by community members, health

providers, and policy makers. I obtained input from the stakeholders to see how they would like to see the data shared. I have also made myself available to those who participated in the stakeholder consultations to personally discuss the findings with them further.

6.4. Strengths and Limitations

There were five major strengths of this project: the use of CLSA data, the use of wealth variables, the use of the chair rise test as a validated objective measure, the stakeholder consultations, and the investigation of construct validity using the WHO Decade of Heathy Ageing framework. Firstly, the use of CLSA data provides us with a very large sample size with a plethora of diverse health, demographic, and socioeconomic variables. Second, the use of wealth variables in this research may be more informative of one's socioeconomic position than traditional measures of socioeconomic status, such as income, occupation, social class and education.

Third, using the chair rise test as a physical capability measure is beneficial for future policy decisions because of the ease and accessibility of this measure – the chair rise test can be conducted during any clinical visit, with no additional equipment required. Our findings suggest that the chair rise test is a measure of general health that could be used when more complicated measures, like the frailty index, are unavailable. The chair rise motion is used by many of us on a daily basis and is helpful for independent living, as such it may be an important test for geriatricians and other clinicians to assess in their older patients.

Fourth, the stakeholder consultations were another major strength of this research. By ensuring that the project was person-oriented, we made efforts to address the concerns and needs of older adults and healthcare workers who are implicated in the current research. Their insights were invaluable to the data analysis, interpretations, and dissemination of this research, as is discussed in the following section.

Finally, another strength of this project was the consideration of issues with the chair rise as a measure of health. The investigation of the construct validity of the chair rise test using the WHO Decade of Healthy Ageing framework allowed us to better understand what is lacking in current objective health measures. Additionally, the inclusion of individuals who were unable to complete the chair rise test in our analysis provided

useful insight into a group that is typically left out of analyses. Given that I am a student using an existing dataset, I could not make changes to the existing data for this project, however, I hope that this research will inform inclusion criteria and accommodations for future surveys and data collection.

This research has at least three main limitations: the study design was cross-sectional, the CLSA participants were more educated than the general population, and there was a lack of information about why certain individuals did not complete the chair rise test. First, the study design of the current study was cross-sectional, which prevents us from implying causality – with the notable exception of education. A causal relationship could potentially be inferred between education and the chair rise test because one's formal education is typically completed many years prior to participating in the CLSA.

Second, the CLSA participants have been shown to be more educated than the general Canadian population, calling generalizability into question (Raina et al., 2009). This was a limitation of this study since we were addressing the socioeconomic gradient of health in the chair rise test. We hope that the included wealth measures were sufficient to accurately assess socioeconomic position in this sample despite this limitation.

Finally, although the lack of accommodations for nonhuman assistance and medical technologies in the chair rise test is a common measurement practice for the chair rise test, it misses an opportunity to gain valuable information regarding those who cannot perform the chair rise test. Due to the nature of the chair rise test variable, we lacked information about why certain individuals did not complete the chair rise test. By including those who could not complete the chair rise test in our analyses, instead of considering them to be missing values, we were still able to assess those who did not have the intrinsic capacity to complete the chair rise test.

6.5. Policy Implications and Future Directions

By contributing to the growing body of research into appropriate health measures for older adults this research has useful health policy implications. We have further demonstrated the presence of the socioeconomic differences in health, investigating how health is distributed among older adults using the chair rise test as an easy to obtain measure of physical capability. The simplicity of the chair rise test and the implications of this movement on day-to-day activities, make it a promising measure for future

research, clinical practices, and population-based studies. These findings could inform decisions in choosing appropriate health measures and equitable resource distribution.

The conceptual framework provides insight into potential issues with the construct validity of the chair rise test. Future population-based surveys may wish to consider including more environmental supports for individuals who do not have the intrinsic capacity to complete physical capability measures alone. If physical capability measures are meant to represent functional ability in day-to-day life, but if we do not have access to the supports we use on a daily basis (i.e., a walker, a cane, or arms on a chair to help us push up), these measures may not be as representative of functional ability as we think. Future studies should engage in the discussion regarding what exactly we wish to measure with the chair rise test, intrinsic capacity or functional ability, and if the latter, try to incorporate assistive devices into the chair rise test. In the absence of these accommodations, if the interest is measuring functional ability, researchers and analysts should be mindful of whether observations are truly missing various physical capability test scores, or if they can still be assessed and included in different ways.

CHAPTER 7: CONCLUSION

The chair rise test is an easy to obtain, objective measure of health that was correlated with a variety of other health measures, with promising implications to be used in addition to or in place of these other health measures when said measures are unavailable. We found some statistically significant and clinically meaningful associations between some socioeconomic status categories and the chair rise test, but the chair rise test only demonstrate the difference between the lowest and highest income groups. Finally, future studies of physical capability measures should clarify whether they are measuring intrinsic capacity or functional ability, along with performance.

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APPENDIX 1. MISSING ANALYSIS

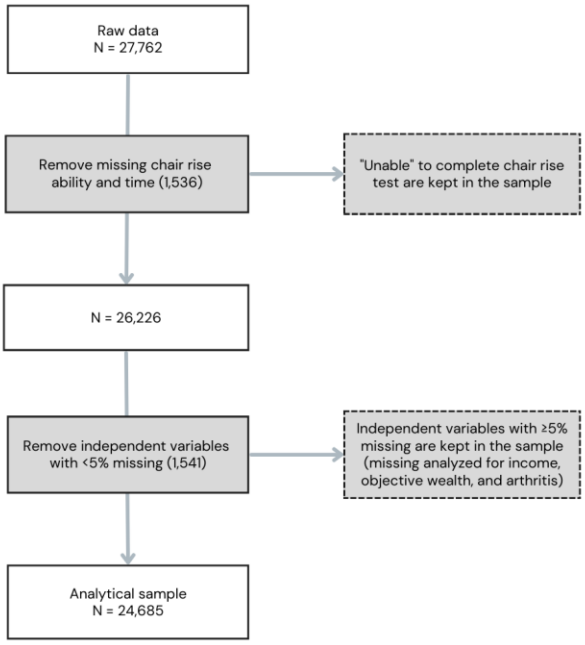
Descriptive characteristics for the missing sample

A total of 24,685 participants were included in the analysis after 3,077 observations were removed due to missing both of the outcome variables (chair rise test ability and time) and/or missing an independent variable with <5% missing (see Figure for missing data flowchart).

Of the missing sample, 912 (29.6%) participants were able to complete the chair rise test, 629 (20.4%) were unable to complete the chair rise test, and 1,536 (49.9%) were missing the chair rise test altogether. The missing sample was generally older, poorer, less educated, and in poorer general health compared to the analytical sample (as shown in Table). Of the missing sample, 37.8% were over the age of 75, compared to 13.1% of the analytical sample; 8.6% reported less than $20,000 in household income compared to 5.0% of the analytical sample; 8.1% reported having less education than a secondary school graduation compared to 14.8% of the analytical sample; 22.0% reported their general health to be “poor” or “fair” compared to 9.61% of the analytical sample. Finally, Nova Scotians are overrepresented in the missing sample, making up 22.0% of the missing sample compared to 3.1% of the analytical sample.

Figure

Missing Analysis



Note. The missing data workflow, showing how missing observations were handled in this analysis.

Table

Selected descriptive characteristics of the missing sample (n=3,077) compared to the analytical sample (n=24,685).

	Missing Sample		Analytical Sample	
Variable	N	%	N	%
Age (years)				
45-54	357	11.6	4036	27.6
55-64	757	24.6	8378	34.8
65-74	801	26.0	7434	24.1
75+	1162	37.8	4837	13.1
Sex				
Female	1579	51.3	12,552	52.6
Male	1498	48.7	12,133	47.4
Self-rated health				
Poor	187	6.1	360	1.4
Fair	491	16.0	1959	8.2
Good	995	32.3	7204	31.9
Very good	997	32.4	10,460	40.6
Excellent	369	12.0	4702	17.9
Income				
<$20k	266	8.6	1037	5.0
$20k-$50k	809	26.3	4807	19.6
$50k-$100k	975	31.7	8310	31.7
$100k-$150k	400	13.0	4818	20.3
$150k+	299	9.7	4318	17.9
missing	328	10.7	1395	5.5
Education				
Less than secondary	249	8.1	1131	14.8
Secondary grad	342	11.1	2196	11.2
Some post-secondary	266	8.6	1756	9.1
Post-secondary grad	2177	70.8	19,602	64.8
Province				
Alberta	260	8.5	2510	11.0
British Columbia	535	17.4	5248	29.2
Manitoba	345	11.2	2530	7.0
Newfoundland and Lab	211	6.7	1782	1.9
Nova Scotia	676	22.0	2100	3.1
Ontario	521	16.9	5474	17.1
Quebec	529	17.2	5041	30.7
Total	**3,077**	**100.0**	**24,685**	**100.0**

APPENDIX 2. CLSA CHAIR RISE TEST STANDARD OPERATING PROCEDURE

clsa élcv Canadian Longitudinal Study on Aging Étude longitudinale canadienne sur le vieillissement	**Title:**	**Chair Rise Test**		
	Version Date:	2014-JUL-10	**Document Number:**	SOP_DCS_0024
	Effective Date:	2014-OCT-15		
Data Collection Site (DCS)	**Version:**	1.2	**Number of Pages:**	4

1.0 Purpose:
The purpose of this document is to describe the standardized procedure for administering the chair rise test.

2.0 Scope:
This document is to be used by the DCS staff when administering the chair rise test to 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:
Not applicable

6.0 Equipment:
Not applicable

7.0 Supplies:
- Chair without arm rests; and,
- Validated stopwatch.

8.0 Procedure Steps:
Contraindications:
- The participant is unable to stand or rise from a chair unassisted (Contraindications Questionnaire).
-

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

Before starting the test, be sure to place the back of the chair right up against a wall to prevent movement during the test.

Step 1: At the *Interview Tab* in Onyx, look for 'Chair Rise' in the list of stages. Then select **Start** in that row.

Step 2: The "Chair Rise: Start" window will pop up.

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

Step 4: Explain the procedure in full and demonstrate the test to the participant. Demonstrate the technique by standing up and sitting down one time, returning completely to the correct starting position.

Inform the participant that improper technique (such as not standing completely upright, not sitting all the way back down, lifting feet off the floor, etc.) will not be counted.

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

Step 6: Ask the participant to sit as far back in the chair as possible. The position of the participant should be as follows:
The participant's feet should be positioned approximately hip distance apart and planted firmly on the floor for support.

The back of the participant's legs should be positioned away from the chair.

The participant's knees should be bent at a 90 degree angle with his/her arms crossed over his/her chest.

The participant should not use their hands to get up.
NOTE: An individual of average or taller height will be able to sit with his/her back against the back of the chair, while someone of shorter height will not be able to touch the back of the chair. Shorter participants are not required to touch the back of the chair during testing as doing so will affect their proper starting position.

Figure 1.0: Example of the proper seated and standing position

Step 7: Click **Next** in Onyx.

Step 8: Inform the participant that the timed assessment will begin on the command, "Ready, Set, Go," and on this command, the participant is to stand up and sit back down five times as quickly and safely as possible, with no rest in between.

Step 9: The DCS research staff member will begin timing by starting the stopwatch immediately after speaking the command "**Ready, Set, Go**." Count each chair stand out loud when the participant is in the standing position. Offer positive encouragement to the participant throughout the test.
Note: See additional instructions for counting repetitions after **Step 15**.

Step 10: On the 5th repetition, **Stop** the stopwatch while the participant is in the standing position.

Step 11: **Record** the number of rises and the time or the five true trials and the time for them (i.e., do not record results from the practice trial).

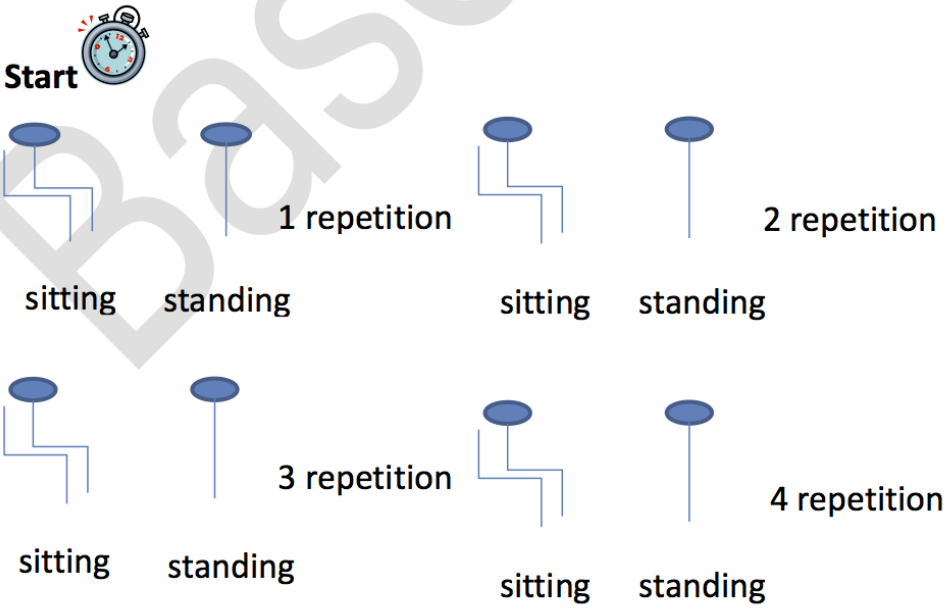
Step 12: Click **Next**. The conclusion screen will appear indicating that you have completed the measurements.

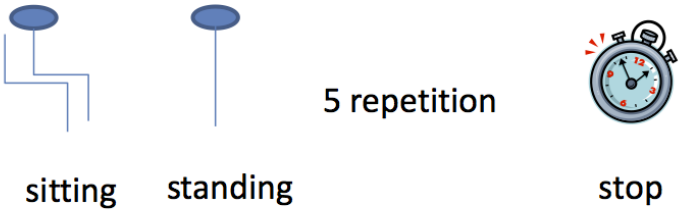
Step 13: Click **Finish**. The "Chair Rise: Finish" window will pop up.

Step 14: 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 15: Click **Continue** to return to the status page.

Counting Repetitions:





9.0 Documentation and Forms:

- **CRF_DCS_0024** - Chair Rise Case Report Form

10.0 References:

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Revision History:

New Version #	Revision Date	Revision Author	Content Approval
1.2	2014-JUL-10	Lorraine Moss	Mark Oremus
Summary of Revisions			
Added 'stop' symbols to emphasize step in CI and Step 4			
Added note to Step 9: See additional instructions for counting repetitions after Step 15.			
Added illustration 'Counting Repetitions'			
SOP formatting updated.			
Wording of Scope, Purpose and Responsibilities updated and clarified.			
New Version #	**Revision Date**	**Revision Author**	**Content Approval**
1.1	2013-Nov-30	Lorraine Moss	Mark Oremus
Summary of Revisions			
Chair with arms changed to without in section 5.0.			
Grammatical correction in note on step 6.			
Added document numbers to section 7.0			

APPENDIX 3. FRAILTY INDEX

Variables for the frailty index, based on the frailty index used by Radford (2021).

Variable	Variable name in the CLSA	Cut-point	Notes
Self-rated health	GEN_HLTH_COF1	0: Excellent, 0.25: Very good, 0.5: Good, 0.75 Fair, 1.0: Poor	
Hearing rating (self-rated)	HRG_HRG_COF1	0: Excellent 0.25: Very good 0.5: Good 0.75: Fair 1.0: Poor	
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	
Sense of balance	PKD_CAL_COF1	0: Good sense of balance 1: Poor sense of balance	
CES-D scale: Frequency feel lonely	DEP_LONELY_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)	
OARS scale: Able to travel	IAL_ABLTRV_COF1	0: Able to travel around 1: Unable to travel around	
OARS scale: Able to do housework	IAL_ABLWRK_COF1	0: Able to do housework 1: Unable to do housework	
OARS scale: Able to go shopping	IAL_ABLGRO_COF1	0: Able to go shopping 1: Unable to go shopping	
OARS scale: Able to prepare meals	IAL_ABLML_COF1	0: Able to prepare meals 1: Unable to prepare meals	
OARS scale: Able to take bath	ADL_ABLBT_COF1	0: Able to take bath 1: Unable to take bath	
OARS scale: Trouble getting to bathroom in time	ADL_BATH_COF1	0: No 1: Yes	

Coughed most days – last 12 months	CAO_COFPY_COF1	0: Don't cough most days 1: Cough most days	
Have prosthetic limb or joint	ICQ_PROSLIM_COF1	0: Don't have prosthetic limb or joint 1: Have prosthetic limb or joint	
Other Arthritis	CCC_AETOT_COF1	0: No other arthritis 1: Have other arthritis	
Osteoarthritis Hand	CCC_OAHAND_COF1	0: Don't have osteoarthritis in one or both hands 1: Have osteoarthritis in one or both hands	
Osteoarthritis Hip	CCC_OAHIP_COF1	0: Don't have osteoarthritis in the hip 1: Have osteoarthritis in the hip	
Osteoarthritis Knee	CCC_OAKNEE_COF1	0: Don't have osteoarthritis in the knee 1: Have osteoarthritis in the knee	
Stroke or CVA	CCC_CVA_COF1	0: No stroke or CVA 1: Have stroke or CV	
Glaucoma	ICQ_GLAUC_COF1	0: No glaucoma 1: Have glaucoma	
Osteoporosis	CCC_OSTPO_COF1	0: No osteoporosis 1: Have osteoporosis	
High blood pressure	CCC_HBP_COF1	0: No high blood pressure/ hypertension 1: Have high blood pressure/hypertension	
Diabetes	DIA_DIAB_COF1	0: No diabetes 1: Have diabetes	
Heart attack	CCC_AMI_COF1	0: No heart attack 1: Have heart attack	
Mini-stroke or TIA	CCC_TIA_COF1	0: Never experienced a ministroke or TIA 1: Did experience a ministroke or TIA before	
Cataracts	ICQ_CA TRCT_COF1	0: Never suffer from cataracts 1: Had/have cataracts	
Heart disease	CCC_HEART_COF1	0: No heart disease 1: Have heart disease	

Intestinal or stomach ulcers	CCC_ULCR_COF1	0: No intestinal or stomach ulcers 1: Have intestinal or stomach ulcers	
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	
Angina	CCC_ANGI_COF1	0: No angina 1: Have angina	
Peripheral vascular disease	CCC_PVD_COF1	0: No peripheral vascular disease 1: Have peripheral vascular disease	
Urinary incontinence	CCC_URIINC_COF1	0: No urinary incontinence 1: Have urinary incontinence	
Macular degeneration	CCC_MACDEG_COF1	0: No macular degeneration 1: Have macular degeneration	
Under-active thyroid gland	CCC_UTHYR_COF1	0: No under-active thyroid gland 1: Have under-active thyroid gland	
Kidney disease	CCC_KIDN_COF1	0: No kidney disease or kidney failure 1: Have kidney disease or kidney failure	
Bowel incontinence	CCC_BOWINC_COF1	0: No bowel incontinence 1: Have bowel incontinence	
Cancer	CCC_CANC_COF1	0: No cancer 1: Had cancer	
Wears dentures or false teeth	ORH_DENT_COF1	0: No 1: Yes	
Walking speed (time required to walk 4m)	WLK_TIME_COF1	0: < 6.0s 1: >= 6.0s	Cut-points based on the slowest 5% of people.

APPENDIX 4. SOCIOECONOMIC STATUS VARIABLES

As is common in the health inequality literature, income and education will be used to measure socioeconomic status. Additionally, we will use two wealth variables to measure socioeconomic status, as wealth is potentially a more accurate measure of socioeconomic status than income and education (Allin et al., 2009).

Variable	**Variable name in the CLSA**	**Responses**	**References**	**Notes**
Income	INC_TOT_COF1	1: Less than $20,000 2: $20,000 to $49,000 3: $50,000 to $99,999 4: $100,000 to $149,999-$150,000+	Tiihonen et al., 2017	There are shown to be associations between income and the chair rise test.
Education (CLSA derived variable)	ED_UDR04_COM	1: Less than secondary school graduation 2:Secondary school graduation, no post-secondary 3: Some post-secondary education 4: Post-secondary degree/diploma	Tiihonen et al., 2017	There are shown to be associations between education and the chair rise test.
Objective wealth – savings and investments (WEA_2)	WEA_SVNGSSVL_COF1	1: Less than $50,000 2: $50,000 to less than $100,000 3: $100,000 to less than $1 million 4: $1 million or more	Allin et al, 2009	Wealth measures appear to be a more meaningful measure of socioeconomic status than traditional measures. *What is the approximate total value of these savings and investments? (Referring to an account at a bank, credit union or*

				elsewhere, RRSPs, financial investments outside of RRSPs).
Subjective wealth – financial status (WEA_6)	WEA_FNSTATUS_COF1	1: Manage very well 2: Manage quite well 3: Get by alright 4: Don't manage very well/Have some or severe financial difficulties	Allin et al, 2009	Wealth measures appear to be a more meaningful measure of socioeconomic status than traditional measures. *Which of these phrases best describes how you (and your spouse/partner) are getting along financially these days?*

APPENDIX 5. ACTIVITIES OF DAILY LIVING VARIABLES

Variable	Variable name in the CLSA	Responses	References	Notes
Activities of Daily Living (ADL)	ADL_ABLDR_COF1 ADL_HPDR_COF1 ADL_UNDR_COF1 ADL_ABLFD_COF1 ADL_HPFD_COF1 ADL_UNFD_COF1 ADL_ABLAP_COF1 ADL_HPAP_COF1 ADL_UNAP_COF1 ADL_ABLBD_COF1 ADL_HPBD_COF1 ADL_UNBD_COF1 ADL_ABLBT_COF1 ADL_HPBT_COF1 ADL_UNBT_COF1 ADL_BATH_COF1	1: One or most difficulties/inability 2: No difficulties/inability	Guralnik et al., 1994; Meng & D'Arcy, 2016	Difficulty with ADLs are associated with slower chair rise test time or inability to complete the chair rise test.
Instrumental Activities of Daily Living (IADL)	IAL_ABLTEL_COF1 IAL_ABLTRV_COF1 IAL_ABLGRO_COF1 IAL_ABLWRK_COF1 IAL_ABLML_COF1 IAL_ABLMED_COF1 IAL_ABLMO_COF1 IAL__COF1	1: One or most difficulties/inability 2: No difficulties/inability	Guralnik et al., 1994; Meng & D'Arcy, 2016	Difficulty with IADLs are associated with slower chair rise test time or inability to complete the chair rise test.
Self-rated health (SRH)	GEN_HLTH_COF1	1: Excellent 2: Very good 3: Good 4: Fair 5: Poor	Cesari et al., 2008	SRH is shown to be associated with the chair rise test.

Chronic conditions	CCC_CVA_COF1 DIA_DIAB_COF1 CCC_ASTHM_COF1 CCC_COPD_COF1 CCC_HEART_COF1 CCC_ALZH_COF1 CCC_P ARK_COF1 DEP_FLDP_COF1	1: No conditions or no response 2: 1 condition 3: 2 conditions 4: 3 or more conditions	Tiihonen et al., 2017; Cooper, 2010; 2011; Groll et al., 2005	

APPENDIX 6. DETERMINANTS OF THE CHAIR RISE TEST

Variable	Variable Name in the CLSA	Measurement	Reference(s)	Notes
Demographic variables				
Age	AGE_NMBR_COM	Continuous 1: 45 to 54 2: 55 to 64 3: 65 to 74 4: 75 +	Cooper, Hardy, et al., 2011	Older age is associated with chair rise time and other physical capability measures.
Sex	SEX_ASK_COM	0: Male 1: Female	Cooper, Hardy, et al., 2011; Kuh et al., 2005	Sex is associated with chair rise time and other physical capability measures.
Weight	WGT_WEIGHT_KG_COF1	Continuous (kilograms)	Rothman, 2008	BMI is a frequently used measure of general health, however its specificity and sensitivity have been shown to be poor, which worsens with age. For this reason, we will assess height and weight separately.
Height	HGT_HEIGHT_M_COF1	Continuous (centimeters)		
Social variables				
Cultural/racial background	SDC_DCGT_COM	1: White 2: Black 3: East/Southeast Asian 4: South Asian 5: Multiple racial/cultural origins	Meng & D'Arcy, 2016	Given the associations with cultural/racial background and SRH, we expect there may be associations

		6: Other racial/cultural origin(s) or racial/cultural origin(s) not reported		with the chair rise test as well.
High 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 SSA_SHFEAR_COF1 SSA_SUGG_COF1 SSA_ENJOY_COF1 SSA_PROBLM_COF1 SSA_LOVU_COF1 SSA_PET_COF1	1 : Yes 2 : No/no response (Tangible support: 0- 100 Affection: 0-100 Positive interaction: 0-100 Emotional or informational support: 0-100)	Meng & D'Arcy, 2016; van Jaarsveld et al., 2007	Given the associations between social support and self-rated health, we expect there may be associations with the chair rise test as well.
Health behaviour variables				
Smoking	SMK_CURRCG_COF1	1: Never 2: Former 3: Current	van Jaarsveld et al., 2007	Given the associations between smoking status and self-rated health, we expect there may be associations

				with the chair rise test as well.
Alcohol consumption	ALC_FREQ_COF1	1: Regular drinker (at least once a month) 2: Occasional drinker 3: Did not drink in the last 12 months	van Jaarsveld et al., 2007	Given the associations between alcohol consumption and self-rated health, we suspect there may be associations with the chair rise test as well.
Physical activity	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_C OF1	1: Normal level of physical activity 2: Low level of physical activity (Physical Activity Scale for the Elderly (PASE) score 0 – 793)	Tsai et al., 2010	Given the associations between physical activity and self-rated health, we expect there may be associations with the chair rise test as well.

	PA2_WRKPA_COF 1 PA2_REPRTN_COF 1 PA2_PALVL_COF1 PA2_PARTPA_COF 1 PA2_PRVPA_COF1			
Nutrition	NUR_FRYVEG_CO F1	1: <2 servings 2: 2-4 servings 3: 5-7 servings 4: >7 servings	Tiihonen et al., 2017	There are associations between nutrition and the chair rise test. Daily fruit and vegetable intake.
Geographic location				
Residence	SDC_URBAN_RUR AL _COF1	0: Urban 1: Rural	Nummela et al., 2009	Given the associations between rurality and self-rated health, we suspect there may be associations with the chair rise test as well.

Province	WGHTS_PROV_COF1	1: Alberta 2: British Columbia 3: Manitoba 4: Newfoundland and Labrador 5: Nova Scotia 6: Ontario 7: Québec		

APPENDIX 7. UNWEIGHTED DESCRIPTIVE CHARACTERISTICS

Table

Sample characteristics (unweighted).

(N = 24,685)

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Demographic and anthropometric								
Age (categorical)				<0.001		<0.001		<0.001
45-54	4036	16.4	123	3.1	11.74	3.16	0.07	0.05
55-64	8378	33.9	309	3.7	12.26	3.12	0.10	0.07
65-74	7434	30.1	353	4.8	13.00	3.25	0.15	0.08
75+	4837	19.6	503	10.4	14.48	4.06	0.20	0.09
Sex				<0.001		0.7218		<0.001
Female	12,552	50.8	730	5.8	12.82	3.60	0.14	0.09
Male	12,133	49.2	558	4.6	12.80	3.35	0.12	0.08
Cultural/racial background				0.099		<0.001		0.003
White	23,366	94.7	1209	5.2	12.79	3.47	0.13	0.09
Black	160	0.7	15	9.4	13.50	3.74	0.14	0.10
East/Southeast Asian	285	1.2	10	3.5	12.63	3.23	0.11	0.08
South Asian	201	0.8	13	6.5	13.87	3.78	0.13	0.08
Multiple racial/cultural origins	372	1.5	24	6.5	13.10	3.62	0.13	0.09

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	301	1.2	17	5.7	12.74	3.49	0.13	0.09
Rurality				0.003		0.104		<0.001
Urban	22,672	91.9	1211	5.3	12.82	3.50	0.13	0.09
Rural	2013	8.2	77	3.8	12.69	3.19	0.12	0.08
Province				<0.001		<0.001		<0.001
Alberta	2510	10.2	127	5.1	11.96	3.35	0.13	0.09
British Columbia	5248	21.3	228	4.3	13.40	3.44	0.13	0.09
Manitoba	2530	10.3	97	3.8	12.87	3.45	0.12	0.08
Newfoundland and Labrador	1782	7.2	69	3.9	14.04	3.44	0.13	0.08
Nova Scotia	2100	8.5	146	7.0	11.59	3.01	0.12	0.08
Ontario	5474	22.2	265	4.8	13.10	3.57	0.13	0.09
Québec	5041	20.4	356	7.1	12.32	3.36	0.14	0.09
Height (cm) (mean (SD))		0.707						
168.34 (9.66)								
Weight (kg) (mean(SD))		<0.001						
79.65 (17.73)								
Socioeconomic status								
Education				<0.001		<0.001		<0.001
Less than secondary school graduation	1131	4.6	114	10.1	14.27	3.92	0.20	0.10

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Secondary school graduation, no post-secondary	2196	8.9	154	7.0	13.15	3.34	0.15	0.09
Some post-secondary	1756	7.1	123	7.0	13.16	3.90	0.14	0.09
Post-secondary degree/diploma	19,602	79.4	897	4.6	12.66	3.40	0.12	0.09
Income				<0.001		<0.001		<0.001
< $20,000	1037	4.2	131	12.6	14.33	4.34	0.20	0.11
$20,000 to < $50,000	4807	19.5	383	8.0	13.55	3.67	0.17	0.10
$50,000 to <$100,000	8310	33.7	393	4.7	12.90	3.38	0.13	0.08
$100,000 to <$150,000	4818	19.5	155	3.2	12.39	3.18	0.11	0.07
$150,00 or more	4318	17.5	127	2.9	11.85	3.04	0.09	0.07
Missing	1395	5.7	99	7.1	13.30	3.97	0.15	0.10
Objective wealth				<0.001		<0.001		<0.001
Less than $50,000	4682	19.0	379	8.1	13.33	3.76	0.15	0.10
$50,000 to less than $100,000	3450	14.0	187	5.4	12.89	3.45	0.13	0.09
$100,000 to less than $1 million	11,492	46.6	437	3.8	12.59	3.28	0.12	0.08
$1 million or more	2542	10.3	97	3.8	12.28	3.11	0.11	0.08
Missing	2519	10.2	188	7.5	13.33	4.05	0.15	0.10
Subjective wealth				<0.001		<0.001		<0.001
Don’t manage very well/have some or severe financial difficulties	984	4.0	94	9.6	13.38	3.81	0.17	0.10
Get by alright	4329	17.5	272	6.3	13.05	3.47	0.14	0.09
Manage quite well	8322	33.7	424	5.1	12.82	3.55	0.13	0.09
Manage very well	11,050	44.8	498	4.5	12.66	3.39	0.12	0.08

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Health variables								
Self-rated health				<0.001		<0.001		<0.001
Poor	360	1.5	89	24.7	15.36	4.65	0.27	0.12
Fair	1959	7.9	266	13.6	14.22	4.14	0.21	0.10
Good	7204	29.2	455	6.3	13.27	3.70	0.16	0.09
Very good	10,460	42.4	340	3.3	12.55	3.18	0.11	0.07
Excellent	4702	19.1	138	2.9	12.04	3.09	0.08	0.06
ADL difficulties				<0.001		<0.001		<0.001
No difficulties or inability to complete	20,956	84.9	832	4.0	12.63	3.35	0.11	0.08
1 or more	3729	15.1	456	12.2	13.91	4.03	0.22	0.10
IADL difficulties				<0.001		<0.001		<0.001
No difficulties or inability to complete	23,336	94.5	884	3.8	12.69	3.37	0.12	0.08
1 or more	1349	5.5	404	29.9	15.56	4.65	0.28	0.11
Able to get in/out of bed				<0.001		<0.001		<0.001
Yes	24,610	99.7	1237	5.0	12.81	3.47	0.13	0.09
No	75	0.3	51	68.0	15.37	8.11	0.32	0.12
Number of chronic conditions				<0.001		<0.001		<0.001
No conditions or no response	6256	25.3	152	2.4	12.06	3.03	0.06	0.04
1 condition	7337	29.7	269	3.7	12.55	3.34	0.10	0.06
2 conditions	5602	22.7	321	5.7	13.13	3.53	0.15	0.07

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
3 or more conditions	5490	22.2	546	10.0	13.78	3.85	0.22	0.09
Health behaviour and other factors								
Eyesight				<0.001		<0.001		<0.001
Poor or non-existent/blind	267	1.1	39	14.6	14.15	4.50	0.23	0.11
Fair	1790	7.3	128	7.2	13.33	3.94	0.18	0.10
Good	8517	34.5	431	5.1	12.95	3.49	0.14	0.09
Very good	9863	40.0	462	4.7	12.64	3.27	0.12	0.08
Excellent	4248	17.2	228	5.4	12.62	3.61	0.10	0.08
Hearing				<0.001		<0.001		<0.001
Poor	446	1.8	35	7.9	13.67	4.08	0.20	0.10
Fair	3051	12.4	195	6.4	13.28	3.76	0.17	0.10
Good	9809	39.7	435	4.4	12.88	3.50	0.14	0.09
Very good	8073	32.7	409	5.1	12.62	3.27	0.11	0.08
Excellent	3306	13.4	214	6.5	12.54	3.49	0.10	0.08
High social support availability				<0.001		<0.001		<0.001
Yes	21,447	86.9	993	4.6	12.69	3.41	0.12	0.09
No or no response	3238	13.1	295	9.1	13.68	3.79	0.17	0.10
Arthritis (hip or knee)				<0.001		<0.001		<0.001
No hip or knee arthritis	18,443	74.7	746	4.0	12.62	3.33	0.11	0.07
Has hip or knee arthritis	5720	23.2	482	8.4	13.42	3.82	0.19	0.10
Missing	522	2.1	60	11.5	13.07	4.20	0.17	0.10

			Chair rise ability		Chair rise test time (in seconds)		Frailty index	
	N	**%**	**Unable (N)**	**%**	**Mean**	**SD**	**Mean**	**SD**
Fruit and vegetable intake (daily)				<0.001		<0.001		<0.001
Fewer than 2 servings	5878	23.8	447	7.6	13.14	3.52	0.14	0.09
2 to 4 servings	8552	34.6	423	5.0	12.89	3.48	0.13	0.09
5 to 7 servings	7321	29.7	291	4.0	12.65	3.47	0.13	0.09
More than 7 servings	2934	11.9	127	4.3	12.31	3.34	0.12	0.08
Physical activity (PASE)				<0.001		<0.001		<0.001
Normal level of physical activity	13,347	54.1	431	3.2	12.35	3.20	0.11	0.07
Low level of physical activity	11,338	45.9	857	7.6	13.38	3.71	0.16	0.10
Alcohol consumption				<0.001		<0.001		<0.001
Regular drinker (at least once a month)	18,940	76.7	822	4.3	12.65	3.39	0.12	0.08
Occasional drinker	2874	11.6	210	7.3	13.26	3.68	0.16	0.10
Did not drink in the last 12 months	2871	11.6	256	8.9	13.44	3.77	0.16	0.11
Smoking status				<0.001		<0.001		<0.001
Never	12,447	50.4	603	4.8	12.44	3.46	0.12	0.08
Former	10,476	42.4	546	5.2	13.03	3.50	0.14	0.09
Current	1762	7.1	139	7.9	13.11	3.34	0.14	0.09
Total	**24,685**	**100.0**	**1288**	**5.2**	**12.81**	**3.48**	**0.13**	**0.09**

Note. The chair rise ability percentage represents the percentage of those unable to complete the chair rise test in the given category, and not the overall sample. Abbreviations used in this table: Standard Deviation (SD), Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Physical Activity Scale for the Elderly (PASE). P-values refer to the differences between categories within the variables.

APPENDIX 8. CHI-SQUARE TESTS OF INDEPENDENCE

Table

Chi-square Tests of Independence for Chair Rise Test Ability and Selected Variables

Test statistic	Value	Degrees of freedom	P-value	Asymptotic standard error
Frailty Index				
Pearson Chi-square	2,000.0	5	<0.001	
Likelihood Ratio Chi-square	1,100.0	5	<0.001	
Cramér's V	0.2863			
Gamma Distribution	0.5603			0.017
Kendall's tau-b	0.1677			0.006
Self-rated health				
Pearson Chi-square	702.8	4	<0.001	
Likelihood Ratio Chi-square	517.1	4	<0.001	
Cramér's V	0.1687			
Gamma Distribution	-0.4203			0.020
Kendall's tau-b	-0.1187			0.006
Age (categorical)				
Pearson Chi-square	343.9	3	<0.001	
Likelihood Ratio Chi-square	298.7	3	<0.001	
Cramér's V	0.1180			
Gamma Distribution	0.3369			0.021
Kendall's tau-b	0.0926			0.006
Sex				
Pearson Chi-square	18.5	1	<0.001	
Likelihood Ratio Chi-square	18.5	1	<0.001	
Cramér's V	0.0274			
Gamma Distribution	0.1232			0.028
Kendall's tau-b	0.0274			0.006

APPENDIX 9. EXTENDED TABLES FOR OBJECTIVE 2

Table 1

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and ADL Difficulties

Variable	Marginal means (CRT, sec.)	Linearized standard error	t	P-value	99% CI	
ADL difficulties						
No difficulties	12.41	0.04	290.73	<0.001	12.30	12.52
1 or more	13.41	0.12	112.71	<0.001	13.10	13.72

CRT: Chair rise test

CI: Confidence interval

Table 2

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and IADL Difficulties

Variable	Marginal means (CRT, sec.)	Linearized standard error	t	P-value	99% CI	
IADL difficulties						
No difficulties	12.46	0.04	305.58	<0.001	12.35	12.56
1 or more	14.82	0.23	65.03	<0.001	14.23	15.40

CRT: Chair rise test

CI: Confidence interval

Table 3

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and Self-rated Health

Variable	Marginal means (CRT, sec.)	Linearized standard error	t	P-value	99% CI	
Self-rated health						
Excellent	11.73	0.09	135.91	<0.001	11.51	11.95
Very good	12.32	0.06	215.44	<0.001	12.18	12.47
Good	12.88	0.08	162.88	<0.001	12.67	13.08
Fair	13.83	0.17	83.05	<0.001	13.40	14.26
Poor	15.28	0.41	37.07	<0.001	14.22	16.34

CRT: Chair rise test

CI: Confidence interval

Table 4

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and the Frailty Index

Variable	Marginal means (CRT, sec.)	Linearized standard error	t	P-value	99% CI	
Frailty index						
≤0.1	11.96	0.06	203.95	<0.001	11.81	12.11
>0.1 & ≤0.2	12.69	0.07	176.38	<0.001	12.51	12.88
>0.2 & ≤0.3	13.67	0.13	107.42	<0.001	13.34	14.00
>0.3 & ≤0.4	14.75	0.25	58.97	<0.001	14.11	15.39
>0.4 & ≤0.5	15.43	0.58	26.48	<0.001	13.93	16.93
>0.5	22.19	2.19	10.16	<0.001	16.58	27.84

CRT: Chair rise test

CI: Confidence interval

Table 5

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and Chronic Conditions

Variable	Marginal means (CRT, sec.)	Linearized standard error	t	P-value	99% CI	
Number of chronic conditions						
No conditions/ no response	12.15	0.07	179.40	<0.001	11.97	12.32
1 condition	12.30	0.07	164.09	<0.001	12.11	12.50
2 conditions	12.70	0.10	132.00	<0.001	12.44	12.94
3 conditions or more	13.25	0.09	141.68	<0.001	13.01	13.49

CRT: Chair rise test

CI: Confidence interval

APPENDIX 10. EXTENDED TABLES FOR OBJECTIVE 3

Table 1

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and Income

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
Age						
45 to 54	11.94	0.09	135.63	<0.001	11.71	12.16
55 to 64	12.33	0.06	206.73	<0.001	12.18	12.48
65 to 74	12.84	0.07	178.48	<0.001	12.66	13.03
75+	13.75	0.12	115.84	<0.001	13.44	14.05
Sex						
Female	12.52	0.06	220.57	<0.001	12.37	12.67
Male	12.54	0.05	228.55	<0.001	12.40	12.68
Income						
< $20,000	13.05	0.20	66.75	<0.001	12.54	13.54
$20,000 to < $50,000	12.78	0.10	127.61	<0.001	12.52	13.04
$50,000 to <$100,000	12.65	0.07	178.18	<0.001	12.47	12.84
$100,000 to <$150,000	12.32	0.08	151.72	<0.001	12.11	12.53
$150,00 or more	12.02	0.08	158.29	<0.001	11.83	12.22
Missing	12.94	0.17	77.18	<0.001	12.51	13.38
Education						
Less than secondary school graduation	13.05	0.17	74.86	<0.001	12.61	13.50
Secondary school graduation, no post-secondary	12.48	0.10	126.78	<0.001	12.22	12.73

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
Some post-secondary	12.42	0.11	108.18	<0.001	12.12	12.71
Post-secondary degree/diploma	12.44	0.04	306.14	<0.001	12.33	12.54
Cultural/racial background						
White	12.50	0.04	298.89	<0.001	12.39	12.61
Black	13.65	0.46	29.98	<0.001	12.48	14.82
East/Southeast Asian	12.64	0.24	53.78	<0.001	12.03	13.24
South Asian	13.59	0.50	27.32	<0.001	12.31	14.87
Multiple racial/cultural origins	12.66	0.26	49.51	<0.001	12.00	13.32
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	12.61	0.27	46.76	<0.001	11.92	13.31
Smoking						
Never	12.36	0.05	234.22	<0.001	12.22	12.49
Former	12.63	0.06	209.25	<0.001	12.47	12.78
Current	13.01	0.15	89.23	<0.001	12.63	13.38
Alcohol consumption						
At least once a month	12.46	0.05	268.96	<0.001	12.34	12.58
Occasional drinker	12.71	0.11	119.01	<0.001	12.44	12.99
Did not drink in the last 12 months	12.76	0.12	106.37	<0.001	12.45	13.07
Fruit and vegetable consumption						
<2 servings	12.57	0.08	155.65	<0.001	12.36	12.78
2-4 servings	12.70	0.06	208.74	<0.001	12.55	12.86
5-7 servings	12.45	0.07	174.42	<0.001	12.27	12.64
>7 servings	12.06	0.11	113.99	<0.001	11.78	12.33
Physical activity						
Normal level of physical activity	12.38	0.05	241.13	<0.001	12.24	12.51
Low level of physical activity	12.73	0.06	199.98	<0.001	12.57	12.90
High social support availability						

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
No or no response	12.96	0.12	111.13	<0.001	12.66	13.26
Yes	12.47	0.04	294.01	<0.001	12.36	12.58
Rural/Urban						
Rural	12.63	0.12	106.58	<0.001	12.32	12.93
Urban	12.53	0.04	300.41	<0.001	12.42	12.63
Province						
Alberta	12.01	0.09	131.93	<0.001	11.77	12.24
British Columbia	13.69	0.07	192.09	<0.001	13.51	13.88
Manitoba	12.81	0.09	145.40	<0.001	12.58	13.03
Newfoundland and Labrador	13.93	0.12	116.39	<0.001	13.62	14.24
Nova Scotia	11.45	0.08	142.43	<0.001	11.24	11.66
Ontario	13.17	0.07	186.53	<0.001	12.98	13.35
Québec	11.15	0.08	137.74	<0.001	10.94	11.36

CRT: Chair rise test

CI: Confidence interval

Table 2

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and Objective Wealth

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
Age						
45 to 54	11.84	0.08	139.27	<0.001	11.62	12.05
55 to 64	12.30	0.06	207.85	<0.001	12.15	12.46
65 to 74	12.96	0.07	181.14	<0.001	12.77	13.14
75+	13.86	0.11	121.96	<0.001	13.57	14.15
Sex						
Female	12.54	0.05	229.82	<0.001	12.40	12.69
Male	12.52	0.06	219.80	<0.001	12.37	12.66
Education						
Less than secondary school graduation	13.08	0.17	76.52	<0.001	12.64	13.52
Secondary school graduation, no post-secondary	12.51	0.10	127.82	<0.001	12.26	12.76
Some post-secondary	12.44	0.12	106.69	<0.001	12.14	12.74
Post-secondary degree/diploma	12.42	0.04	308.24	<0.001	12.32	12.53
Objective wealth (savings and investments)						
Less than $50,000	12.82	0.09	139.26	<0.001	12.58	13.06
$50,000 to less than $100,000	12.72	0.11	117.64	<0.001	12.44	13.00
$100,000 to less than $1 million	12.34	0.05	225.36	<0.001	12.20	12.48
$1 million or more	12.08	0.10	122.18	<0.001	11.82	12.33
Missing	12.85	0.13	100.34	<0.001	12.52	13.18
Cultural/racial background						

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
White	12.50	0.04	298.38	<0.001	12.39	12.61
Black	13.65	0.45	30.21	<0.001	12.49	14.81
East/Southeast Asian	12.64	0.23	54.16	<0.001	12.04	13.24
South Asian	13.55	0.50	27.27	<0.001	12.27	14.84
Multiple racial/cultural origins	12.65	0.26	48.72	<0.001	11.98	13.32
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	12.60	0.27	46.27	<0.001	11.90	13.30
Smoking						
Never	12.35	0.05	232.74	<0.001	12.22	12.49
Former	12.63	0.06	208.76	<0.001	12.47	12.78
Current	13.02	0.15	89.71	<0.001	12.65	13.40
Alcohol consumption						
At least once a month	12.46	0.04	268.49	<0.001	12.34	12.58
Occasional drinker	12.73	0.11	117.78	<0.001	12.45	13.01
Did not drink in the last 12 months	12.78	0.12	106.24	<0.001	12.47	13.09
Fruit and vegetable consumption						
<2 servings	12.57	0.08	155.32	<0.001	12.36	12.78
2-4 servings	12.71	0.06	207.52	<0.001	12.55	12.87
5-7 servings	12.45	0.07	173.52	<0.001	12.26	12.63
>7 servings	12.06	0.11	113.83	<0.001	11.78	12.33
Physical activity						
Normal level of physical activity	12.37	0.04	239.85	<0.001	12.23	12.50
Low level of physical activity	12.75	0.11	198.60	<0.001	12.58	12.92

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
High social support availability						
No	13.02	0.11	113.68	<0.001	12.72	13.31
Yes	12.46	0.04	292.09	<0.001	12.35	12.57
Rural/Urban						
Rural	12.64	0.12	104.12	<0.001	12.32	12.95
Urban	12.53	0.04	300.65	<0.001	12.42	12.63
Province						
Alberta	12.01	0.09	131.69	<0.001	11.78	12.25
British Columbia	13.75	0.07	188.72	<0.001	13.56	13.94
Manitoba	12.81	0.09	146.38	<0.001	12.59	13.04
Newfoundland and Labrador	13.86	0.12	115.37	<0.001	13.55	14.17
Nova Scotia	11.43	0.08	141.89	<0.001	11.22	11.64
Ontario	13.15	0.07	184.98	<0.001	12.96	13.33
Québec	11.12	0.08	137.58	<0.001	10.91	11.32

CRT: Chair rise test

CI: Confidence interval

Table 3

The Estimated Marginal Means for the OLS Regression for the Chair Rise Test Time and Subjective Wealth

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
Age						
45 to 54	11.82	0.08	139.53	<0.001	11.60	12.04
55 to 64	12.29	0.06	209.63	<0.001	12.14	12.44
65 to 74	12.96	0.07	182.89	<0.001	12.78	13.14
75+	13.93	0.11	122.44	<0.001	13.64	14.23
Sex						
Female	12.57	0.05	229.74	<0.001	12.43	12.71
Male	12.49	0.06	222.38	<0.001	12.35	12.64
Education						
Less than secondary school graduation	13.16	0.17	77.59	<0.001	12.72	13.60
Secondary school graduation, no post-secondary	12.54	0.10	125.89	<0.001	12.28	12.79
Some post-secondary	12.42	0.12	107.50	<0.001	12.13	12.72
Post-secondary degree/diploma	12.40	0.04	313.35	<0.001	12.30	12.51
Subjective Wealth						
Don’t manage very well/have some or severe difficulties	13.09	0.18	72.28	<0.001	12.63	13.56
Get by alright	12.71	0.08	156.98	<0.001	12.50	12.91
Manage quite well	12.60	0.06	196.03	<0.001	12.44	12.77
Manage very well	12.32	0.06	198.74	<0.001	12.16	12.48
Cultural/racial background						
White	12.50	0.04	299.14	<0.001	12.39	12.61

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
Black	13.65	0.45	30.56	<0.001	12.49	14.80
East/Southeast Asian	12.63	0.23	55.46	<0.001	12.05	13.22
South Asian	13.64	0.50	27.39	<0.001	12.35	14.92
Multiple racial/cultural origins	12.65	0.26	48.04	<0.001	11.97	13.33
Other racial/cultural origin(s) or racial/cultural origin(s) not reported	12.66	0.28	45.85	<0.001	11.95	13.37
Smoking						
Never	12.35	0.05	234.03	<0.001	12.22	12.49
Former	12.63	0.06	209.15	<0.001	12.47	12.78
Current	13.02	0.15	89.20	<0.001	12.64	13.39
Alcohol consumption						
At least once a month	12.45	0.05	270.60	<0.001	12.33	12.57
Occasional drinker	12.74	0.11	118.02	<0.001	12.46	13.02
Did not drink in the last 12 months	12.81	0.12	106.57	<0.001	12.50	13.12
Fruit and vegetable consumption						
<2 servings	12.59	0.08	155.87	<0.001	12.38	12.80
2-4 servings	12.70	0.06	206.71	<0.001	12.54	12.86
5-7 servings	12.44	0.07	175.09	<0.001	12.26	12.63
>7 servings	12.04	0.11	114.45	<0.001	11.77	12.31
Physical activity						
Normal level of physical activity	12.36	0.05	240.83	<0.001	12.23	12.50
Low level of physical activity	12.75	0.06	199.61	<0.001	12.59	12.92

Variable	Marginal means (CRT, sec.)	Standard err.	t	P-value	99% CI	
High social support availability						
Yes	12.46	0.04	293.35	<0.001	12.35	12.57
No	13.01	0.12	111.39	<0.001	12.71	13.31
Rural/Urban						
Urban	12.53	0.04	300.52	<0.001	12.42	12.63
Rural	12.63	0.12	104.64	<0.001	12.32	12.94
Province						
Alberta	11.94	0.09	133.16	<0.001	11.71	12.17
British Columbia	13.69	0.07	191.66	<0.001	13.51	13.88
Manitoba	12.80	0.09	146.25	<0.001	12.58	13.03
Newfoundland and Labrador	13.93	0.12	116.32	<0.001	13.62	14.24
Nova Scotia	11.47	0.08	142.31	<0.001	11.27	11.68
Ontario	13.13	0.07	185.81	<0.001	12.95	13.32
Québec	11.18	0.08	138.92	<0.001	10.98	11.39

CRT: Chair rise test

CI: Confidence interval

APPENDIX 11. SEX-STRATIFIED ANALYSIS FOR DIMENSIONS OF HEALTH AND THE CHAIR RISE TEST

Table 1

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Activities of Daily Living (ADL) Difficulties by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	3.58	<0.001	0.01	0.08			
65-74	0.11	0.01	7.74	<0.001	0.07	0.14			
75+	0.20	0.02	12.93	<0.001	0.16	0.24			
ADL difficulties									
No difficulties	Ref.						12.43	12.27	12.60
1 or more	0.07	0.01	6.66	<0.001	0.05	0.10	13.38	13.04	13.72
(Constant)	2.42	0.01	234.76	<0.001	2.39	2.44			
R-squared: 0.0765									
Male									
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	3.29	0.001	0.01	0.07			
65-74	0.10	0.01	7.66	<0.001	0.06	0.13			
75+	0.16	0.02	8.51	<0.001	0.11	0.20			

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
ADL difficulties									
No difficulties	Ref.						12.39	12.24	12.52
1 or more	0.09	0.02	4.35	<0.001	0.04	0.14	13.53	12.84	14.22
(Constant)	2.43	0.01	245.91	<0.001	2.40	2.45			
R-squared: 0.0485									

Table 2

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Instrumental Activities of Daily Living (IADL) Difficulties by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Age (categorical)									
45-54	Ref.								
55-64	0.05	0.01	3.65	<0.001	0.01	0.08			
65-74	0.11	0.01	8.24	<0.001	0.08	0.15			
75+	0.20	0.02	13.20	<0.001	0.16	0.24			
IADL difficulties									
No difficulties	Ref.						12.51	12.36	12.66
1 or more	0.15	0.02	8.09	<0.001	0.10	0.20	14.56	13.87	15.24
(Constant)	2.42	0.01	234.63	<0.001	2.39	2.45			
R-squared: 0.0790									

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Male									
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	3.22	0.001	0.01	0.07			
65-74	0.10	0.01	7.80	<0.001	0.07	0.13			
75+	0.15	0.02	8.13	<0.001	0.10	0.20			
ADL difficulties									
No difficulties	Ref.						12.40	12.25	12.55
1 or more	0.23	0.03	9.22	<0.001	0.17	0.30	15.63	14.63	16.62
(Constant)	2.43	0.01	240.35	<0.001	2.40	2.46			

R-squared: 0.0546

Table 3

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Self-Rated Health (SRH) by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Age (categorical)									
45-54	Ref.								
55-64	0.05	0.01	3.89	<0.001	0.02	0.08			
65-74	0.12	0.01	8.76	<0.001	0.08	0.15			
75+	0.21	0.02	14.02	<0.001	0.17	0.25			
Self-rated health									

Excellent	Ref.						11.74	11.46	12.02
Very good	0.06	0.01	4.81	<0.001	0.03	0.09	12.41	12.20	12.62
Good	0.10	0.01	7.83	<0.001	0.07	0.13	12.98	12.69	13.28
Fair	0.17	0.02	8.96	<0.001	0.12	0.22	13.98	13.37	14.59
Poor	0.26	0.03	8.27	<0.001	0.18	0.33	15.18	14.02	16.34
(Constant)	2.35	0.01	177.88	<0.001	2.32	2.39			
R-squared: 0.0994									
Male									
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	3.22	0.001	0.01	0.07			
65-74	0.10	0.01	7.94	<0.001	0.07	0.13			
75+	0.16	0.02	8.99	<0.001	0.12	0.21			
Self-rated health									
Excellent	Ref.						11.73	11.38	12.08
Very good	0.04	0.01	3.10	0.002	0.01	0.08	12.23	12.03	12.44
Good	0.08	0.01	5.84	<0.001	0.05	0.12	12.76	12.48	13.03
Fair	0.15	0.02	7.34	<0.001	0.10	0.21	13.67	13.06	14.27
Poor	0.27	0.05	5.95	<0.001	0.15	0.39	15.36	13.62	17.10
(Constant)	2.37	0.01	172.67	<0.001	2.33	2.41			
R-squared: 0.0739									

Table 4

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and the Frailty Index by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Age (categorical)									
45-54	Ref.								
55-64	0.03	0.01	2.23	0.026	0.00	0.06			
65-74	0.06	0.01	4.48	<0.001	0.03	0.10			
75+	0.13	0.02	7.08	<0.001	0.08	0.18			
Frailty index									
≤0.1	Ref.						11.74	11.46	12.02
>0.1 & ≤0.2	0.06	0.01	5.16	<0.001	0.03	0.09			
>0.2 & ≤0.3	0.14	0.02	9.17	<0.001	0.10	0.18	12.41	12.20	12.62
>0.3 & ≤0.4	0.20	0.02	8.44	<0.001	0.14	0.26	12.98	12.69	13.28
>0.4 & ≤0.5	0.27	0.05	5.44	<0.001	0.14	0.40	13.98	13.37	14.59
>0.5	0.55	0.10	5.22	<0.001	0.28	0.82	15.18	14.02	16.34
(Constant)	2.40	0.01	240.47	<0.001	2.38	2.43			
R-squared: 0.1042									
Male									
Age (categorical)									
45-54	Ref.								
55-64	0.03	0.01	1.98	0.048	-0.01	0.06			
65-74	0.16	0.01	4.06	<0.001	0.02	0.09			
75+	0.09	0.02	4.60	<0.001	0.04	0.15			
Frailty index									
≤0.1	Ref.						11.96	11.76	12.16
>0.1 & ≤0.2	0.06	0.01	5.46	<0.001	0.03	0.09	12.75	12.46	13.03
>0.2 & ≤0.3	0.13	0.02	7.60	<0.001	0.08	0.17	13.59	13.08	14.10
>0.3 & ≤0.4	0.23	0.03	8.90	<0.001	0.16	0.29	15.01	14.08	15.94

>0.4 & ≤0.5	0.19	0.04	4.31	<0.001	0.07	0.30	14.42	12.84	16.01
>0.5	1.08	0.13	8.43	<0.001	0.75	1.41	35.12	23.59	46.64
(Constant)	2.42	0.01	235.71	<0.001	2.39	2.44			
R-squared: 0.0747									

Table 5

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Number of Chronic Conditions by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Age (categorical)									
45-54	Ref.								
55-64	0.04	0.01	2.78	0.005	0.00	0.07			
65-74	0.09	0.01	6.69	<0.001	0.06	0.12			
75+	0.19	0.02	12.01	<0.001	0.15	0.23			
Number of chronic conditions									
No conditions/no response	Ref.						12.11	11.86	12.36
1 condition	0.02	0.01	1.29	0.196	-0.02	0.05	12.29	12.03	12.55
2 conditions	0.06	0.01	4.28	<0.001	0.02	0.09	12.80	12.47	13.14
3 or more conditions	0.11	0.01	8.82	<0.001	0.08	0.14	13.53	13.19	13.86
(Constant)	2.40	0.01	215.93	<0.001	2.37	2.43			
R-squared: 0.0875									
Male									
Age (categorical)									
45-54	Ref.								
55-64	0.03	0.01	2.71	0.007	0.02	0.07			

65-74	0.08	0.01	6.43	<0.001	0.05	0.12			
75+	0.14	0.02	7.47	<0.001	0.09	0.19			
Number of chronic conditions									
No conditions/no response	Ref.						12.19	11.95	12.43
1 condition	0.01	0.01	0.86	0.389	-0.02	0.04	12.31	12.03	12.60
2 conditions	0.03	0.01	2.19	0.028	-0.01	0.07	12.56	12.20	12.92
3 or more conditions	0.06	0.01	4.71	<0.001	0.03	0.09	12.95	12.61	13.28
(Constant)	2.42	0.01	211.45	<0.001	2.39	2.45			

R-squared: 0.0489

APPENDIX 12. AGE-STRATIFIED ANALYSIS FOR DIMENSIONS OF HEALTH AND THE CHAIR RISE TEST

Table 1

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Activities of Daily Living (ADL) Difficulties by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
ADL difficulties									
No difficulties	Ref.						11.63	11.42	11.84
1 or more	0.09	0.04	2.70	0.007	0.01	0.19	12.79	11.65	13.93
(Constant)	2.42	0.01	347.79	<0.001	2.40	2.44			
R-squared: 0.0085									
55-64 years									
ADL difficulties									
No difficulties	Ref.						12.17	12.01	12.33
1 or more	0.07	0.01	5.18	<0.001	0.03	0.10	13.04	12.63	13.45
(Constant)	2.47	0.01	475.08	<0.001	2.45	2.48			
R-squared: 0.0066									
65-74 years									
ADL difficulties									
No difficulties	Ref.						12.83	12.61	13.04
1 or more	0.08	0.01	5.92	<0.001	0.05	0.12	13.95	13.49	14.41
(Constant)	2.52	0.01	410.26	<0.001	2.51	2.54			
R-squared: 0.0158									

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
75+ years									
ADL difficulties									
No difficulties	Ref.						14.06	13.70	14.43
1 or more	0.06	0.02	3.29	0.001	0.01	0.11	14.99	14.38	15.60
(Constant)	2.61	0.01	242.08	<0.001	2.58	2.63			
R-squared: 0.0085									

Table 2

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Instrumental Activities of Daily Living (IADL) Difficulties by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
IADL difficulties									
No difficulties	Ref.						11.68	11.46	11.90
1 or more	0.18	0.03	5.23	<0.001	0.09	0.27	14.00	12.78	15.22
(Constant)	2.43	0.01	346.55	<0.001	2.40	2.44			
R-squared: 0.0049									
55-64 years									
IADL difficulties									
No difficulties	Ref.						12.19	12.04	12.35
1 or more	0.18	0.03	6.69	<0.001	0.11	0.24	14.66	13.64	15.68

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
(Constant)	2.47	0.00	506.59	<0.001	2.46	2.48			
R-squared: 0.0124									
65-74 years									
IADL difficulties									
No difficulties	Ref.						12.93	12.73	13.13
1 or more	0.18	0.03	6.44	<0.001	0.11	0.25	15.48	14.39	16.58
(Constant)	2.53	0.01	449.28	<0.001	2.52	2.54			
R-squared: 0.0159									
75+ years									
IADL difficulties									
No difficulties	Ref.						14.03	13.71	14.34
1 or more	0.16	0.03	5.18	<0.001	0.08	0.24	16.43	15.21	17.65
(Constant)	2.60	0.01	275.10	<0.001	2.58	2.63			
R-squared: 0.0276									

Table 3

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Self-Rated Health (SRH) by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
SRH									
Poor	0.17	0.06	2.93	0.003	0.02	0.32	13.01	11.12	14.90
Fair	0.19	0.03	5.65	<0.001	0.11	0.28	13.32	12.26	14.38
Good	0.09	0.02	4.21	<0.001	0.03	0.14	11.96	11.53	12.39
Very good	0.05	0.02	2.83	0.005	0.00	0.10	11.55	11.25	11.84
Excellent	Ref.						10.96	10.54	11.38
(Constant)	2.36	0.01	234.76	<0.001	2.32	2.40			
R-squared: 0.0342									
55-64 years									
SRH									
Poor	0.32	0.05	6.31	<0.001	0.19	0.46	15.82	13.79	17.86
Fair	0.15	0.02	7.25	<0.001	0.10	0.21	13.36	12.76	13.96
Good	0.09	0.02	6.22	<0.001	0.05	0.13	12.55	12.28	12.81
Very good	0.05	0.01	3.79	<0.001	0.02	0.09	12.09	11.86	12.32
Excellent	Ref.						11.45	11.10	11.80
(Constant)	2.41	0.01	201.47	<0.001	2.38	2.44			
R-squared: 0.0364									
65-74 years									
SRH									
Poor	0.20	.03	6.13	<0.001	0.12	0.29	15.10	13.90	16.30
Fair	0.15	.02	6.40	<0.001	0.09	0.21	14.31	13.58	15.04
Good	0.09	.02	5.64	<0.001	0.05	0.14	13.54	13.15	13.94
Very good	0.02	.01	1.68	0.092	-0.01	0.06	12.64	12.38	12.91

Excellent	Ref.						12.34	11.95	12.72
(Constant)	2.48	.01	205.90	<0.001	2.45	2.51			
R-squared: 0.0385									
75+ years									
SRH									
Poor	0.38	0.08	4.70	<0.001	0.17	0.59	19.05	15.31	22.80
Fair	0.16	0.03	4.67	<0.001	0.07	0.25	15.34	14.45	16.23
Good	0.12	0.03	3.70	<0.001	0.03	0.20	14.64	14.03	15.25
Very good	0.08	0.03	2.67	0.008	0.00	0.16	14.13	13.65	14.61
Excellent	Ref.						13.05	12.20	13.90
(Constant)	2.53	0.02	96.05	<0.001	2.46	2.60			
R-squared: 0.0360									

Table 4

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and the Frailty Index by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
Frailty index									
≤0.1	Ref.						11.38	11.16	11.60
>0.1 & ≤0.2	0.10	0.02	5.13	<0.001	0.05	0.15	12.59	12.01	13.18
>0.2 & ≤0.3	0.18	0.06	3.11	0.002	0.03	0.32	13.57	11.59	15.55
>0.3 & ≤0.4	0.43	0.05	9.45	<0.001	0.31	0.55	17.46	15.45	19.48
>0.4 & ≤0.5	-0.39	0.01	-52.37	<0.001	-0.41	-0.37	7.68	7.65	7.71
(Constant)	2.40	0.01	319.80	<0.001	2.38	2.42			
R-squared: 0.0379									
55-64 years									
Frailty index									
≤0.1	Ref.						11.86	11.66	12.06
>0.1 & ≤0.2	0.05	0.01	4.49	<0.001	0.02	0.07	12.43	12.18	12.68
>0.2 & ≤0.3	0.14	0.02	7.31	<0.001	0.09	0.19	13.62	13.00	14.24
>0.3 & ≤0.4	0.25	0.04	7.01	<0.001	0.16	0.34	15.17	13.83	16.52
>0.4 & ≤0.5	0.21	0.08	2.54	0.011	0.00	0.43	14.67	11.51	17.83
(Constant)	2.44	0.01	364.51	<0.001	2.42	2.46			
R-squared: 0.0355									
65-74 years									
Frailty index									
≤0.1	Ref.						12.40	12.12	12.69
>0.1 & ≤0.2	0.03	0.01	2.59	0.010	0.00	0.06	12.81	12.51	13.11
>0.2 & ≤0.3	0.12	0.01	7.93	<0.001	0.08	0.16	13.95	13.52	14.37

>0.3 & ≤0.4	0.17	0.03	5.40	<0.001	0.09	0.25	14.65	13.54	15.76
>0.4 & ≤0.5	0.37	0.05	7.14	<0.001	0.23	0.50	17.91	15.57	20.25
>0.5	0.36	0.08	4.30	<0.001	0.14	0.57	17.75	13.96	21.55
(Constant)	2.49	0.01	283.28	<0.001	2.47	2.51			
R-squared: 0.0453									
75+ years									
Frailty index									
≤0.1	Ref.						13.28	11.84	14.72
>0.1 & ≤0.2	0.04	0.04	0.82	0.411	-0.08	0.15	13.77	13.37	14.18
>0.2 & ≤0.3	0.10	0.05	2.08	0.037	-0.02	0.22	14.62	14.02	15.22
>0.3 & ≤0.4	0.18	0.05	3.58	<0.001	0.05	0.30	15.83	14.87	16.80
>0.4 & ≤0.5	0.20	0.06	3.08	0.002	0.03	0.36	16.18	14.20	18.17
>0.5	0.66	0.11	5.98	<0.001	0.38	0.94	25.70	18.96	32.44
(Constant)	2.55	0.04	59.36	<0.001	2.4	2.66			
R-squared: 0.0539									

Table 5

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Number of Chronic Conditions by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
Number of chronic conditions									
No conditions/no response	Ref.						11.41	11.11	11.71
1 condition	0.04	0.02	2.29	0.022	0.00	0.08	11.85	11.46	12.24
2 conditions	0.03	0.02	1.35	0.176	-0.03	0.09	11.79	11.13	12.44
3 or more conditions	0.09	0.03	3.56	<0.001	0.03	0.16	12.51	11.75	13.28
(Constant)	2.40	0.01	236.77	<0.001	2.38	2.43			
R-squared: 0.0107									
55-64 years									
Number of chronic conditions									
No conditions/no response	Ref.						12.03	11.79	12.28
1 condition	-0.01	0.01	-0.64	0.522	-0.04	0.03	11.93	11.62	12.24
2 conditions	0.04	0.01	3.00	0.003	0.01	0.07	12.49	12.18	12.79
3 or more conditions	0.07	0.01	5.26	<0.001	0.04	0.11	12.92	12.55	13.29
(Constant)	2.45	0.01	313.52	<0.001	2.43	2.47			
R-squared: 0.0139									
65-74 years									

Number of chronic conditions									
No conditions/no response	Ref.						12.40	12.06	12.74
1 condition	0.03	0.01	1.87	0.061	-0.01	0.06	12.73	12.44	13.02
2 conditions	0.05	0.02	2.86	0.004	0.00	0.09	13.03	12.57	13.50
3 or more conditions	0.10	0.01	6.61	<0.001	0.06	0.14	13.69	13.32	14.06
(Constant)	2.49	0.01	234.58	<0.001	2.46	2.52			
R-squared: 0.0208									
75+ years									
Number of chronic conditions									
No conditions/no response	Ref.						13.73	13.04	14.42
1 condition	-0.02	0.03	-0.80	0.426	-0.09	0.05	13.43	12.81	14.05
2 conditions	0.05	0.03	1.97	0.049	-0.02	0.12	14.46	13.81	15.11
3 or more conditions	0.08	0.03	3.15	0.002	0.01	0.15	14.90	14.27	15.53
(Constant)	2.58	0.02	132.59	0.000	2.53	2.63			
R-squared: 0.0240									

APPENDIX 13. SEX-STRATIFIED ANALYSIS FOR SOCIOECONOMIC STATUS AND THE CHAIR RISE TEST

Table 1

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Income by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Education									
Less than secondary school graduation	Ref.						13.17	11.63	13.71
Secondary school graduation, no post-secondary	-0.06	0.02	-3.05	0.002	-0.10	-0.01	12.45	12.13	12.78
Some post-secondary	-0.06	0.02	-2.94	0.003	-0.10	-0.01	12.51	12.14	12.88
Post-secondary degree/diploma	-0.05	0.02	-3.19	0.001	-0.10	-0.01	12.51	12.35	12.66
Income									
< $20,000	Ref.						13.05	12.43	13.67
$20,000 to < $50,000	-0.02	0.02	-1.14	0.254	-0.08	0.03	12.79	12.46	13.11
$50,000 to <$100,000	-0.03	0.02	-1.31	0.189	-0.08	0.03	12.76	12.51	13.01
$100,000 to <$150,000	-0.06	0.02	-2.71	0.007	-0.11	0.00	12.34	12.03	12.65
$150,00 or more	-0.08	0.02	-3.82	<0.001	-0.14	-0.03	12.02	11.73	12.31
Missing	-0.01	0.02	-0.56	0.576	-0.07	0.05	12.91	12.41	13.41

(Constant)	1.77	0.11	16.70	<0.001	1.51	2.05			
R-squared: 0.2514									
Male									
Education									
Less than secondary school graduation	Ref.						12.88	12.18	13.58
Secondary school graduation, no post-secondary	-0.02	0.02	-0.81	0.416	-0.08	0.04	12.56	12.16	12.96
Some post-secondary	-0.04	0.02	-1.68	0.093	-0.11	0.02	12.29	11.82	12.75
Post-secondary degree/diploma	-0.04	0.02	-1.69	0.091	-0.09	0.02	12.37	12.23	12.50
Income									
< $20,000	Ref.						13.12	12.28	13.96
$20,000 to < $50,000	-0.03	0.03	-0.90	0.366	-0.10	0.05	12.75	12.33	13.17
$50,000 to <$100,000	-0.04	0.03	-1.63	0.104	-0.12	0.03	12.55	12.30	12.82
$100,000 to <$150,000	-0.07	0.03	-2.50	0.012	-0.14	0.00	12.28	12.02	12.55
$150,00 or more	0.09	0.03	-3.34	0.001	-0.16	-0.02	12.02	11.76	12.27
Missing	-0.11	0.03	-0.32	0.748	-0.10	0.08	12.96	12.16	13.77
(Constant)	2.10	0.12	17.90	<0.001	1.80	2.41			
R-squared: 0.1702									

Table 2

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Subjective Wealth by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Education									
Less than secondary school graduation	Ref.						13.24	12.72	13.77
Secondary school graduation, no post-secondary	-0.06	0.02	-3.23	0.001	-0.10	-0.01	12.51	12.19	12.84
Some post-secondary	-0.06	0.02	-3.27	0.001	-0.11	-0.01	12.53	12.16	12.90
Post-secondary degree/diploma	-0.06	0.02	-3.86	<0.001	-0.10	-0.02	12.48	12.33	12.63
Subjective Wealth									
Don't manage very well/have some or severe difficulties	Ref.						13.11	12.50	13.72
Get by alright	-0.02	0.02	-1.02	0.307	-0.07	0.03	12.79	12.50	13.07
Manage quite well	-0.02	0.02	-1.18	0.238	-0.07	0.03	12.73	12.50	12.96
Manage very well	-0.05	0.02	-2.57	0.010	-0.10	0.00	12.34	12.13	12.55
(Constant)	1.80	0.11	16.96	<0.001	1.53	2.07			
R-squared: 0.2478									
Male									
Education									

Less than secondary school graduation	Ref.						13.02	12.32	13.71
Secondary school graduation, no post-secondary	-0.03	0.02	-1.10	0.272	-0.10	0.04	12.62	12.22	13.02
Some post-secondary	-0.05	0.02	-2.19	0.028	-0.12	0.01	12.28	11.81	12.75
Post-secondary degree/diploma	-0.05	0.02	-2.43	0.015	-0.11	0.00	12.33	12.20	12.46
Subjective Wealth									
Don't manage very well/have some or severe difficulties	Ref.						13.17	12.48	13.85
Get by alright	-0.04	0.02	-1.86	0.063	-0.10	0.02	12.65	12.35	12.95
Manage quite well	-0.05	0.02	-2.55	0.011	-0.11	0.00	12.46	12.23	12.69
Manage very well	-0.07	0.02	-3.16	0.002	-0.12	-0.01	12.28	12.04	12.51
(Constant)	2.12	0.12	17.74	<0.001	1.81	2.43			
R-squared: 0.1653									

Table 3

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Objective Wealth by Sex

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
Female									
Education									
Less than secondary school graduation	Ref.						13.17	12.65	13.70
Secondary school graduation, no post-secondary	-0.05	0.02	-3.04	0.002	-0.10	-0.01	12.50	12.17	12.82
Some post-secondary	-0.05	0.02	-2.91	0.004	-0.10	-0.01	12.56	12.18	12.94
Post-secondary degree/diploma	-0.06	0.02	-3.49	<0.001	-0.10	-0.01	12.49	12.34	12.65
Objective Wealth									
Less than $50,000	Ref.						12.96	12.65	13.27
$50,000 to less than $100,000	-0.01	0.01	-1.08	0.279	-0.05	0.02	12.76	12.41	13.11
$100,000 to less than $1 million	-0.04	0.01	-3.60	<0.001	-0.07	-0.01	12.37	12.18	12.57
$1 million or more	-0.07	0.01	-4.88	<0.001	-0.11	-0.03	12.03	11.66	12.40
Missing	0.00	0.01	-0.24	0.808	-0.04	0.03	12.82	12.44	13.20
(Constant)	1.76	0.11	16.54	<0.001	1.49	2.04			
R-squared: 0.2503									
Male									
Education									

Less than secondary school graduation	Ref.						12.92	12.23	13.62
Secondary school graduation, no post-secondary	-0.02	0.02	-0.89	0.375	-0.08	0.04	12.59	12.19	12.99
Some post-secondary	-0.05	0.02	-1.82	0.069	-0.11	0.02	12.29	11.82	12.76
Post-secondary degree/diploma	-0.04	0.02	-1.98	0.048	-0.10	0.01	12.35	12.22	12.49
Objective Wealth									
Less than $50,000	Ref.						12.86	12.32	13.04
$50,000 to less than $100,000	0.00	0.02	-0.09	0.927	-0.05	0.04	12.65	12.23	13.08
$100,000 to less than $1 million	-0.03	0.01	-2.35	0.019	-0.06	0.00	12.30	12.10	12.50
$1 million or more	-0.04	0.02	-2.92	0.004	-0.08	-0.01	12.11	11.77	12.44
Missing	0.02	0.02	0.93	0.352	-0.04	0.08	12.90	12.29	13.51
(Constant)	2.06	0.12	17.63	<0.001	1.76	2.36			
R-squared: 0.1672									

Note. All of the above models are adjusted for demographic, anthropomorphic, and health behaviour variables.

APPENDIX 14. AGE-STRATIFIED ANALYSIS FOR SOCIOECONOMIC STATUS AND THE CHAIR RISE TEST

Table 1

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Income by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
Education									
Less than secondary school graduation	Ref.						12.53	11.26	13.81
Secondary school graduation, no post-secondary	-0.07	0.05	-1.44	0.149	-0.18	0.05	11.82	11.23	12.41
Some post-secondary	-0.10	0.05	-2.26	0.024	-0.22	0.01	11.32	10.65	12.00
Post-secondary degree/diploma	-0.08	0.04	-1.93	0.054	-0.19	0.03	11.65	11.43	11.86
Income									
< $20,000	Ref.						12.47	11.10	13.84
$20,000 to < $50,000	-0.08	0.05	-1.52	0.129	-0.20	0.05	11.67	10.93	12.41
$50,000 to <$100,000	-0.03	0.05	-0.61	0.544	-0.14	0.09	12.25	11.86	12.63
$100,000 to <$150,000	-0.09	0.05	-2.03	0.042	-0.21	0.02	11.46	11.12	11.81

$150,00 or more	-0.12	0.05	-2.31	0.021	-0.22	0.01		11.28	10.98	11.61
Missing	-0.06	0.06	-1.01	0.311	-0.20	0.09		11.87	10.68	13.06
(Constant)	1.97	0.17	11.62	<0.001	1.53	2.41				
R-squared: 0.1967										
55-64 years										
Education										
Less than secondary school graduation	Ref.							13.07	12.25	13.90
Secondary school graduation, no post-secondary	-0.07	0.03	-2.43	0.015	-0.14	0.00		12.02	11.64	12.41
Some post-secondary	-0.05	0.03	-1.86	0.062	-0.12	0.02		12.25	11.78	12.72
Post-secondary degree/diploma	-0.05	0.03	-2.12	0.034	-0.12	0.01		12.18	12.02	12.34
Income										
< $20,000	Ref.							12.69	11.94	13.44
$20,000 to < $50,000	0.01	0.03	0.41	0.682	-0.06	0.08		12.77	12.29	13.22
$50,000 to <$100,000	-0.03	0.03	-1.07	0.286	-0.10	0.04		12.33	12.06	12.60
$100,000 to <$150,000	-0.05	0.03	-1.84	0.065	-0.12	0.02		12.08	11.80	12.37
$150,00 or more	-0.07	0.03	-2.71	0.007	-0.14	0.00		11.83	11.58	12.09
Missing	0.01	0.03	0.44	0.662	-0.07	0.10		12.85	12.07	13.62
(Constant)	2.10	0.11	18.66	<0.001	1.81	2.39				
R-squared: 0.1783										
65-74 years										

Education									
Less than secondary school graduation	Ref.						13.35	12.59	14.12
Secondary school graduation, no post-secondary	-0.02	0.03	-0.75	0.456	-0.09	0.05	13.07	12.62	13.52
Some post-secondary	-0.02	0.03	-0.86	0.388	-0.09	0.05	13.04	12.48	13.60
Post-secondary degree/diploma	-0.04	0.02	-1.52	0.127	-0.10	0.02	12.88	12.70	13.06
Income									
< $20,000	Ref.						13.19	12.37	14.01
$20,000 to < $50,000	0.01	0.03	0.44	0.661	-0.06	0.08	13.36	12.97	13.74
$50,000 to <$100,000	-0.02	0.03	-0.90	0.367	-0.10	0.05	12.88	12.57	13.18
$100,000 to <$150,000	-0.02	0.03	-0.83	0.405	-0.10	0.05	12.86	12.41	13.30
$150,00 or more	-0.06	0.03	-1.95	0.051	-0.13	0.02	12.48	12.08	12.89
Missing	0.00	0.03	-0.12	0.902	-0.08	0.07	13.18	12.57	13.78
(Constant)	2.29	0.14	16.16	<0.001	1.92	2.66			
R-squared: 0.1374									
75+ years									
Education									
Less than secondary school graduation	Ref.						14.54	13.71	15.37

Secondary school graduation, no post-secondary	-0.03	0.03	-1.05	0.293	-0.10	0.04	14.18	13.59	14.78
Some post-secondary	-0.03	0.03	-1.20	0.229	-0.10	0.04	13.99	13.42	14.55
Post-secondary degree/diploma	-0.03	0.02	-1.47	0.141	-0.10	0.03	14.09	13.79	14.39
Income									
< $20,000	Ref.						14.73	13.55	15.91
$20,000 to < $50,000	-0.05	0.03	-1.49	0.135	-0.13	0.04	14.01	13.57	14.44
$50,000 to <$100,000	-0.04	0.04	-0.96	0.339	-0.14	0.07	14.23	13.49	14.96
$100,000 to <$150,000	-0.03	0.04	-0.67	0.502	-0.14	0.08	14.47	13.47	15.47
$150,00 or more	-0.10	0.04	-2.36	0.018	-0.20	0.01	13.50	12.58	14.42
Missing	0.03	0.04	0.70	0.482	-0.07	0.13	15.02	14.15	15.88
(Constant)	1.94	0.20	9.74	<0.001	1.42	2.45			

R-squared: 0.1912

Table 2

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Subjective Wealth by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
Education									
Less than secondary school graduation	Ref.						12.66	11.32	14.00
Secondary school graduation, no post-secondary	-0.07	0.05	-1.46	0.145	-0.19	0.05	11.91	11.29	12.53
Some post-secondary	-0.11	0.05	-2.32	0.020	-0.23	0.01	11.37	10.69	12.06
Post-secondary degree/diploma	-0.09	0.04	-2.16	0.031	-0.21	0.02	11.62	11.41	11.83
Subjective Wealth									
Don't manage very well/have some or severe difficulties	Ref.						12.50	11.64	13.34
Get by alright	-0.05	0.03	-1.70	0.089	-0.12	0.02	11.85	11.45	12.25
Manage quite well	-0.06	0.03	-2.27	0.023	-0.13	0.01	11.67	11.35	11.99
Manage very well	-0.07	0.03	-2.73	0.006	-0.14	0.00	11.46	11.13	11.78
(Constant)	1.96	0.17	11.88	<0.001	1.54	2.39			
R-squared: 0.1856									
55-64 years									
Education									

Less than secondary school graduation	Ref.						13.23	12.44	14.03
Secondary school graduation, no post-secondary	-0.08	0.03	-2.89	0.004	-0.15	-0.01	12.07	11.68	12.46
Some post-secondary	-0.07	0.03	-2.41	0.016	-0.13	0.00	12.26	11.78	12.73
Post-secondary degree/diploma	-0.07	0.02	-2.93	0.003	-0.13	-0.01	12.15	11.99	12.30
Subjective Wealth									
Don't manage very well/have some or severe difficulties	Ref.						12.83	12.10	13.55
Get by alright	-0.03	0.02	-1.14	0.253	-0.09	0.03	12.47	12.16	12.78
Manage quite well	-0.04	0.02	-1.69	0.091	-0.09	0.02	12.32	12.08	12.56
Manage very well	-0.06	0.02	-2.62	0.001	-0.12	0.00	12.01	11.78	12.24
(Constant)	2.14	0.12	18.58	<0.001	1.85	2.44			
R-squared: 0.1720									
65-74 years									
Education									
Less than secondary school graduation	Ref.						13.45	12.70	14.20
Secondary school	-0.02	0.03	-0.88	0.381	-0.09	0.04	13.12	12.67	13.57

graduation, no post-secondary									
Some post-secondary	-0.03	0.03	-1.13	0.259	-0.10	0.04	13.04	12.47	13.61
Post-secondary degree/diploma	-0.05	0.02	-2.01	0.045	-0.10	0.01	12.85	12.67	13.02
Subjective Wealth									
Don't manage very well/have some or severe difficulties	Ref.						13.26	12.46	14.05
Get by alright	-0.02	0.03	-0.86	0.389	-0.09	0.04	13.00	12.65	13.35
Manage quite well	-0.01	0.02	-0.23	0.818	-0.07	0.06	13.10	12.79	13.41
Manage very well	-0.01	0.02	-0.75	0.452	-0.08	0.05	12.93	12.62	13.23
(Constant)	2.34	0.14	16.26	<0.001	1.97	2.72			
R-squared: 0.1327									
75+ years									
Education									
Less than secondary school graduation	Ref.						14.55	13.77	15.33
Secondary school graduation, no post-secondary	-0.03	0.03	-1.03	0.302	-0.10	0.04	14.22	13.62	14.82
Some post-secondary	-0.04	0.02	-1.50	0.133	-0.10	0.03	13.96	13.40	14.51
Post-secondary degree/diploma	-0.04	0.02	-1.77	0.076	-0.10	0.02	14.08	13.80	14.36
Subjective Wealth									
Don't manage very well/have	Ref.						14.28	13.40	15.15

some or severe difficulties									
Get by alright	0.02	0.03	0.75	0.455	-0.05	0.10	14.55	13.93	15.17
Manage quite well	0.02	0.03	0.56	0.577	-0.06	0.09	14.51	14.02	15.01
Manage very well	-0.02	0.03	-0.68	0.495	-0.10	0.06	13.98	13.50	14.45
(Constant)	1.90	0.21	9.17	<0.001	1.36	2.43			

R-squared: 0.1862

Table 3

Weighted OLS Regression for the Log-transformed Chair Rise Test Time Variable and Objective Wealth by Age

Variable	Coef.	Standard error	t	P-value	99% CI		Marginal means (CRT, sec.)	99% CI for marginal means (CRT, seconds)	
45-54 years									
Education									
Less than secondary school graduation	Ref.						12.61	11.25	13.97
Secondary school graduation, no post-secondary	-0.07	0.05	-1.39	0.166	-0.19	0.06	11.90	11.30	12.49
Some post-secondary	-0.11	0.05	-2.26	0.024	-0.24	0.02	11.34	10.63	12.05
Post-secondary degree/diploma	-0.09	0.04	-2.02	0.043	-0.20	0.02	11.13	11.42	11.84
Objective Wealth									
Less than $50,000	Ref.						11.90	11.47	12.32
$50,000 to less than $100,000	0.01	0.02	0.31	0.759	-0.05	0.06	11.96	11.39	12.53
$100,000 to less than $1 million	-0.03	0.02	-2.20	0.028	-0.08	0.01	11.45	11.20	11.71
$1 million or more	-0.06	0.02	-2.77	0.006	-0.12	0.00	11.13	10.60	11.65
Missing	0.05	0.03	1.78	0.075	-0.02	0.12	12.50	11.64	13.36
(Constant)	1.90	0.16	11.61	<0.001	1.47	2.32			
R-squared: 0.1916									
55-64 years									
Education									

Less than secondary school graduation	Ref.						13.17	12.38	13.96
Secondary school graduation, no post-secondary	-0.07	0.03	-2.78	0.005	-0.14	-0.01	12.06	11.67	12.44
Some post-secondary	-0.06	0.03	-2.21	0.027	-0.13	0.01	12.27	11.79	12.74
Post-secondary degree/diploma	-0.07	0.02	-2.72	0.006	-0.13	0.00	12.16	12.00	12.32
Objective Wealth									
Less than $50,000	Ref.						12.58	12.19	12.98
$50,000 to less than $100,000	-0.01	0.02	-0.72	0.474	-0.05	0.03	12.44	12.09	12.78
$100,000 to less than $1 million	-0.04	0.01	-2.67	0.008	-0.07	0.00	12.09	11.89	12.29
$1 million or more	-0.05	0.02	-2.89	0.004	-0.10	-0.01	11.91	11.52	12.30
Missing	0.00	0.02	-0.12	0.903	-0.05	0.05	12.46	11.94	12.97
(Constant)	2.10	0.12	18.05	<0.001	1.80	2.40			
R-squared: 0.1726									
65-74 years									
Education									
Less than secondary school graduation	Ref.						13.37	12.61	14.13

Secondary school graduation, no post-secondary	-0.02	0.03	-0.76	0.449	-0.09	0.05	13.09	12.64	13.54
Some post-secondary	-0.03	0.03	-0.92	0.356	-0.10	0.05	13.05	12.48	13.61
Post-secondary degree/diploma	-0.04	0.02	-1.62	0.095	-0.10	0.02	12.87	12.70	13.05
Objective Wealth									
Less than $50,000	Ref.						13.35	12.88	13.83
$50,000 to less than $100,000	-0.01	0.02	-0.63	0.530	-0.08	0.05	13.14	12.52	13.75
$100,000 to less than $1 million	-0.13	0.02	-1.76	0.079	-0.07	0.01	12.89	12.62	13.17
$1 million or more	-0.06	0.02	-2.90	0.004	-0.11	-0.01	12.50	12.04	12.95
Missing	0.00	0.02	-0.07	0.948	-0.05	0.05	13.21	12.72	13.70
(Constant)	2.32	0.14	16.38	<0.001	1.96	2.69			
R-squared: 0.1365									
75+ years									
Education									
Less than secondary school graduation	Ref.						14.48	13.69	15.28
Secondary school graduation, no post-secondary	-0.02	0.03	-0.86	0.387	-0.09	0.05	14.21	13.60	14.82
Some post-secondary	-0.03	0.03	-1.11	0.266	-0.10	0.04	14.01	13.45	14.58
Post-secondary degree/diploma	-0.03	0.02	-1.38	0.167	-0.09	0.03	14.12	13.82	14.41

Objective Wealth									
Less than $50,000	Ref.						14.41	13.78	15.03
$50,000 to less than $100,000	0.00	0.03	-0.07	0.943	-0.07	0.07	14.37	13.55	15.19
$100,000 to less than $1 million	-0.02	0.03	-0.99	0.322	-0.09	0.04	14.06	13.51	14.61
$1 million or more	-0.04	0.03	-1.26	0.208	-0.12	0.04	13.86	12.95	14.76
Missing	0.00	0.03	0.14	0.887	-0.07	0.08	14.47	13.66	15.29
(Constant)	1.91	0.20	9.36	<0.001	1.39	2.44			
R-squared: 0.1841									

Note. All of the above models are adjusted for demographic, anthropomorphic, and health behaviour variables.