Subjective Health as a Predictor of Physical Function in Older Women

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Introduction: Globally, populations are ageing, which has increased the urgency of supporting health in older adults. Two key measures used to examine health in older populations are subjective health, a measure of global health, and physical function, a measure of functional ability and disability. Subjective health is a predictor of physical function; however, it is not clear whether this relationship remains significant in older women.

Aims: The purpose of this study was to determine the association between subjective health and subsequent physical function in older women and whether that association changes with time and measure of subjective health.

Methods: This study used data from the Nun Study, a cohort study of 678 religious sisters aged 75+ at baseline. Data on up to 12 approximately annual assessments included measures of subjective health (self-rated health and function) and physical function (basic and instrumental activities of daily living). Using baseline self-rated health and function as independent exposures and subsequent basic and instrumental activities of daily living as independent outcomes, generalized estimating equations conditional upon survival were developed to address the aims of this study.

Results: Self-rated health was a significant predictor of independence in instrumental but not basic activities of daily living. In contrast, self-rated function was a significant predictor for both basic and instrumental activities of daily living. Overall, self-rated function was a stronger predictor of physical function than self-rated health.

All relationships showed a positive dose-response between subjective health and physical function. Further, the relationships between self-rated health and physical function, and between self-rated health and instrumental activities of daily living were not modified by time. However,

the relationship between self-rated function and basic activities of daily living was modified by time, such that the relationship became stronger at assessments further from baseline.

Conclusion: Subjective health, specifically self-rated function, is a promising measure that could be used to identify older women at risk for decline in physical function for over a decade from baseline. Thus, subjective health could be used to inform treatment plans to prevent functional decline and to predict trajectories of health needs for older women.

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Dedication

To Grandpa.

Thank you.

Thank you for being a godly example.

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I love you.

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List of Abbreviations

ADLs	Activities of daily living
bADLs	Basic activities of daily living
GEEs	Generalized estimating equations
iADLs	Instrumental activities of daily living
MMSE	Mini-mental State Examination
SH	Subjective health
SRF	Self-rated function
SRH	Self-rated health

Chapter One: Introduction and Overview

Just as the whole is made up of the sum of its parts, so populations are described and characterized by the individuals therein. Birth rates, death rates and causes of death of individuals within a population can be used to categorize that population into the stages of the epidemiological transition, which reflects patterns of disease and disability (Olshansky & Ault, 1986; Omran, 1971). As populations shift from the stage of pestilence and disease to the stage of delayed degeneration, infant and child mortality decreases while life expectancy and standards of living increase (Olshansky & Ault, 1986; Omran, 1971). However, ageing populations are at greater risks of chronic conditions and degenerative diseases, leading to a rise in morbidity alongside higher life expectancies (Omran, 1971; United Nations, 2015). Increased and complicated comorbidities during later life provide unique challenges and considerations for older populations.

Populations are ageing in Canada and worldwide. Globally, there is a higher prevalence of individuals over the age of 65 than ever before (United Nations, 2015). Within the ageing population, the fastest growing cohort is the oldest old (those over the age of 80) (United Nations, 2015). Canada mirrors this trend as 15% of Canadians are currently older than 65 years of age compared to 5% in 1971. Further, this shift is expected to continue until a quarter of Canadians will be older than 65 by 2030 (Government of Canada, 2014). The rapid increase in population age has shifted health priorities.

Increases in life expectancy lead to populations with more years of disease and disability in later life (Lang et al., 2018; Westendorp, 2006). As a result, there has been an increased recognition of health priorities to compress morbidity, which will result in more years of life with "good health" (Robine & Michel, 2004). Thus, it is imperative to determine methods to support the health and well-being of older adults.

In supporting the health and well-being of older adults, some groups have studied healthy ageing as a separate process from ageing with disease and disability. Although healthy ageing has many definitions, it is commonly measured through objective measures of health, such as the ability to perform physical tasks, and subjective measures of health, such as self-rated health (SRH) (Bowling & Dieppe, 2005). However, some studies have shown that for older adults, functional ability is more important than disease (Galenkamp et al., 2013; Straatmann et al., 2020), which suggests that to support older adults an emphasis should be placed on physical function.

Physical function and subjective health are two health measures that are commonly assessed in older adults. Physical function relates to an individual's physical capability to perform daily activities (Cosco et al., 2014; Depp & Jeste, 2006; Kim & Park, 2017), and is commonly measured through activities of daily living (ADLs), which are classified as basic (bADLs) or instrumental (iADLs). Subjective health is an individual's perception of personal health and is used by physicians to gain insight into an individual's overall health (Cosco et al., 2014; Depp & Jeste, 2006; Kim & Park, 2017). Further, evidence suggests that subjective health can predict both current and future levels of physical function (Femia et al., 1997; Fujiwara et al., 2008; Greiner et al., 1996; Hirosaki et al., 2017; Idland et al., 2014; Idler et al., 2000; Kaplan et al., 1993; Kempen et al., 2006; Sang Hyuck Kim et al., 2017; Lee, 2000; Tomioka et al., 2017). Therefore, subjective health, a readily available measure of health that is inexpensive and non-invasive, may be useful in predicting future physical function, and thus, an individual's future ability to perform daily functions and maintain independence.

The purpose of this study was to examine subjective health as a predictor of physical function in older women and to determine whether that association changed with time and with measures of subjective health. These associations were examined using data from the Nun Study,

a longitudinal study of 678 members of the School Sisters of Notre Dame in the United States. The Nun Study collected later-life data through 12 approximately annual assessments including age and measures of subjective health, physical function and cognition (Greiner et al., 1996, 1999). Baseline subjective health (SRH and self-rated function [SRF]) was examined as a predictor of subsequent physical function (bADLs and iADLs) across all follow-up assessment periods using partly conditional generalized estimating equations (GEEs), which are conditional on survival. To determine whether this association changed with time, interactions between baseline subjective health and assessment timepoints were examined. Finally, comparisons were made between different measures of baseline subjective health and their association with physical function.

The current research seeks to extend knowledge on the association between subjective health and physical function. This is important as subjective health is a simple measure of health, while performance-based physical function is more complex to assess. Further, as more individuals are living longer, there is a greater need to predict physical function, which decreases with age. Thus, if subjective health predicts physical function in older women, subjective health could be used to inform treatment plans that focus on preventing decline in physical function and to predict trajectories of health needs in older women.

Chapter Two: Literature Review

2.1 Health and Well-Being in Older Adults

To support health and well-being in older adults it is essential to understand what health and well-being means in late adulthood. This requires knowledge of both ageing and health concepts. Ageing is frequently defined as the accumulation of small changes in physical function and cognition across the lifespan of individuals (Carnes et al., 2008). Changes associated with ageing are characterized as being cumulative, universal, intrinsic, progressive and deleterious (Carnes et al., 2008; Strehler, 1959). Juxtaposed with ageing is health, defined by WHO as "a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity" (WHO, 1946, p. 1). Through the combination of these two concepts, healthy ageing emerges: simply put, the process of ageing while maintaining a state of health.

2.1.1 Healthy Ageing

Healthy ageing is defined in numerous ways (Bowling & Iliffe, 2006; Depp & Jeste, 2006; Larson, 1997; Perales et al., 2014) and has several names, including successful ageing, ageing well, effective ageing and productive ageing. The earliest definition of healthy ageing that resembles the current understanding was developed in the 1960s by Havighurst, who stated that the prevailing definition of healthy ageing should be operationalizable and attainable (Havighurst, 1961; Martin et al., 2015). These considerations remain important for current definitions of healthy ageing, which are classified as biomedical, psychosocial or both (Bowling & Dieppe, 2005). Biomedical approaches are easily operationalized, defining healthy ageing through objective measures of physical and cognitive function. Psychosocial approaches rely on an individual's perspective of their well-being, social engagement and personal growth and result in a high proportion of individuals who could be classified as having aged healthily (Bowling & Dieppe,

2005). Therefore, to define healthy ageing in a manner that is both operationalizable and attainable, a combined biomedical and psychosocial approach may be needed.

Two of the more common definitions of healthy ageing have been defined by Rowe and Kahn (1997) and by Baltes and Baltes (Baltes & Smith, 2003; Freund & Baltes, 1998). Rowe and Kahn (1997) defined healthy ageing as having low probability of disease and disability, having high levels of physical and cognitive function, and being actively engaged in life. Their definition distinguishes between healthy ageing, non-pathological ageing (high functional ability despite increased probability of disease and disability) and pathological ageing (Rowe & Kahn, 1997). While easily applied, there are relatively few (<35%) older adults that meet the requirements of this definition (Martinson & Berridge, 2015; Strawbridge et al., 2002), which suggests the need for a different approach to healthy ageing. Baltes and Baltes approach healthy ageing through a process known as selective optimization with compensation (Baltes & Smith, 2003; Freund & Baltes, 1998), which comprises three sections: selection (an individual must determine goals given limited resources), optimization (the process of allocating resources to the selected goals) and compensation (modifying behaviour as a result of loss in function to accomplish the desired outcome) (Freund & Baltes, 1998). A concern of Baltes and Baltes's approach to healthy ageing is that it is a reactive approach to decline in health and well-being instead of a proactive approach to support healthy ageing (Ouwehand et al., 2007). These two common definitions showcase the advantages and disadvantages of using purely a biomedical or psychosocial approach to healthy ageing.

To date, there are more than 85 unique definitions of healthy ageing that comprise different measures (Cosco et al., 2014; Depp & Jeste, 2006; Kim & Park, 2017). Common components of healthy ageing are lack of disease and disability, physical function, cognitive function, and active

engagement in life (Cosco et al., 2014; Depp & Jeste, 2006; Kim & Park, 2017). Additional components of healthy ageing identified in these reviews and other studies include life satisfaction, well-being, and subjective health (Cosco et al., 2014; Depp et al., 2007; Depp & Jeste, 2006; Kim & Park, 2017). Despite the lack of consensus on the definition of healthy ageing, it remains clear that healthy ageing is a multidimensional construct (Cosco et al., 2014). In order to comply with WHO's definition of healthy ageing, "the process of developing and maintaining the functional ability that enables well-being in older age" (Beard et al., 2016, p. 7), multiple domains of health, including both objective and subjective measures, need to be included.

2.1.2 Disease and Disability

As seen in the various definitions and components of healthy ageing, there appears to be a balance required between considering objective measures of health and subjective measures of life enjoyment. Thus, it is important to note how objective measures of health change with age and which measures play a larger role in life satisfaction in older adults.

Both disease and disability increase with age (Lang et al., 2018; Öztürk et al., 2011; Westendorp, 2006), while life satisfaction and quality of life tend to decrease with age (Öztürk et al., 2011). Further, as the number of chronic conditions and diseases rise in adults, the level of physical function decreases, which is especially important in older women who tend to have higher levels of chronic conditions and disease compared to older men (Öztürk et al., 2011). In younger populations, perceptions of health and well-being are commonly associated with chronic conditions and diseases, but with age there appears to be a shift in perceptions of health and well-being toward a closer link to functional ability (Galenkamp et al., 2013; Straatmann et al., 2020). This change appears to happen in later life, with younger old adults (<78 years) placing more importance on number of chronic conditions while older adults (≥78 years) place more importance

on functional abilities and limitations (Straatmann et al., 2020). Further, there appears to be a greater association of quality of life with functional ability than with diseases in older women, although this trend is less evident in men (Öztürk et al., 2011). This suggests that it may be more important to emphasize functional ability than disease and illness in older adults, particularly older women, when supporting and promoting health and well-being during the ageing process.

2.2 Physical Function

Functional ability is a key component in enabling health and well-being in older adults. One aspect of functional ability is physical function, the maintenance of which impacts an individual's quality of life. Specifically, decline in physical function in older adults has been associated with increased risk of depression, and decreased levels of life satisfaction and social engagement (Asakawa et al., 2000; Enkvist et al., 2013). Further, levels of physical function impact the amount and type of care needed by an individual. Older adults with greater physical function capacity are more likely to live independently than in assisted living or long-term care facilities (Karlsson et al., 2008; Laukkanen et al., 2001). Finally, low levels of physical function are associated with increased risk of mortality (Ganguli et al., 2002; Suh, 2006). Therefore, it is important to predict maintenance and decline of physical function in older adults, as physical function is related to quality of life, health care needs and mortality.

2.2.1 Definition and Measures of Physical Function

Physical function measures the physical ability of an individual to perform tasks throughout the day. As an assessment of ability and physical performance, physical function can be measured in a variety of ways. Common measures of physical function include measures of physical performance, such as hand-grip strength, as well as the ability to perform ADLs, such as bADLs and iADLs (Depp & Jeste, 2006). bADLs are a measure of self-care, such as toileting or

dressing, while iADLs are a measure of the ability to perform day-to-day tasks, such as using a telephone or cooking (Lawton & Brody, 1969). The ability to perform these activities provides individuals with the means to perform necessary tasks and those for enjoyment and pleasure, and thus is a good measure of functional abilities and limitations. As physical function has a variety of definitions, physical function here will encompass any combination of bADLs, iADLs and physical performance, unless otherwise specified.

Physical function, which can be measured in a variety of ways, can also be assessed through different methods. The ability to perform these activities can be self-reported, caregiver-reported or performance-based; however, self-reported and caregiver-reported measures of physical function do not always correlate with performance-based measurements (Baldwin et al., 2017; Cress et al., 1995; Figueredo & Jacob-Filho, 2018; Hoeymans et al., 1997; Zanetti et al., 1995). Specifically, self-report less accurately represents physical performance with increasing age (Baldwin et al., 2017; Figueredo & Jacob-Filho, 2018) and declining cognition (Cress et al., 1995; Hoeymans et al., 1997). While self-report of physical function is associated with disability status in older adults (Mayhew et al., 2020), both self-report and caregiver report of physical function overestimate functional ability (Figueredo & Jacob-Filho, 2018). Further, individuals who experience cognitive decline are not always able to properly assess their functional ability and may provide a self-report which does not correlate with their observable physical function (Cress et al., 1995). Therefore, while physical function may be easy to assess through self- or proxy-report, in older adults or individuals with cognitive decline observable physical function is a more reliable method to ascertain functional abilities and limitations.

2.2.2 Impact of Age, Sex and Other Covariates on Physical Function

Physical function is dynamic and is influenced by several non-modifiable factors. Physical function declines and disability increases with age (Alcock et al., 2015). Decline in physical function occurs throughout middle age (Brown et al., 2017) and continues through old age, with the majority of adults over the age of 90 experiencing difficulties in ADLs and those over the age of 100 experiencing dependency in ADLs (Berlau et al., 2009). Further, while levels of independence in bADLs and iADLs appear to be similar in middle-aged adults, there is a higher level of dependence in iADLs than bADLs in older adults (Brown et al., 2017). Finally, women have more disabilities and comorbidities for a longer duration than men, due to lower mortality rates in women than men (La Croix et al., 1997; Merrill et al., 1997; Schon et al., 2011). Therefore, older women are a specific population at greater risk for dependence and low levels of physical function.

In addition to age and sex, physical function is impacted by modifiable factors, such as cognition. Cognition, the mental ability to learn, recall information and process logic, can be measured within specific domains or globally. Global cognition, commonly measured using the Mini-mental State Examination (MMSE) (Folstein et al., 1975), is a strong predictor of both physical function and mortality (Johnson et al., 2007). Specifically, cognitive impairment is associated with worse physical function (Auyeung et al., 2008; Tabira et al., 2020). This impact is seen in earlier stages of cognitive impairment, where levels of both bADLs and iADLs decrease; however, as cognition declines from mild cognitive impairment to dementia, independence in iADLs is lost earlier than bADLs due to the higher cognitive demand of iADLs (Tabira et al., 2020).

Although decline in physical function is expected with age, there are certain lifestyles and activities that can help to reduce or prevent that decline. For example, high levels of physical activity and low levels of smoking reduce the risk of decline in physical function in older age (Berkman et al., 1993; Fillenbaum et al., 2010). Additionally, high levels of education and income are known to protect against decline in physical function (Berkman et al., 1993; Fillenbaum et al., 2010). Finally, an individual's perspective on the ageing process impacts physical function, where older adults who express positive age stereotypes are more likely to recover from disability (Levy et al., 2012) and experience higher levels of functional ability (Levy et al., 2002) than older adults who express negative age stereotypes.

2.3 Subjective Health

Subjective health is a common component of healthy ageing that measures global health (Banerjee et al., 2010; Perez-Zepeda et al., 2016) and provides a snapshot of multiple domains of health, including physical function, cognition and social activity (Finkel et al., 2020; Lisko et al., 2020; Mavaddat et al., 2011; Straatmann et al., 2020). Subjective health is an individual's perspective on their health and may provide insight into their health that cannot always be objectively measured. The importance of subjective health is exemplified by the predictive nature of subjective health on many objective measure of health, but specifically on mortality in older adults regardless of physical function, cognition, sex, gender, education and a number of other factors (Falk et al., 2017; Greiner et al., 1999; Idler et al., 1990; Ishizaki et al., 2006; Sajjad et al., 2017; Walker et al., 2004). Further, subjective health has been shown to be a significant predictor of mortality over follow-up periods ranging up to 12 years (Falk et al., 2017; Greiner et al., 1999; Idler et al., 1990; Ishizaki et al., 2006; Sajjad et al., 2017; Walker et al., 2004). Thus, subjective health is an important measure that appears to accurately reflect the overall health of individuals.

2.3.1 Definition and Measures of Subjective Health

Subjective health is measured in numerous ways. A common measure of subjective health is global SRH, "How would you rate your overall health: excellent, very good, good, fair or poor?" (Choi, 2002; Sargent-Cox et al., 2008; Vuorisalmi et al., 2006). Other variations of subjective health include assessing different domains of health such as ability to care for oneself or level of activity (Bernard et al., 1997; Finkel et al., 2020; Greiner et al., 1999). These different measures of subjective health are often used interchangeably despite reflecting distinct aspects of one's health (Bernard et al., 1997; Finkel et al., 2020; Greiner et al., 1999). Global SRF, "How would you rate your ability to take care of yourself: excellent, very good, good, fair or poor?", is similar to global SRH such that global SRF also predicts both subsequent physical function and mortality (Bernard et al., 1997; Greiner et al., 1996, 1999), and may be a stronger predictor of mortality (Bernard et al., 1997) and physical function (Greiner et al., 1996) than global SRH. Subjective health, whether assessing global health or a specific domain of health, is a tool that may be used to measure the overall health and well-being of individuals.

Subjective health can be measured using different frames of reference in addition to different domains. Three common frames of reference for subjective health are general subjective health, comparative to previous health (self-comparative subjective health), or comparative to peers (peer-comparative subjective health) (Choi, 2002; Finkel et al., 2020; Mora et al., 2013; Sargent-Cox et al., 2008; VanderZee et al., 1995; Vuorisalmi et al., 2006). Levels of self-comparative subjective health are lower (Sargent-Cox et al., 2008) and levels of peer-comparative subjective health are higher than general subjective health (Finkel et al., 2020; Sargent-Cox et al., 2008; VanderZee et al., 1995; Vuorisalmi et al., 2006). The difference seen with self-comparative subjective health is linked to loss of function and ability with time (Sargent-Cox et al., 2008), while

that seen with peer-comparative subjective health appears to be caused by older adults viewing their health and functional status as better than other adults their own age and may not accurately represent their health status respective to their peers (Finkel et al., 2020; Sargent-Cox et al., 2008; VanderZee et al., 1995; Vuorisalmi et al., 2006). Physical function is more strongly associated with general subjective health than peer-comparative subjective health (Vuorisalmi et al., 2006). Further, general subjective health is a more significant predictor of mortality than peer-comparative subjective health (Mora et al., 2013). Therefore, is it necessary to be aware of the frame of reference used in subjective health measures.

2.3.2 Impact of Age, Sex and Other Covariates on Subjective Health

Subjective health is impacted by both non-modifiable and modifiable factors. In general, subjective health decreases with age (Finkel et al., 2020; Pinquart, 2001). Generally, subjective health is linked to chronic conditions and diseases; however, this varies by age. Specifically, in older populations subjective health is more closely linked to functional abilities and limitations, and psychological factors such as depression (Finkel et al., 2020; Lisko et al., 2020; Straatmann et al., 2020). Further, older adults have generally lower standards of good subjective health compared to younger adults, which may reflect declines in overall health (Lisko et al., 2020). Interestingly, despite older adults having lower standards of good subjective health, they appear to perceive their health better than their peers, as comparative subjective health increases with age (Finkel et al., 2020).

In addition to age, subjective health also differs in men and women. Women generally have lower levels of subjective health than men (Banerjee et al., 2010; Finkel et al., 2020) and place more value on chronic conditions, while men place a higher emphasis on fatal illnesses (Finkel et al., 2020). Despite these differences, the rate of decline of subjective health between men and

women with age does not differ (Finkel et al., 2020). From the effects of age and sex, it is essential that both demographic variables be taken into consideration when examining subjective health.

In addition to age and sex, subjective health is dependent on individual characteristics, such as cognition and race. Individuals with normal cognition, mild cognitive impairment and dementia assess subjective health differently, which may modify the associations between subjective health and other measures of health (Lisko et al., 2020; Waldorff et al., 2010). Therefore, when possible, cognitive function should be examined when assessing subjective health. Further, subjective health appears to be modified by race and culture, as individuals from diverse cultures interpret health differently or conform to cultural pressures regarding health attitudes (Ailinger, 1989; Banerjee et al., 2010; Boyington et al., 2008; Menec et al., 2007). Additionally, individuals with depression, lower income, worse physical function, increased number of chronic conditions and lower social participation have worse subjective health (Banerjee et al., 2010; Chalise et al., 2007; Dong et al., 2017; Ishizaki et al., 2009; Millán-Calenti et al., 2012; Mulsant et al., 1997).

Finally, self-reported measures such as subjective health may be prone to bias. Specifically, individuals may be less likely to rate their health as poor. This was seen in the study by Ailinger (1989), where their sample of Hispanic men were unlikely to report poor SRH, even when their objective measures of health were poor. Further, bias may also be a concern for specific measures of subjective health, such as peer-comparative subjective health, where individuals tend to view their health as better than peers their own age (Spitzer & Weber, 2019). Therefore, when using measures of subjective health, one should be aware of not only the impact of using specific types of subjective health measures, but also the potential for bias in reporting of subjective health.

2.4 Subjective Health as a Predictor of Physical Function

Physical function and subjective health are two key components of health that are cross-sectionally and longitudinally associated. Physical function is a measure of an individual's physical ability to perform day-to-day tasks, while subjective health provides a personal perspective on an individual's health and function. Subjective health is a unique simple marker that may correlate to current and predict future physical function and consequently one's ability to carry out daily activities.

2.4.1 Historical Perspective

In the late 1970s, subjective health had been linked to mortality in older adults (Bernard et al., 1997; Maddox & Douglass, 1973). In an effort to understand the relationship between subjective health and mortality, several groups began to examine the construct of subjective health, including whether subjective health was dependent on physical function or whether physical function was predicted by subjective health, thereby explaining the link to mortality (Bernard et al., 1997; Greiner et al., 1996; Idler & Kasl, 1995). This led to a new field of research with more groups studying the impact of subjective health on concurrent and subsequent physical function in older adults (Ailinger, 1989; Femia et al., 1997; Gama et al., 2000; Idler et al., 2000; Kaplan et al., 1993; Lee, 2000). The focus appears to have shifted from general older adults to the association of subjective health on subsequent physical function in specific populations of older adults, such as stroke survivors (Boyington et al., 2008). However, with ageing populations, there has been a resurgence of examining subjective health as a predictor of subsequent physical function in the general older adult population, particularly in Japan and South Korea (Fong & Kok, 2020; Fujiwara et al., 2008; Hirosaki et al., 2017; Sang Hyuck Kim et al., 2017; Tomioka et al., 2017).

Additionally, a few recent studies examine this association in the oldest old populations in Europe and North America (Idland et al., 2014; Kempen et al., 2006; Storeng et al., 2018).

2.4.2 Cross-Sectional Studies of Subjective Health and Physical Function

Four studies have cross-sectionally examined the relationship between subjective health and physical function in older adults (Ailinger, 1989; Gama et al., 2000; Nogueira et al., 2010; Sebastiao, 2016). Although each study examined different measures of physical function, there was a general trend that poor subjective health was associated with worse physical function, after adjusting for age, sex, education and cognition (Gama et al., 2000; Nogueira et al., 2010; Sebastiao, 2016). Two of these studies showed that subjective health was significantly associated with individual bADLs and iADLs (Gama et al., 2000; Sebastiao, 2016). Further, subjective health appears to be significantly associated with a combined bADLs and iADLs score (Nogueira et al., 2010). Although Ailienger et al. (1989) did not find significant correlations between subjective health and physical function, the other three cross-sectional studies support an association between subjective health and physical function.

The relationship between subjective health and physical function appears to be modified by race. Specifically, subjective health does not predict physical function in Black and Hispanic Americans, a finding that may reflect cultural differences in concepts of health (Ailinger, 1989; Boyington et al., 2008). When rating subjective health, Black Americans appear to place more emphasis on health conditions while White Americans place more emphasis on level of daily functioning (Boyington et al., 2008). This cultural difference in how individuals view subjective health may explain differences in the association between subjective health and physical function between different cultures and races. As culture appears to impact the association between

subjective health and physical function it is important to further understand in which populations this relationship is significant.

2.4.3 Longitudinal Studies of Subjective Health and Physical Function

As the cross-sectional studies cannot establish directionality, longitudinal studies provide stronger evidence of subjective health as a predictor of physical function. These studies span follow-up periods from 1 to 11 years and show that in older adults there is a relationship between subjective health and future physical function, even after adjusting for covariates such as education (Femia et al., 1997; Fujiwara et al., 2008; Greiner et al., 1999; Hirosaki et al., 2017; Idland et al., 2014; Idler et al., 2000; Idler & Kasl, 1995; Kaplan et al., 1993; Kempen et al., 2006; Sang Hyuck Kim et al., 2017; Lee, 2000; Storeng et al., 2018; Tomioka et al., 2017). Excellent subjective health has been shown to predict improvement in physical function while poor subjective health predicts decline in physical function (Fujiwara et al., 2008; Kempen et al., 2006). However, studies with small sample sizes and potentially limited statistical power did not find this relationship to be significant at four years (Femia et al., 1997; Idland et al., 2014) and significance was lost after adjusting for covariates at six and ten years (Idler et al., 2000; Kaplan et al., 1993). Overall, these longitudinal studies provide strong evidence that subjective health is a predictor of future physical function in older adults.

It is unclear whether the association between subjective health and subsequent physical function remains significant in the oldest of adults. Two studies that have examined adults over the age of 75 found that subjective health does predict change in physical function in this age group (Femia et al., 1997; Greiner et al., 1996). However, two other studies found that poor subjective health was not a predictor of decline in physical function in adults older than 75 (Tomioka et al.,

2017) and 87 years of age (Idland et al., 2014). Therefore, further research is needed to determine in which age groups subjective health is a predictor of subsequent physical function.

Additionally, the impact of sex/gender on the association between subjective health and physical function is inconsistent. It is worth noting that literature has not been consistent in the use of the concepts of sex or gender in reports of these associations, which may contribute to the lack of consistency in results. Studies have reported that subjective health is a significant predictor of physical function only in men (Idler et al., 2000), only in women (Lee, 2000) or that the association is significant in both men and women (Hirosaki et al., 2017; Lee, 2000; Tomioka et al., 2017). Thus, it is important to further study the impact of subjective health as a predictor of physical function in men and women separately.

In addition to age and sex there are other covariates that may impact the association between subjective health and physical function. Specifically, the impact of depression on subjective health as a predictor of subsequent physical function is not well understood. Tomioka et al. (2017) suggested that depression may weaken the relationship between subjective health and change in physical function, while others found that depression did not reduce the significance of subjective health as a predictor of physical function (Hirosaki et al., 2017; Sang Hyuck Kim et al., 2017). Despite the inconsistencies in the association between subjective health and physical function in older adults with depression, there appears to generally be a significant association between subjective health and change in physical function in older adults.

Finally, it is also important to consider the impact of time and the measures of subjective health and physical function. Because of a lack of common methods between studies it is not feasible to directly compare whether the length of follow-up period impacted the association between subjective health and physical function. However, two studies examined subjective health

as a predictor of subsequent physical function at multiple follow-up timepoints (Femia et al., 1997; Idler & Kasl, 1995). Femia et al. (1997) found that with time the significance of subjective health as a predictor of physical function was lost, while Idler et al. (1995) found significant associations with increasing effect sizes on subjective health as a predictor of physical function from one to six years of follow-up. The difference between these findings could be caused by differences in sample sizes: the study by Femia et al. (1997) had a small samples size (n=95) compared to the study by Idler et al. (1995) (n=1477).

Further, the impact of the association between subjective health and physical function may depend on the measures used to assess subjective health and physical function. SRF has been shown to be a stronger predictor of decline in physical function than SRH in older adults (Greiner et al., 1996; Lee, 2000). However, when stratifying by sex, SRF appears to be a stronger predictor of physical function in women, while SRH appears to be a stronger predictor of physical function in men (Lee, 2000). Finally, the strength of subjective health as a predictor of physical function does not appear to differ greatly whether the outcome is measured through bADLs or iADLs, although subjective health appears to be a slightly stronger predictor of bADLs than iADLs (Fong & Kok, 2020; Sang Hyuck Kim et al., 2017; Storeng et al., 2018).

2.5 Summary

Subjective health is a simple measure that may assess current physical function as well as predict future physical function. This association between subjective health and physical function is important as subjective health is a quick, inexpensive and non-invasive measure of health, while data on performance-based measures of physical function are more time-consuming and complex to collect. Further, it is useful to predict physical function, as levels of physical function in older adults relate both to quality of life and amount of required care. Therefore, understanding the

association between subjective health and physical function is important in supporting older adults to age well.

Chapter Three: Study Rationale and Research Questions

Subjective health as a predictor of physical function is an important relationship to explore for several reasons. Primarily, physical function is a measure of health that has implications for life satisfaction, quality of life and levels of required care and assistance (Asakawa et al., 2000; Enkvist et al., 2013; Karlsson et al., 2008; Laukkanen et al., 2001). As such, predicting physical function is important to determine future quality of life and levels of care. Subjective health is a tool that is simple to assess and that could be used to measure and predict physical function. Evidence is unclear as to whether subjective health remains a significant predictor of physical function in older women. Although one study has shown that in women over the age of 75, poor subjective health predicted decline of independence in bADLs in a one-year follow-up period (Greiner et al., 1996), a second study showed that good subjective health did not predict independence in bADLs over a four-year follow-up period in a group of women with a mean age of 88 (Idland et al., 2014). Given that populations are ageing (Government of Canada, 2014; United Nations, 2015) and older adults have declining levels of physical function (Lang et al., 2018; Westendorp, 2006), specifically, in women compared to men (Wheaton & Crimmins, 2016), it is important to understand the association between subjective health and physical function in older women.

Previous research regarding subjective health and physical function has not made full use of longitudinal analysis. Longitudinal research has examined single follow-up assessments and has not typically explored the association between subjective health and physical function across multiple follow-up assessments. Studies that have examined more than two timepoints have developed individual models of subjective health as a predictor of physical function for each follow-up period using only the surviving population (Femia et al., 1997; Idler & Kasl, 1995). This

method of analyzing longitudinal data does not fully utilize repeated measures or the correlation between these measures. To address the lack of longitudinal analyses that examine subjective health as a predictor of physical function, the proposed study will examine this relationship through partly conditional GEEs.

Finally, many measures of subjective health have been examined as predictors of physical function, but differences between measures of subjective health are not commonly investigated. Subjective health can be assessed through many different questions and surveys, and these different measures of subjective health may reflect different domains of health (Choi, 2002; Greiner et al., 1999; Mora et al., 2013; Sargent-Cox et al., 2008; Vuorisalmi et al., 2006) and be unique predictors of physical function (Greiner et al., 1996; Lee, 2000). To add to this area of research, the present study will explore both SRH and SRF as predictors of physical function.

Research Questions

1. Is subjective health a predictor of subsequent physical function in older women?
2. Does the association between subjective health and subsequent physical function change with time in older women?
3. Does the association between subjective health and subsequent physical function differ between measures of subjective health, specifically SRH and SRF, in older women?

Chapter Four: Methodology

4.1 Ethics

The Nun Study originally received ethics approval from the University of Kentucky in 1990. Consent for participation was obtained at time of enrollment in 1991 and renewed in 2006. The current study has received ethics approval from the University of Waterloo (ORE #41939). To maintain confidentiality, data sets for this study are stored on a password-protected server at the University of Waterloo and researchers who are granted access to these data are required to sign a confidentiality agreement.

4.2 Literature Search Strategy

To review evidence of subjective health as a predictor of physical function in older adults, a systematic literature search was originally conducted in PubMed and CINAHL in July 2020 and updated in November 2020. A flow chart of this search can be seen in Figure 1. The search concepts included terms related to population (older adults), exposure (subjective health) and outcome (physical function). The full search strategy can be found in Appendix A. The search was limited to human-based peer-reviewed articles written in English or French. The initial search resulted in 5159 articles from PubMed and 2552 articles from CINAHL. There were 6996 unique articles after removing duplicates. An additional 121 articles were found in November 2020, with 86 articles from PubMed and 43 articles from CINAHL (8 duplicates).

Several exclusion criteria were applied during screening. Articles were excluded if the population did not include older adults, the population was specific to a disease or health condition, the exposure was not subjective health, subjective health was reported by a caregiver, or the outcome was not physical function. Forty-four articles remained for a full manuscript review. After

this search, 18 articles were identified as having examined self-reported subjective health as a predictor of physical function in older adults. These articles are summarized in Appendix B.

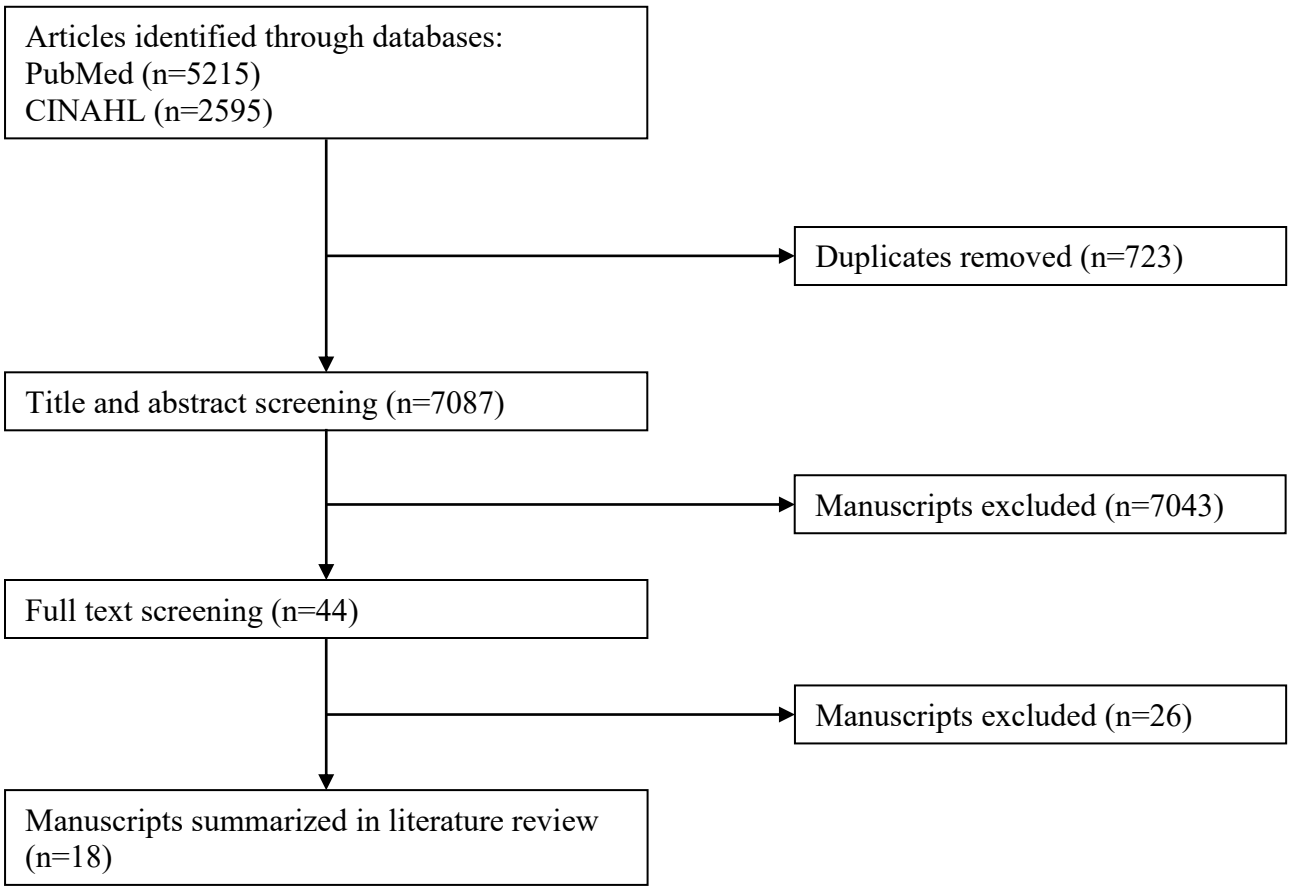

Figure 1: Flow chart of systematic literature search

4.3 Data Source

This study used secondary data from the Nun Study, a longitudinal study of the religious congregation of the School Sisters of Notre Dame in the United States. Sisters were 75 years or older when invited to join the study. Of all eligible sisters, 678 were enrolled in the study from 1991 to 1993, resulting in a participation rate of 66% (Greiner et al., 1996). Participants and non-participants did not differ significantly in age, race or mortality rate (Greiner et al., 1999).

The Nun Study collected information across lifespans of participants that can be used to provide insight into changes in older women's health, such as physical function, while controlling for earlier life variables, such as education. Early-life and midlife data were collected through archival convent data and include place of birth, autobiographical sketches written at the time of joining the congregation, level of education and occupation (Greiner et al., 1999; Patzwald & Wildt, 2004). Later-life data were collected during 12 approximately annual assessments through a battery of tests that included performance-based measures of bADLs and iADLs, and cognitive screening tools such as the MMSE (Greiner et al., 1996). Following death, neuropathological assessments identified Alzheimer and other types of pathologies (Greiner et al., 1999).

4.4 Study Population

As the association being addressed is whether subjective health is predictive of subsequent physical function, Nun Study participants were excluded if they did not have at least one follow-up physical function assessment (n=103). Further, participants were excluded from the sample if they were missing baseline measures (n=51) of age, MMSE, education, occupation and place of birth. A flow chart of excluded participants is shown in Figure 2. The measures used in this study span the lifetime of the participants. They are described in detail in Section 4.5; however, a brief timeline of these measures is depicted in Figure 3.

Of the 678 individuals who participated in the Nun Study, 549 were included in the analysis (Figure 2). Excluded participants were significantly older, had worse subjective health, worse physical function, worse baseline MMSE scores and were less educated than participants included in the analytic sample. Details regarding the excluded participants can be found in Appendix C.

In addition to participants who were excluded from the analytic sample, 38 participants withdrew from the study after completing at least one follow-up assessment and 6 participants were intermittently missing follow-up assessments. A description of the number of participants who were included in the analysis for each time point can be found in Table 1. Participants who withdrew or had intermittently missing measures did not differ in baseline SRH, SRF, MMSE and bADL scores from those who did not withdraw and did not have any missing data. However, those who were missing data were on average slightly younger at baseline and had higher baseline iADL scores. A logistic regression was conducted to determine whether individuals who were missing follow-up assessments or withdrew were missing at random. The logistic regression models showed that age, time of withdrawal and occupation were significant predictors of whether participants were missing information or withdrew. A more detailed exploration of missing follow-up assessments and withdrawal within the analytic sample can be found in Appendix D.

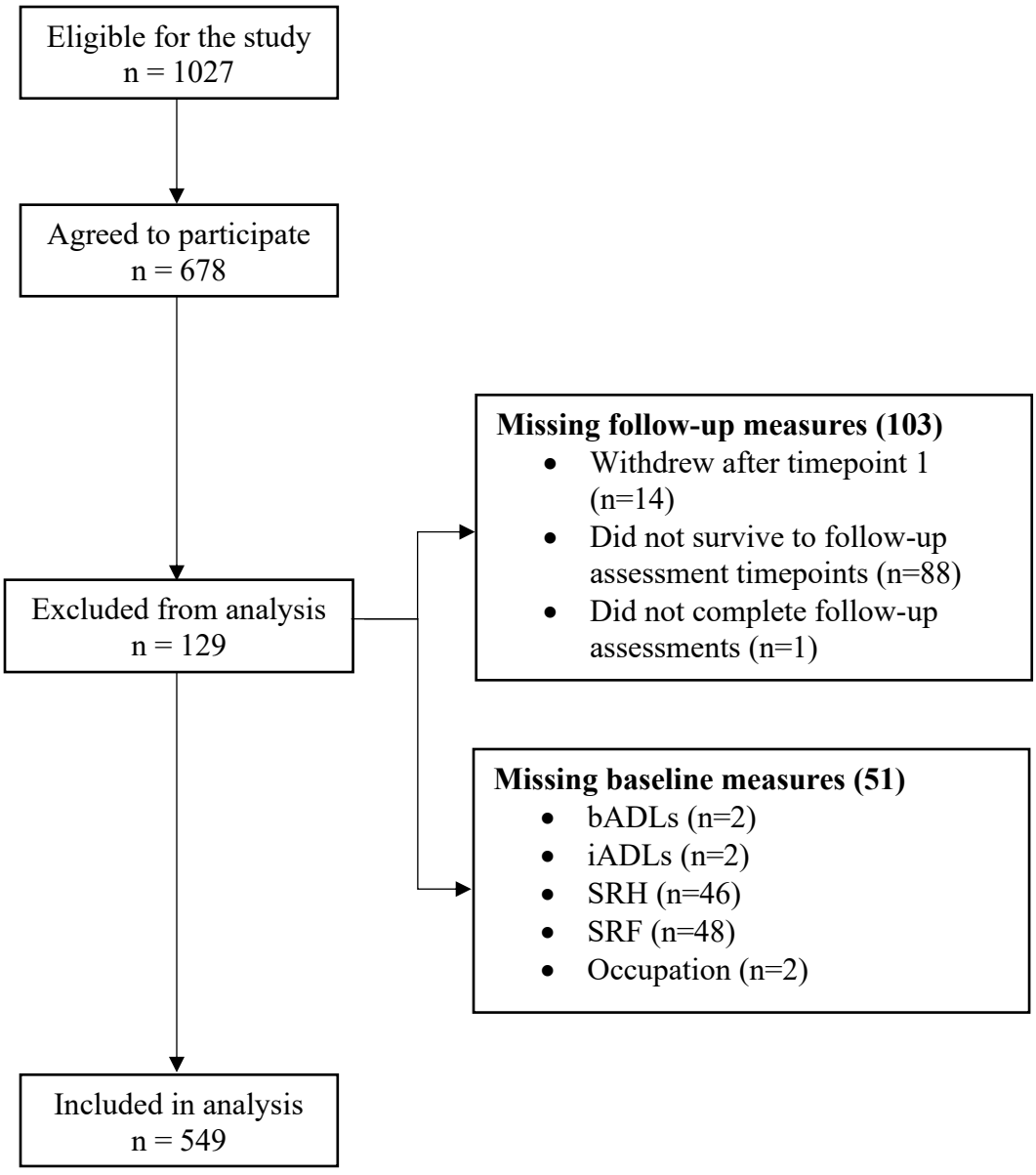

Figure 2: Flow chart of analytic sample (n=529)

Figure 2 displays the flow chart of the Nun Study population from eligibility to analytic sample. Note: 25 participants were missing both follow-up and baseline measures.

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; SRF, self-rated function; SRH, self-rated health

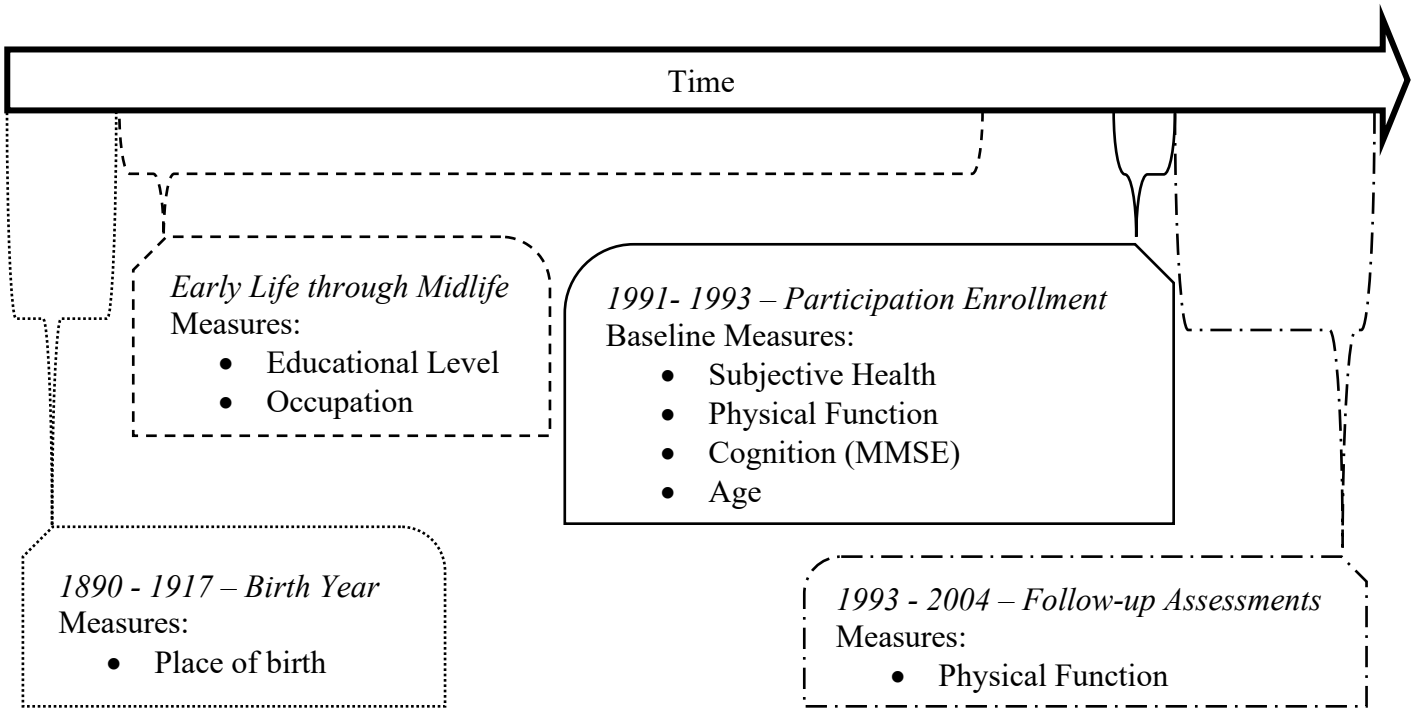

Figure 3: Study population timeline

Abbreviation: MMSE, Mini-mental State Examination

Table 1: Description of participant dropout and mortality in the analytic sample (n=549)

Timepoint	*Included in Analysis*	*Missing Outcome*	*Withdrew Previous/Total*	*Deceased Previous/Total*
T1	549	0		
T1-T2			0/0	0/0
T2	548	1		
T2-T3			8/8	62/62
T3	479	0		
T3-T4			13/21	77/139
T4	386	3		
T4-T5			2/23	56/195
T5	329	2		
T5-T6			5/28	45/240
T6	280	1		
T6-T7			2/30	57/297
T7	221	1		
T7-T8			5/35	34/331
T8	183	0		
T8-T9			1/36	29/360
T9	153	0		
T9-T10			1/37	30/390
T10	122	0		
T10-T11			0/37	27/417
T11	95	0		
T11-T12			1/38	19/436
T12	75	0		

For each timepoint the sample size included in the analysis is shown.

The missing data column represents the number of the participants who survived to that timepoint but who were missing bADL and iADL scores.

The withdrew column represents the number of participants who withdrew between the two specified timepoints. This column also shows the total number of participants who withdrew since baseline (timepoint 1).

The deceased column represents the number of participants who died between the specified timepoints. This column also shows the total number of participants who died since baseline (timepoint 1).

Abbreviations: T, timepoint.

4.5 Measures

4.5.1 Physical Function

Physical function was measured at each assessment with five performance-based bADLs (standing, dressing, walking, eating and toileting) and five performance-based iADLs (reading, ability to use the phone, telling time, taking medication and handling money) (Tyas et al., 2007). bADLs and iADLs were scored out of five, where a score of *q* means participants were able to independently perform *q* activities. Independence in each activity was based on observation from research personnel on whether participants did not require assistance from either another person or a piece of equipment, such as a walker (Greiner et al., 1996), with the exception of toileting which was assessed through self-report or nurse's report (Tyas et al., 2007).

4.5.2 Subjective Health

Two measures of baseline subjective health were explored: SRH and SRF. SRH was measured by asking "Compared to sisters your age, would you say your health is excellent, very good, good, fair or poor?" (Greiner et al., 1996, 1999). SRF was measured by asking "Compared to sisters your age, would you say your ability to take care of yourself is excellent, very good, good, fair or poor?" (Greiner et al., 1996, 1999).

4.5.3 Covariates

Five baseline covariates were included in the analyses: age, MMSE, education, occupation and place of birth. Age at baseline assessment was calculated from date of birth. Global cognition at baseline was screened during the annual assessment using the MMSE, which has a score ranging from 0 to 30 (Greiner et al., 1996). The level of education for each participant was recorded using archival convent data (Patzwald & Wildt, 2004). Levels of education were recorded as less than high school, high school, Bachelor's degree, and Master's degree or higher. Occupation for each

participant was recorded as teacher, domestic worker or nurse's aid/other. Finally, place of birth for each participant was recorded from archival convent data (Butler & Snowdon, 1996; Patzwald & Wildt, 2004), and dichotomized as to whether participants were born in the United States or not.

4.6 Analytic Methods

All analyses for this study were conducted in SAS Studio Enterprise Edition 3.6 (SAS Institute Inc., Cary, North Carolina).

4.6.1 Descriptive Analysis

Univariate and bivariate analyses were conducted for the exposure, outcome and covariates to provide a description of the sample and the relationship of subjective health and covariates with physical function. Distributions for the exposure, outcome and covariates were determined, using counts and percentages for dichotomous and categorical measures, and means and standard deviations for continuous measures. Spearman Rho correlations and Kruskal-Wallis tests were used to determine associations of subjective health and covariates with physical function across all assessments. Finally, Spearman Rho correlations were determined between measures of subjective health and physical function.

To provide a visualization of the outcome variable over time, trajectories of physical function were plotted. Individual trajectories of bADL and iADL scores for 19 random participants were plotted across all time points to visualize the heterogeneity of the sample. The average trajectories of bADLs and iADLs across all time points stratified by levels of SRH and SRF were also plotted.

4.6.2 Multivariable Analysis

Partly conditional GEEs that are conditional on survival were used to address the research questions. As the study participants were older adults, there is high attrition due to mortality.

Therefore, all models used a dynamic population, wherein the outcome at time *t* is conditional on participants' survival at time *t* (Kurland et al., 2009). Independent correlation structures are used with GEEs that are conditional on survival (Diggle et al., 2013; Kurland & Heagerty, 2005). GEEs, a form of regression, use robust standard errors to construct confidence intervals and test hypotheses (Diggle et al., 2013), such that the estimates and confidence intervals and thus the interpretation of the results are not changed by misclassified working correlation structures.

To address research question one, partly conditional GEEs were developed without interactions between subjective health and timepoint assessments. To address research question two, partly conditional GEEs were developed with interactions between subjective health and timepoint assessments. To address research question three, GEE models for SRH and SRF were compared with each other. For each group of models based on subjective health and physical function measures, three sets of models were developed. First, the base models were developed to determine the association between subjective health at baseline and physical function at each annual assessment while adjusting for baseline age. Second, the full models were developed, which included all remaining baseline covariates: educational attainment, MMSE, occupation and whether participants were born in the United States. Third, the reduced models were streamlined to only include subjective health and significant covariates. In the reduced models, the included covariates remained the same across all configurations of subjective health and physical function. Figure 4 provides an overview of the 24 models that were developed.

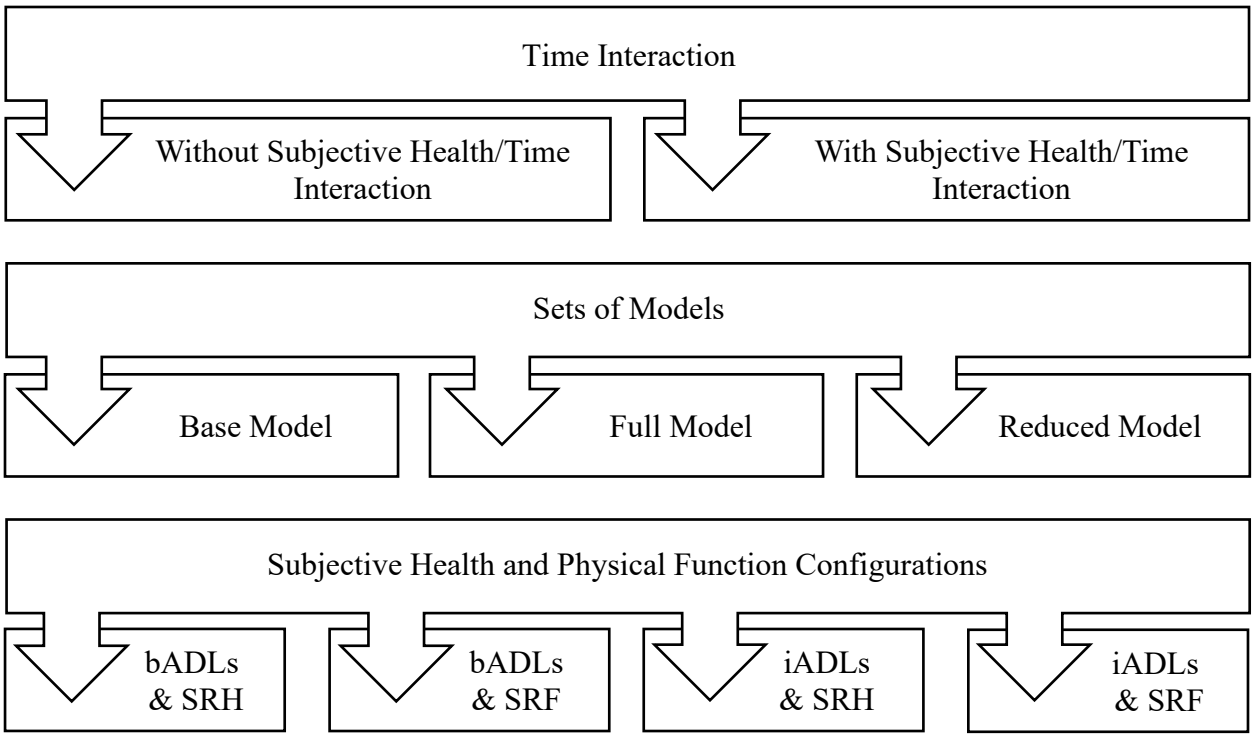

Figure 4: Flow chart of GEE development and configurations

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; SRF, self-rated function; SRH, self-rated health

Chapter Five: Results

5.1 Descriptive Analysis of the Analytic Sample

Table 2 provides an overview of the characteristics of the analytic sample (n=549). The surviving population at earlier timepoints had lower baseline SRH, SRF and MMSE scores than the surviving population at later timepoints. Additionally, the average baseline age of the surviving population at earlier timepoints (Timepoint 1: 82.7 +/- 5.4 years) was older than that of the surviving population at later timepoints (Timepoint 12: 79.6 +/- 3.0 years).

The bivariate associations between physical function at timepoints 1 to 12 with baseline subjective health and covariates are presented in Table 3 for bADLs and Table 4 for iADLs. Baseline measures of SRH, SRF, MMSE and education were positively associated, and age at baseline negatively associated, with number of independent bADLs and iADLs. Occupation was significantly associated with iADLs, wherein teachers tended to have greater independence in iADLs compared to domestic workers. A full description of these associations is found in Table 3 (bADLs) and Table 4 (iADLs).

The associations between measures of subjective health (SRH and SRF) and between measures of physical function (bADLs and iADLs) are summarized in Table 5. Baseline SRH and SRF were significantly associated ($r=0.51$; $p<0.0001$). bADLs and iADLs at each timepoint were significantly correlated ($r=0.52$ to 0.72; p-values <0.0001). Further correlations between measures of physical function across all timepoints can be found in Appendix E.

Figures 5 and 6 display trajectories of physical function. Figure 5 shows random trajectories of 19 participants, while Figure 6 shows the average trajectories of physical function for the analytic sample, stratified by level of baseline subjective health.

Table 2: Distribution of baseline subjective health, timepoint assessments of physical function and baseline covariates in the surviving analytic sample for timepoints 1 to 12 (n=549)

		T1		***T2***		***T3***		***T4***		***T5***		***T6***	
N		549		548		479		386		329		280	
Categorical Variables	***Category***	***C***	***%***	***C***	***%***	***C***	***%***	***C***	***%***	***C***	***%***	***C***	***%***
Baseline SRH	Excellent	85	15.48	84	15.33	72	15.03	64	16.58	54	16.41	49	17.50
	Very Good	206	37.52	206	37.59	184	38.41	153	39.64	136	41.34	112	40.00
	Good	167	30.42	167	30.47	156	32.57	123	31.87	99	30.09	85	30.36
	Fair	78	14.21	78	14.23	59	12.32	39	10.10	34	10.33	29	10.36
	Poor	13	2.37	13	2.37	8	1.67	7	1.82	6	1.82	5	1.79
Baseline SRF	Excellent	252	45.90	251	45.80	225	46.97	198	51.30	176	53.50	150	53.57
	Very Good	188	34.24	188	34.31	168	35.07	124	32.12	99	30.09	84	30.00
	Good	72	13.11	72	13.14	60	12.53	49	12.69	41	12.46	37	13.21
	Fair	29	5.28	29	5.29	23	4.80	14	3.63	12	3.65	8	2.86
	Poor	8	1.46	8	1.46	3	0.63	1	0.26	1	0.30	1	0.36
Educational Attainment	< High School	47	8.56	47	8.58	44	9.19	30	7.77	25	7.60	21	7.50
	High School	28	5.10	28	5.11	22	4.59	17	4.40	14	4.26	11	3.93
	Bacherlors Degree	225	40.98	225	41.06	192	40.08	154	39.90	129	39.21	109	38.93
	≥ Masters Degree	249	45.36	248	45.26	221	46.14	185	47.93	160	48.94	139	49.64
Occupation	Teacher	497	90.53	496	90.51	432	90.19	353	91.45	301	91.79	259	92.50
	Domestic Worker	40	7.29	40	7.30	36	7.52	26	6.74	21	6.38	17	6.07
	Other	12	2.19	12	2.19	11	2.30	7	1.81	6	1.82	4	1.43
Place of Birth	US Born	514	93.62	514	93.80	451	94.15	365	94.56	312	94.83	264	94.29
	Not US Born	35	6.62	34	6.20	28	5.85	20	5.44	17	5.17	16	5.71
Continuous Variables		***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
bADLs		4.60	1.09	4.25	1.54	4.21	1.56	3.96	1.77	3.99	1.71	3.75	1.87
iADLs		3.96	1.26	3.59	1.56	3.65	1.49	3.45	1.67	3.48	1.64	3.34	1.64
Baseline Age		82.7	5.1	82.7	5.1	82.3	4.9	82.0	4.7	81.6	4.5	81.2	4.2
Baseline MMSE		26.0	4.8	26.0	4.9	26.4	4.4	26.8	4.0	27.3	3.4	27.6	3.0

		T7		***T8***		***T9***		***T10***		***T11***		***T12***	
N		221		183		153		122		95		75	
Categorical Variables	***Category***	***C***	***%***	***C***	***%***	***C***	***%***	***C***	***%***	***C***	***%***	***C***	***%***
Baseline SRH	Excellent	44	19.91	40	21.86	36	23.53	30	24.59	26	27.37	20	26.67
	Very Good	92	41.63	75	40.98	62	40.52	50	40.98	38	40.00	29	38.67
	Good	60	27.15	48	26.23	39	25.49	30	24.59	23	24.21	21	28.00
	Fair	22	9.95	17	9.29	13	8.50	11	9.02	7	7.37	5	6.67
	Poor	3	1.36	3	1.64	3	1.96	1	0.82	1	1.05	-	-
Baseline SRF	Excellent	125	56.56	106	57.92	91	59.48	74	60.66	58	61.05	47	62.67
	Very Good	68	30.77	57	31.15	46	30.07	35	28.69	28	29.47	23	30.67
	Good	22	9.95	15	8.20	13	8.50	11	9.02	9	9.47	5	6.67
	Fair	6	2.71	5	2.73	3	1.96	2	1.64	-	-	-	-
	Poor	-	-	-	-	-	-	-	-	-	-	-	-
Educational Attainment	< High School	13	5.88	11	6.01	9	5.88	5	4.10	3	3.16	3	4.00
	High School	8	3.62	6	3.28	4	2.61	4	3.28	2	2.11	2	2.67
	Bacherlors Degree	88	39.82	71	38.80	59	38.56	45	36.89	31	32.63	24	32.00
	≥ Masters Degree	112	50.68	95	51.91	81	52.94	68	55.74	59	62.11	46	61.33
Occupation	Teacher	207	93.67	172	93.99	142	93.46	116	95.08	92	96.84	72	96.00
	Domestic Worker	11	4.98	9	4.92	8	5.23	5	4.10	2	2.11	2	2.67
	Other	3	1.36	2	1.09	2	1.31	1	0.82	1	1.05	1	1.33
Place of Birth	US Born	208	94.12	171	93.44	144	94.12	115	94.26	90	94.74	70	93.33
	Not US Born	13	5.88	12	6.56	9	5.88	7	5.74	5	5.26	5	6.67
Continuous Variables		***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
bADLs		3.63	1.91	3.54	1.97	3.54	2.05	3.56	1.97	3.62	1.91	3.40	1.91
iADLs		3.30	1.70	3.27	1.73	3.22	1.84	3.10	1.69	3.37	1.80	3.11	1.80
Baseline Age		80.6	3.9	80.4	3.7	80.0	3.3	79.9	3.3	79.7	3.1	79.6	3.0
Baseline MMSE		27.9	2.2	28.0	2.2	28.0	2.2	28.2	2.0	28.5	1.5	28.7	1.2

Abbreviations: bADLs, basic activities of daily living; C, count; iADLs, instrumental activities of daily living; M, mean; MMSE, Mini-mental State Examination; SD, standard deviation; SRF, self-rated function; SRH, self-rated health; T, timepoint.

Table 3: Bivariate analysis of baseline subjective health and covariates with basic activities of daily living in the surviving analytic sample across timepoints 1 to 12 (n=549)

	SRH	*SRF*	*Age*	*MMSE*	*Education*	*Occupation*	*US Born*
Timepoint 1							
Correlation/ F-Value	0.2106	0.3872	-0.2248	0.4879	0.2081	4.2196	3.6248
P-Value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	0.1213	0.0569
Timepoint 2							
Correlation/ F-Value	0.1805	0.3668	-0.2712	0.4931	0.1146	1.2925	1.0493
P-Value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0071**	0.5240	0.3057
Timepoint 3							
Correlation/ F-Value	0.1226	0.3107	-0.2275	0.4031	0.1372	2.6597	0.3660
P-Value	**0.0064**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0032**	0.2645	0.5452
Timepoint 4							
Correlation/ F-Value	0.1302	0.2797	-0.2391	0.4279	0.1432	6.4945	0.1934
P-Value	**0.0092**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0066**	**0.0389**	0.6601
Timepoint 5							
Correlation/ F-Value	0.1971	0.3095	-0.2752	0.4815	0.2108	6.5799	0.3983
P-Value	**0.0002**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0002**	**0.0373**	0.5280
Timepoint 6							
Correlation/ F-Value	0.1281	0.2698	-0.2167	0.3801	0.2119	10.5248	0.4351
P-Value	**0.0241**	**<0.0001**	**0.0002**	**<0.0001**	**0.0008**	**0.0052**	0.5095
Timepoint 7							
Correlation/ F-Value	0.1038	0.266	-0.2176	0.2996	0.184	2.0474	0.0298
P-Value	0.1165	**<0.0001**	**0.001**	**<0.0001**	**0.0073**	0.3593	0.8628
Timepoint 8							
Correlation/ F-Value	0.022	0.2708	-0.2232	0.3487	0.1918	2.7709	0.0302
P-Value	0.7671	**0.0001**	**0.0017**	**<0.0001**	**0.0084**	0.2502	0.8620
Timepoint 9							
Correlation/ F-Value	0.1191	0.2903	-0.1336	0.4032	0.1556	3.3050	1.4861
P-Value	0.161	**0.0003**	0.0923	**<0.0001**	0.0589	0.1916	0.2228
Timepoint 10							
Correlation/ F-Value	0.2119	0.3180	-0.1507	0.3446	0.1833	4.1572	0.5343
P-Value	**0.0296**	**0.0005**	0.0953	**0.0001**	**0.0455**	0.1251	0.4648
Timepoint 11							
Correlation/ F-Value	0.1696	0.3780	-0.1975	0.3045	0.1024	1.7683	0.3098
P-Value	0.1216	**0.0002**	0.0579	**0.0038**	0.3143	0.4131	0.5778
Timepoint 12							
Correlation/ F-Value	0.2741	0.4534	-0.2275	0.2564	0.0532	1.2693	0.0032
P-Value	**0.0195**	**<0.0001**	0.0604	**0.0279**	0.6510	0.5301	0.9551

Spearman Rho correlations were used to determine associations between bADL score with SRH, SRF, age, MMSE score and education. Kruskal-Wallis tests were used to determine the association of bADL score with occupation and whether participants were born in the United States. bADL scores were assessed for each timepoint; all other measures were evaluated at baseline.

Significant p-values are highlighted in green (<0.0001 <0.01 ≤0.05) and bolded, where darker shades of green signify higher levels of significance.

Abbreviations: bADLs, basic activities of daily living, MMSE, Mini-mental State Examination; SRF, self-rated function; SRH, self-rated health.

Table 4: Bivariate analysis of baseline subjective health and covariates with instrumental activities of daily living in the surviving analytic sample across timepoints 1 to 12 (n=549)

	SRH	*SRF*	*Age*	*Cognition*	*Educational*	*Occupation*	*US Born*
				Time 1			
Correlation/ F-Value	0.2429	0.4334	-0.4022	0.5965	0.3558	26.7395	6.3235
P-Value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0119**
				Time 2			
Correlation/ F-Value	0.2425	0.4034	-0.393	0.5944	0.2991	21.1536	7.9932
P-Value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0047**
				Time 3			
Correlation/ F-Value	0.1976	0.3197	-0.3741	0.6255	0.3222	29.5399	8.9063
P-Value	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0028**
				Time 4			
Correlation/ F-Value	0.1722	0.3066	-0.3618	0.5362	0.2436	17.3877	1.7714
P-Value	**0.0005**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0002**	0.1832
				Time 5			
Correlation/ F-Value	0.1491	0.2689	-0.3781	0.5198	0.3046	17.2493	1.3147
P-Value	**0.0045**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0002**	0.2515
				Time 6			
Correlation/ F-Value	0.1988	0.313	-0.293	0.4762	0.2464	16.3532	3.8604
P-Value	**0.0003**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0003**	**0.0494**
				Time 7			
Correlation/ F-Value	0.1463	0.255	-0.2823	0.4596	0.2833	8.8827	0.4338
P-Value	**0.0182**	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**	**0.0118**	0.5101
				Time 8			
Correlation/ F-Value	0.0123	0.1442	-0.2709	0.4641	0.191	7.6148	2.0272
P-Value	0.8719	**0.0496**	**<0.0001**	**<0.0001**	**0.0099**	**0.0222**	0.1545
				Time 9			
Correlation/ F-Value	0.1302	0.1982	-0.1708	0.4843	0.1888	7.2660	0.1798
P-Value	0.1156	**0.0152**	**0.0283**	**<0.0001**	**0.019**	**0.0264**	0.6716
				Time 10			
Correlation/ F-Value	0.1991	0.2731	-0.3070	0.4527	0.1699	3.2198	0.0854
P-Value	**0.0251**	**0.0019**	**0.0001**	**<0.0001**	0.0581	0.1999	0.7701
				Time 11			
Correlation/ F-Value	0.1451	0.2185	-0.2851	0.3779	0.0020	0.3993	0.1319
P-Value	0.1695	**0.0304**	**0.0049**	**<0.0001**	0.9837	0.8190	0.7164
				Time 12			
Correlation/ F-Value	0.1734	0.2281	-0.4318	0.3062	0.0650	1.4487	0.2846
P-Value	0.1476	0.0559	**<0.0001**	**0.0052**	0.5633	0.4846	0.5937

Spearman Rho correlations were used to determine associations between iADL score with SRH, SRF, age, MMSE score and education. Kruskal-Wallis tests were used to determine the association of iADL score with occupation and whether participants were born in the United States. iADL scores were assessed for each timepoint; all other measures were evaluated at baseline.

Significant p-values are highlighted in green (≤0.0001 <0.01 ≤0.05) and bolded, where darker shades of green signify higher levels of significance.

Abbreviations: bADLs, basic activities of daily living, iADLs, instrumental activities of daily living, MMSE, Mini-mentals State Examination; SRF, self-rated function; SRH, self-rated health.

Table 5: Correlations between baseline measures of subjective health and timepoint assessment measures of physical function in the surviving analytic sample for timepoints 1 to 12 (n=549)

Time Point	*N*	*Baseline: SRH and SRF*		*Time Point: bADLs and iADLs*	
		Correlation	*P-Value*	*Correlation*	*P-Value*
Time Point 1	549	0.5144	<0.0001	0.5162	<0.0001
Time Point 2	548	0.5133	<0.0001	0.5882	<0.0001
Time Point 3	479	0.4883	<0.0001	0.562	<0.0001
Time Point 4	386	0.4867	<0.0001	0.6752	<0.0001
Time Point 5	329	0.5301	<0.0001	0.6611	<0.0001
Time Point 6	280	0.5426	<0.0001	0.7227	<0.0001
Time Point 7	221	0.5123	<0.0001	0.6523	<0.0001
Time Point 8	183	0.4854	<0.0001	0.6607	<0.0001
Time Point 9	153	0.4767	<0.0001	0.6821	<0.0001
Time Point 10	122	0.5012	<0.0001	0.6502	<0.0001
Time Point 11	95	0.5164	<0.0001	0.7068	<0.0001
Time Point 12	75	0.4600	<0.0001	0.6481	<0.0001

SRH and SRF were measured at baseline and a dynamic population was used to determine their correlation for timepoints 1 to 12. Physical function (bADLs and iADLs) was assessed at each timepoint. For example, the correlation at timepoint 7 for subjective health is the correlation between baseline SRH and baseline SRF for participants who survived to timepoint 7, while for physical function, the correlation at timepoint 7 is the correlation between bADLs and iADLs collected at timepoint 7.

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; SRF, self-rated function; SRH, self-rated health

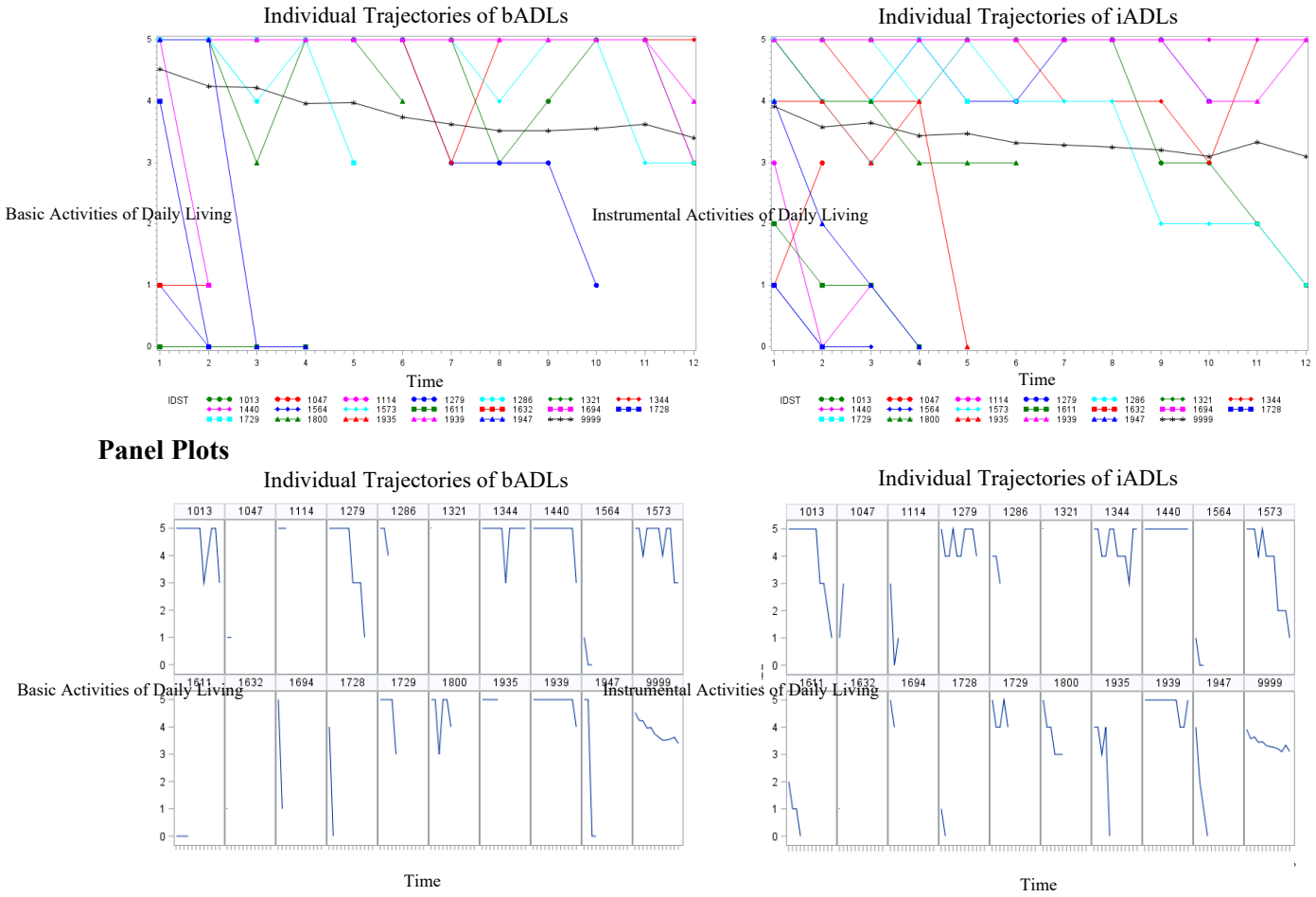

Figure 5: Individual trajectories of physical function for a random sample of the analytic sample (n=19)

Physical function trajectories (left: bADLs; right: iADLs) of 19 random participants and the average trajectory of the study population (9999) are seen. The top panels contain trajectories plotted together (spaghetti plots); the bottom panels have each trajectory plotted individually (panel plots).

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living.

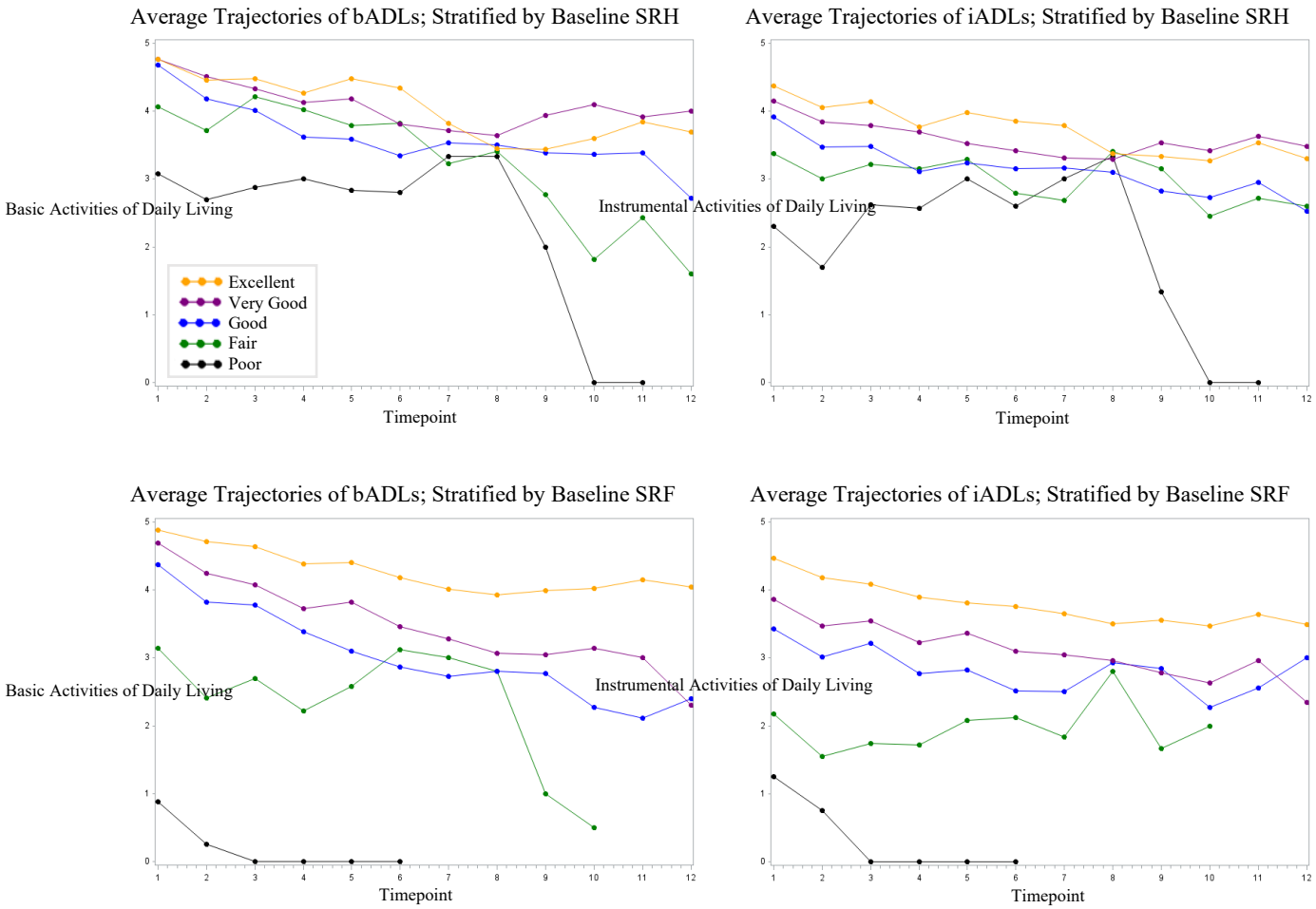

Figure 6: Average trajectories of physical function stratified by baseline subjective health in the analytic sample (n=549)

Average physical function trajectories (left: bADLs; right: iADLs) are plotted and stratified by participants' baseline subjective health (top: SRH; bottom: SRF). Excellent subjective health is plotted in yellow, very good subjective health in purple, good subjective health in blue, fair subjective health in green and poor subjective health is plotted in black.

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; SRF, self-rated function; SRH, self-rated health.

5.2 Multivariable Associations between Subjective Health and Physical Function

5.2.1 Associations between Subjective Health and Subsequent Physical Function

Partly conditional GEEs without interactions between time and subjective health were used to address research question 1: "Is subjective health a predictor of subsequent physical function in older women?" From the base to full model, additional covariates were added. After examining all full models, education and place of birth were removed as they were not found to be significant. In all models, excellent was used as the reference category for subjective health. Table 6 and Table 7 show the estimates and 95% confidence limits for GEEs with bADLs and iADLs as the respective outcomes; Part A and Part B display the results when SRH and SRF respectively are used as the subjective health measures.

GEE Model:

$$\mu_{ij} = \beta_0 + \beta_1 X_{ij1} + \cdots + \beta_p X_{ijp}$$

where,

μ_{ij} is the mean response at the j^{th} assessment timepoint,

$X_{ij1}, \ldots, X_{ijp}$ are the predictors associated with the mean response μ_{ij},

β_0 is the intercept, and

$\beta_1, \ldots, \beta_p$ are the effects/slopes corresponding to the predictors.

Predictors in Base GEE Models:

Base GEE models include subjective health, age and assessment timepoints. Subjective health and assessment timepoints are categorical variables.

Predictors in Full GEE Models:

Full GEE models include subjective health, age, assessment timepoints, cognition, occupation, education and place of birth. Subjective health, assessment timepoints, occupation, education and place of birth are categorical variables.

Predictors in Reduced GEE Models:

Reduced GEE models include subjective health, age, assessment timepoints, cognition and occupation. Subjective health, assessment timepoints and occupation are categorical variables.

In the base models, the GEE estimates showed that the lower the level of subjective health, the worse the level of physical function. However, in the full and reduced models, SRH was not a significant predictor of bADLs (Table 6A). SRH was a significant predictor of iADLs (Table 7A), and SRF was a significant predictor of both bADLs (Table 6B) and iADLs (Table 7B) in the reduced models. Further, there was a dose-response effect, where for each lower level of subjective health, the predicted level of physical function decreased. The reduced models included baseline age and assessment timepoints, which had negative associations with physical function; baseline MMSE, which had a positive association with physical function; and occupation.

Table 6A: The association between baseline self-rated health and subsequent basic activities of daily living without time interactions in the analytic sample (n=549)

Measure	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Intercept		***10.844***	***9.009***	***12.680***	1.219	-0.738	3.176	1.148	-0.799	3.095
Baseline SRH (vs. Excellent)	Poor	***-1.561***	***-2.676***	***-0.447***	-0.755	-1.581	0.071	-0.740	-1.564	0.085
	Fair	***-0.504***	***-0.883***	***-0.125***	-0.303	-0.627	0.021	-0.295	-0.617	0.027
	Good	***-0.393***	***-0.732***	***-0.054***	-0.280	-0.573	0.013	-0.261	-0.554	0.033
	Very Good	-0.044	-0.350	0.262	-0.050	-0.307	0.208	-0.038	-0.296	0.220
Baseline Age		***-0.073***	***-0.095***	***-0.050***	***-0.021***	***-0.041***	***-0.000***	-0.020	-0.039	0.000
Timepoint (vs. Timepoint 1)	2	***-0.354***	***-0.448***	***-0.260***	***-0.354***	***-0.448***	***-0.260***	***-0.354***	***-0.448***	***-0.260***
	3	***-0.423***	***-0.545***	***-0.302***	***-0.483***	***-0.599***	***-0.367***	***-0.482***	***-0.598***	***-0.366***
	4	***-0.716***	***-0.879***	***-0.553***	***-0.832***	***-0.989***	***-0.676***	***-0.832***	***-0.989***	***-0.676***
	5	***-0.724***	***-0.906***	***-0.542***	***-0.913***	***-1.084***	***-0.742***	***-0.912***	***-1.084***	***-0.740***
	6	***-0.995***	***-1.217***	***-0.774***	***-1.215***	***-1.423***	***-1.006***	***-1.211***	***-1.421***	***-1.002***
	7	***-1.170***	***-1.430***	***-0.910***	***-1.413***	***-1.662***	***-1.164***	***-1.408***	***-1.657***	***-1.159***
	8	***-1.291***	***-1.583***	***-0.998***	***-1.548***	***-1.827***	***-1.269***	***-1.541***	***-1.820***	***-1.261***
	9	***-1.316***	***-1.644***	***-0.988***	***-1.564***	***-1.872***	***-1.257***	***-1.558***	***-1.867***	***-1.248***
	10	***-1.317***	***-1.659***	***-0.974***	***-1.583***	***-1.909***	***-1.256***	***-1.577***	***-1.905***	***-1.249***
	11	***-1.277***	***-1.654***	***-0.900***	***-1.569***	***-1.936***	***-1.202***	***-1.562***	***-1.927***	***-1.197***
	12	***-1.509***	***-1.926***	***-1.092***	***-1.833***	***-2.247***	***-1.420***	***-1.825***	***-2.239***	***-1.411***
Baseline MMSE					***0.201***	***0.177***	***0.225***	***0.200***	***0.177***	***0.223***
Occupation (vs. Teacher)	Domestic Worker				0.125	-0.429	0.679	0.277	-0.161	0.715
	Nurses Aid/Other				-0.095	-0.745	0.554	0.038	-0.648	0.724
Education (vs. ≥ Masters Degree)	< High School				0.173	-0.356	0.702			
	High School				-0.147	-0.737	0.443			
	Bachelors Degree				0.032	-0.161	0.224			
Place of Birth (vs. US Born)	Not US Born				0.193	-0.290	0.676			

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRH, self-rated health.

Table 6B: The association between baseline self-rated function and subsequent basic activities of daily living without time interactions in the analytic sample (n=549)

Measure	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Intercept		***9.034***	***7.227***	***10.841***	1.024	-0.895	2.943	0.969	-0.940	2.878
Baseline SRF (vs. Excellent)	Poor	***-4.104***	***-4.541***	***-3.667***	***-2.684***	***-3.609***	***-1.760***	***-2.674***	***-3.587***	***-1.761***
	Fair	***-1.800***	***-2.518***	***-1.083***	***-0.921***	***-1.432***	***-0.411***	***-0.939***	***-1.442***	***-0.436***
	Good	***-0.921***	***-1.304***	***-0.538***	***-0.593***	***-0.920***	***-0.267***	***-0.590***	***-0.913***	***-0.267***
	Very Good	***-0.535***	***-0.771***	***-0.300***	***-0.424***	***-0.639***	***-0.210***	***-0.409***	***-0.623***	***-0.195***
Baseline Age		***-0.048***	***-0.070***	***-0.026***	-0.011	-0.031	0.009	-0.010	-0.030	0.010
Timepoint (vs. Timepoint 1)	2	***-0.354***	***-0.448***	***-0.260***	***-0.354***	***-0.448***	***-0.260***	***-0.354***	***-0.448***	***-0.260***
	3	***-0.448***	***-0.567***	***-0.329***	***-0.494***	***-0.609***	***-0.378***	***-0.494***	***-0.609***	***-0.379***
	4	***-0.772***	***-0.932***	***-0.611***	***-0.857***	***-1.012***	***-0.701***	***-0.857***	***-1.012***	***-0.701***
	5	***-0.774***	***-0.954***	***-0.594***	***-0.928***	***-1.098***	***-0.758***	***-0.927***	***-1.098***	***-0.757***
	6	***-1.042***	***-1.261***	***-0.823***	***-1.222***	***-1.430***	***-1.014***	***-1.219***	***-1.428***	***-1.010***
	7	***-1.226***	***-1.484***	***-0.968***	***-1.422***	***-1.670***	***-1.174***	***-1.418***	***-1.666***	***-1.169***
	8	***-1.351***	***-1.640***	***-1.062***	***-1.557***	***-1.835***	***-1.279***	***-1.551***	***-1.829***	***-1.273***
	9	***-1.382***	***-1.704***	***-1.059***	***-1.577***	***-1.885***	***-1.269***	***-1.572***	***-1.881***	***-1.263***
	10	***-1.371***	***-1.708***	***-1.034***	***-1.586***	***-1.913***	***-1.258***	***-1.582***	***-1.910***	***-1.253***
	11	***-1.340***	***-1.709***	***-0.971***	***-1.564***	***-1.925***	***-1.203***	***-1.561***	***-1.921***	***-1.201***
	12	***-1.584***	***-1.994***	***-1.174***	***-1.836***	***-2.244***	***-1.429***	***-1.832***	***-2.240***	***-1.423***
Baseline MMSE					***0.182***	***0.158***	***0.206***	***0.181***	***0.158***	***0.205***
Occupation (vs. Teacher)	Domestic Worker				0.410	-0.091	0.911	***0.481***	***0.073***	***0.889***
	Nurses Aid/Other				-0.045	-0.677	0.587	0.035	-0.620	0.691
Education (vs. ≥ Masters Degree)	< High School				0.085	-0.388	0.557			
	High School				-0.130	-0.730	0.470			
	Bachelors Degree				0.059	-0.128	0.247			
Place of Birth (vs. US Born)	Not US Born				0.208	-0.277	0.693			

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRF, self-rated function.

Table 7A: The association between baseline self-rated health and subsequent instrumental activities of daily living without time interactions in the analytic sample (n=549)

Measure	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
Intercept		***13.671***	***12.013***	***15.330***	***3.328***	***1.718***	***4.938***	***3.290***	***1.670***	***4.911***
Baseline SRH (vs. Excellent)	Poor	***-1.681***	***-2.762***	***-0.599***	***-0.777***	***-1.480***	***-0.075***	***-0.769***	***-1.474***	***-0.064***
	Fair	***-0.691***	***-1.053***	***-0.329***	***-0.412***	***-0.699***	***-0.125***	***-0.408***	***-0.690***	***-0.125***
	Good	***-0.547***	***-0.851***	***-0.243***	***-0.379***	***-0.629***	***-0.130***	***-0.371***	***-0.619***	***-0.124***
	Very Good	-0.227	-0.508	0.055	-0.226	-0.454	0.002	-0.221	-0.449	0.008
Baseline Age		***-0.113***	***-0.133***	***-0.092***	***-0.055***	***-0.072***	***-0.039***	***-0.055***	***-0.072***	***-0.038***
Timepoint (vs. Timepoint 1)	2	***-0.367***	***-0.453***	***-0.280***	***-0.367***	***-0.453***	***-0.280***	***-0.367***	***-0.453***	***-0.280***
	3	***-0.354***	***-0.458***	***-0.250***	***-0.413***	***-0.508***	***-0.318***	***-0.413***	***-0.508***	***-0.318***
	4	***-0.614***	***-0.757***	***-0.470***	***-0.740***	***-0.871***	***-0.609***	***-0.739***	***-0.870***	***-0.609***
	5	***-0.635***	***-0.796***	***-0.475***	***-0.839***	***-0.984***	***-0.694***	***-0.838***	***-0.983***	***-0.694***
	6	***-0.825***	***-1.008***	***-0.642***	***-1.063***	***-1.229***	***-0.897***	***-1.061***	***-1.227***	***-0.896***
	7	***-0.938***	***-1.151***	***-0.725***	***-1.205***	***-1.399***	***-1.010***	***-1.203***	***-1.395***	***-1.010***
	8	***-1.008***	***-1.254***	***-0.762***	***-1.289***	***-1.513***	***-1.065***	***-1.286***	***-1.509***	***-1.063***
	9	***-1.104***	***-1.386***	***-0.821***	***-1.371***	***-1.631***	***-1.111***	***-1.368***	***-1.627***	***-1.109***
	10	***-1.259***	***-1.538***	***-0.979***	***-1.555***	***-1.816***	***-1.293***	***-1.552***	***-1.814***	***-1.291***
	11	***-1.059***	***-1.396***	***-0.722***	***-1.390***	***-1.718***	***-1.062***	***-1.387***	***-1.715***	***-1.059***
	12	***-1.302***	***-1.680***	***-0.924***	***-1.661***	***-2.032***	***-1.290***	***-1.658***	***-2.029***	***-1.287***
Baseline MMSE					***0.212***	***0.193***	***0.231***	***0.212***	***0.194***	***0.230***
Occupation (vs. Teacher)	Domestic Worker				-0.354	-0.885	0.177	-0.289	-0.617	0.039
	Nurses Aid/Other				***-0.756***	***-1.402***	***-0.111***	***-0.706***	***-1.240***	***-0.173***
Education (vs. ≥ Masters Degree)	< High School				0.082	-0.459	0.622			
	High School				-0.067	-0.492	0.358			
	Bachelors Degree				0.020	-0.157	0.197			
Place of Birth (vs. US Born)	Not US Born				0.060	-0.304	0.425			

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRH, self-rated health.

Table 7B: The association between baseline self-rated function and subsequent instrumental activities of daily living without time interactions in the analytic sample (n=549)

Measure	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Intercept		***11.935***	***10.225***	***13.645***	***2.937***	***1.286***	***4.587***	***2.923***	***1.260***	***4.586***
Baseline SRF (vs. Excellent)	Poor	***-2.905***	***-3.642***	***-2.169***	-0.971	-1.966	0.025	-0.966	-1.960	0.027
	Fair	***-1.858***	***-2.616***	***-1.099***	***-0.718***	***-1.210***	***-0.227***	***-0.724***	***-1.211***	***-0.238***
	Good	***-0.820***	***-1.194***	***-0.445***	***-0.338***	***-0.603***	***-0.073***	***-0.337***	***-0.599***	***-0.074***
	Very Good	***-0.487***	***-0.722***	***-0.252***	***-0.306***	***-0.513***	***-0.099***	***-0.300***	***-0.502***	***-0.098***
Baseline Age		***-0.091***	***-0.113***	***-0.070***	***-0.049***	***-0.066***	***-0.031***	***-0.049***	***-0.066***	***-0.031***
Timepoint (vs. Timepoint 1)	2	***-0.367***	***-0.453***	***-0.280***	***-0.367***	***-0.453***	***-0.280***	***-0.367***	***-0.453***	***-0.280***
	3	***-0.370***	***-0.472***	***-0.268***	***-0.415***	***-0.510***	***-0.320***	***-0.415***	***-0.510***	***-0.320***
	4	***-0.654***	***-0.796***	***-0.512***	***-0.748***	***-0.879***	***-0.617***	***-0.748***	***-0.879***	***-0.617***
	5	***-0.673***	***-0.833***	***-0.512***	***-0.844***	***-0.990***	***-0.698***	***-0.844***	***-0.990***	***-0.699***
	6	***-0.859***	***-1.040***	***-0.678***	***-1.063***	***-1.229***	***-0.896***	***-1.063***	***-1.228***	***-0.897***
	7	***-0.973***	***-1.184***	***-0.762***	***-1.198***	***-1.392***	***-1.004***	***-1.197***	***-1.390***	***-1.004***
	8	***-1.044***	***-1.288***	***-0.799***	***-1.278***	***-1.503***	***-1.054***	***-1.277***	***-1.501***	***-1.054***
	9	***-1.143***	***-1.424***	***-0.861***	***-1.361***	***-1.622***	***-1.100***	***-1.360***	***-1.620***	***-1.100***
	10	***-1.285***	***-1.565***	***-1.005***	***-1.537***	***-1.799***	***-1.275***	***-1.536***	***-1.798***	***-1.274***
	11	***-1.091***	***-1.432***	***-0.750***	***-1.365***	***-1.695***	***-1.035***	***-1.365***	***-1.695***	***-1.035***
	12	***-1.345***	***-1.723***	***-0.966***	***-1.640***	***-2.011***	***-1.270***	***-1.640***	***-2.011***	***-1.269***
Baseline MMSE					***0.203***	***0.183***	***0.223***	***0.203***	***0.184***	***0.222***
Occupation (vs. Teacher)	Domestic Worker				-0.164	-0.684	0.355	-0.187	-0.511	0.136
	Nurses Aid/Other				***-0.716***	***-1.405***	***-0.027***	***-0.722***	***-1.298***	***-0.146***
Education (vs. ≥ Masters Degree)	< High School				-0.026	-0.558	0.505			
	High School				-0.051	-0.502	0.401			
	Bachelors Degree				0.023	-0.155	0.201			
Place of Birth (vs. US Born)	Not US Born				0.071	-0.310	0.451			

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRF, self-rated function.

5.2.2 Change in Association between Subjective Health and Subsequent Physical Function with Time

Partly conditional GEEs with interactions between assessment timepoint and subjective health were used to address research question 2: "Does the association between subjective health and subsequent physical function change with time in older women?" From the base to full model, additional covariates were added. After examining all full models, education and place of birth were removed as they were not significantly related to physical function. In all models, 'excellent' was used as the reference category for subjective health. Table 8 and Table 9 show the estimates and 95% confidence limits for GEEs with bADLs and iADLs as the respective outcomes; Part A and Part B display the results when SRH and SRF respectively are used as the subjective health measures.

GEE Model:

$$\mu_{ij} = \beta_0 + \beta_1 X_{ij1} + \cdots + \beta_p X_{ijp}$$

where,

μ_{ij} is the mean response at the jth assessment timepoint,

$X_{ij1}, \ldots, X_{ijp}$ are the predictors associated with the mean response μ_{ij},

β_0 is the intercept, and

$\beta_1, \ldots, \beta_p$ are the effects/slopes corresponding to the predictors.

Predictors in Base GEE Models:

Base GEE models include subjective health, age, assessment timepoints and interactions between subjective health and assessment timepoints. Subjective health, assessment timepoints and interaction terms are categorical variables.

Predictors in Full GEE Models:

Full GEE models include subjective health, age, assessment timepoints, cognition, occupation, education, place of birth and interactions between subjective health and assessment timepoints. Subjective health, assessment timepoints, occupation, education, place of birth and interaction terms are categorical variables.

Predictors in Reduced GEE Models:

Reduced GEE models include subjective health, age, assessment timepoints, cognition, occupation and interactions between subjective health and assessment timepoints. Subjective health, assessment timepoints, occupation and interaction terms are categorical variables.

Similar to that seen in section 5.2.1, in the base models, the GEE estimates showed that the lower the level of subjective health, the worse the level of physical function. In the reduced models, lower levels of SRH and SRF were not independently associated with lower levels in bADLs (Table 8A and B). The loss of significance from base model to reduced model in SRH and bADLs is similar to that seen in section 5.2.1 (Table 6A). The reduced models included baseline age and assessment timepoints, which had negative associations with physical function; baseline MMSE, which had a positive association with physical function; and occupation.

In the models for research question two, time interactions were taken into consideration. Generally, it was shown that the association between subjective health and subsequent physical function was not modified by assessment timepoint. Specifically, these interactions were not significant in the associations of SRH with bADLs (Table 8A) and iADLs (9A) or of SRF with iADLs (9B). However, in the models of SRF and bADLs (Table 8B), most of the interactions between SRF and assessment timepoints were significant. In these interactions, there was a dose-response effect where estimates were more negative at lower levels of baseline SRF at later timepoints than higher levels of baseline SRF at earlier timepoints. Further, when examining the

time interactions, lower levels of baseline SRF at earlier timepoints were less likely to be significant than higher levels of baseline SRF at later timepoints.

Table 8A: The association between baseline self-rated health and subsequent basic activities of daily living with time interactions in the analytic sample (n=549)

Parameter	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
Intercept		***10.770***	***8.962***	***12.578***	1.124	-0.797	3.045	1.065	-0.850	2.981
Baseline SRH (vs. Excellent)	Poor	***-1.596***	***-2.656***	***-0.536***	-0.539	-1.557	0.480	-0.523	-1.524	0.478
	Fair	***-0.585***	***-0.988***	***-0.182***	-0.196	-0.488	0.096	-0.194	-0.486	0.099
	Good	-0.047	-0.273	0.179	0.086	-0.110	0.282	0.094	-0.100	0.289
	Very Good	-0.005	-0.226	0.216	-0.001	-0.182	0.180	0.002	-0.180	0.183
Baseline Age		***-0.073***	***-0.095***	***-0.051***	***-0.021***	***-0.041***	***-0.001***	***-0.020***	***-0.040***	***-0.001***
Timepoint (vs. Timepoint 1)	2	***-0.298***	***-0.528***	***-0.067***	***-0.298***	***-0.528***	***-0.067***	***-0.298***	***-0.528***	***-0.067***
	3	***-0.279***	***-0.523***	***-0.035***	***-0.281***	***-0.524***	***-0.037***	***-0.285***	***-0.528***	***-0.041***
	4	***-0.540***	***-0.890***	***-0.189***	***-0.533***	***-0.875***	***-0.191***	***-0.534***	***-0.876***	***-0.193***
	5	-0.364	-0.752	0.024	***-0.531***	***-0.887***	***-0.174***	***-0.535***	***-0.892***	***-0.178***
	6	***-0.555***	***-0.973***	***-0.137***	***-0.717***	***-1.099***	***-0.335***	***-0.723***	***-1.105***	***-0.340***
	7	***-1.098***	***-1.644***	***-0.553***	***-1.269***	***-1.790***	***-0.749***	***-1.276***	***-1.796***	***-0.756***
	8	***-1.472***	***-2.124***	***-0.820***	***-1.676***	***-2.295***	***-1.058***	***-1.683***	***-2.301***	***-1.066***
	9	***-1.516***	***-2.240***	***-0.792***	***-1.730***	***-2.420***	***-1.040***	***-1.739***	***-2.427***	***-1.050***
	10	***-1.337***	***-2.086***	***-0.589***	***-1.579***	***-2.302***	***-0.856***	***-1.588***	***-2.309***	***-0.867***
	11	***-1.109***	***-1.819***	***-0.398***	***-1.357***	***-2.037***	***-0.678***	***-1.369***	***-2.047***	***-0.690***
	12	***-1.265***	***-2.003***	***-0.527***	***-1.540***	***-2.275***	***-0.805***	***-1.557***	***-2.290***	***-0.823***
Baseline MMSE					***0.201***	***0.177***	***0.224***	***0.200***	***0.177***	***0.223***
Occupation (vs. Teacher)	Domestic Worker				0.135	-0.429	0.699	0.278	-0.159	0.716
	Nurses Aid/Other				-0.066	-0.724	0.591	0.056	-0.632	0.744
Education (vs. ≥ Masters Degree)	< High School				0.164	-0.376	0.704			
	High School				-0.143	-0.731	0.446			
	Bachelors Degree				0.029	-0.162	0.219			
Place of Birth (vs. US Born)	Not US Born				0.171	-0.307	0.649			
*Timepoint * SRH (vs. Timepoint 1 and Excellent SRH)*	2 / Poor	-0.087	-0.984	0.810	-0.087	-0.984	0.810	-0.087	-0.984	0.810
	2 / Fair	-0.049	-0.384	0.287	-0.049	-0.384	0.287	-0.049	-0.384	0.287
	2 / Good	-0.205	-0.496	0.085	-0.205	-0.496	0.085	-0.205	-0.496	0.085
	2 / Very Good	0.040	-0.232	0.313	0.040	-0.232	0.313	0.040	-0.232	0.313
	3 / Poor	-0.024	-1.111	1.063	-0.223	-1.220	0.774	-0.228	-1.210	0.754
	3 / Fair	0.383	-0.120	0.886	0.131	-0.308	0.569	0.138	-0.301	0.576
	3 / Good	***-0.410***	***-0.740***	***-0.081***	***-0.455***	***-0.786***	***-0.125***	***-0.450***	***-0.780***	***-0.120***
	3 / Very Good	-0.175	-0.473	0.124	-0.184	-0.479	0.111	-0.179	-0.475	0.117
	4 / Poor	0.366	-0.744	1.477	-0.145	-1.318	1.029	-0.153	-1.315	1.009

Parameter	Level	Base Model			Full Model			Reduced Model		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
*Timepoint * SRH (vs. Timepoint 1 and Excellent SRH)*	4 / Fair	0.457	-0.213	1.126	0.104	-0.493	0.701	0.105	-0.493	0.702
	4 / Good	***-0.564***	***-1.034***	***-0.093***	***-0.633***	***-1.093***	***-0.174***	***-0.630***	***-1.090***	***-0.170***
	4 / Very Good	-0.149	-0.566	0.268	-0.266	-0.676	0.143	-0.266	-0.675	0.144
	5 / Poor	-0.109	-1.444	1.226	-0.821	-2.128	0.485	-0.824	-2.121	0.472
	5 / Fair	0.023	-0.740	0.786	-0.329	-1.017	0.359	-0.324	-1.014	0.365
	5 / Good	***-0.801***	***-1.330***	***-0.272***	***-0.732***	***-1.229***	***-0.234***	***-0.722***	***-1.224***	***-0.220***
	5 / Very Good	-0.295	-0.751	0.161	-0.261	-0.686	0.163	-0.258	-0.681	0.166
	6 / Poor	-0.009	-1.551	1.534	-0.538	-1.990	0.913	-0.542	-1.986	0.902
	6 / Fair	0.231	-0.555	1.018	-0.121	-0.844	0.602	-0.116	-0.839	0.608
	6 / Good	***-0.899***	***-1.498***	***-0.300***	***-0.885***	***-1.451***	***-0.320***	***-0.870***	***-1.438***	***-0.302***
	6 / Very Good	-0.487	-1.026	0.053	***-0.505***	***-1.005***	***-0.004***	-0.495	-0.996	0.006
	7 / Poor	0.895	-2.050	3.840	0.438	-2.127	3.003	0.432	-2.132	2.997
	7 / Fair	0.165	-0.798	1.127	-0.138	-1.048	0.771	-0.133	-1.035	0.768
	7 / Good	-0.226	-0.963	0.511	-0.286	-0.992	0.420	-0.269	-0.976	0.438
	7 / Very Good	-0.081	-0.756	0.595	-0.102	-0.748	0.545	-0.088	-0.735	0.558
	8 / Poor	1.269	-1.698	4.235	0.845	-1.741	3.432	0.840	-1.746	3.426
	8 / Fair	0.651	-0.445	1.746	0.354	-0.700	1.407	0.369	-0.673	1.411
	8 / Good	0.084	-0.774	0.942	0.051	-0.768	0.870	0.068	-0.753	0.888
	8 / Very Good	0.207	-0.583	0.996	0.212	-0.538	0.962	0.230	-0.519	0.980
	9 / Poor	-0.021	-2.869	2.828	-0.434	-3.038	2.169	-0.438	-3.044	2.168
	9 / Fair	-0.012	-1.433	1.409	-0.261	-1.548	1.027	-0.269	-1.562	1.023
	9 / Good	0.000	-0.969	0.969	-0.039	-0.968	0.891	-0.016	-0.947	0.914
	9 / Very Good	0.517	-0.342	1.376	0.560	-0.255	1.375	0.583	-0.230	1.395
	10 / Poor	***-2.252***	***-3.533***	***-0.970***	***-1.990***	***-3.231***	***-0.749***	***-2.004***	***-3.229***	***-0.778***
	10 / Fair	-1.171	-2.433	0.092	***-1.367***	***-2.549***	***-0.184***	***-1.380***	***-2.566***	***-0.193***
	10 / Good	-0.203	-1.239	0.832	-0.210	-1.201	0.781	-0.190	-1.183	0.803
	10 / Very Good	0.507	-0.365	1.379	0.525	-0.317	1.366	0.550	-0.289	1.388
	11 / Poor	***-2.480***	***-3.742***	***-1.219***	***-2.211***	***-3.432***	***-0.991***	***-2.223***	***-3.426***	***-1.020***
	11 / Fair	-0.896	-2.696	0.904	-1.178	-2.910	0.554	-1.163	-2.895	0.570
	11 / Good	-0.378	-1.457	0.701	-0.468	-1.533	0.596	-0.443	-1.503	0.617
	11 / Very Good	0.072	-0.808	0.952	0.105	-0.742	0.952	0.130	-0.712	0.973
	12 / Fair	-1.656	-3.717	0.405	-1.963	-3.994	0.069	-1.941	-3.977	0.095
	12 / Good	-0.882	-2.026	0.262	-0.957	-2.086	0.172	-0.924	-2.061	0.213
	12 / Very Good	0.293	-0.614	1.200	0.326	-0.579	1.230	0.361	-0.541	1.263

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRH, self-rated health.

Table 8B: The association between baseline self-rated function and subsequent basic activities of daily living with time interactions in the analytic sample (n=549)

Parameter	Level	Base Model			Full Model			Reduced Model		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Intercept		***8.905***	***7.106***	***10.705***	0.805	-1.102	2.713	0.745	-1.156	2.645
Baseline SRF (vs. Excellent)	Poor	***-3.662***	***-4.385***	***-2.940***	***-2.135***	***-3.161***	***-1.109***	***-2.116***	***-3.116***	***-1.116***
	Fair	***-1.554***	***-2.243***	***-0.865***	-0.432	-1.061	0.198	-0.444	-1.068	0.180
	Good	***-0.372***	***-0.649***	***-0.095***	0.061	-0.203	0.325	0.068	-0.195	0.330
	Very Good	-0.086	-0.242	0.069	0.103	-0.048	0.254	0.114	-0.032	0.260
Baseline Age		***-0.049***	***-0.072***	***-0.027***	-0.013	-0.033	0.008	-0.012	-0.031	0.008
Timepoint (vs. Timepoint 1)	2	***-0.175***	***-0.280***	***-0.071***	***-0.175***	***-0.280***	***-0.071***	***-0.175***	***-0.280***	***-0.071***
	3	***-0.255***	***-0.383***	***-0.128***	***-0.259***	***-0.387***	***-0.131***	***-0.259***	***-0.387***	***-0.131***
	4	***-0.515***	***-0.695***	***-0.335***	***-0.537***	***-0.716***	***-0.358***	***-0.537***	***-0.716***	***-0.358***
	5	***-0.511***	***-0.710***	***-0.312***	***-0.588***	***-0.778***	***-0.398***	***-0.586***	***-0.776***	***-0.396***
	6	***-0.755***	***-1.018***	***-0.491***	***-0.855***	***-1.109***	***-0.601***	***-0.854***	***-1.109***	***-0.600***
	7	***-0.940***	***-1.240***	***-0.640***	***-1.032***	***-1.323***	***-0.742***	***-1.029***	***-1.319***	***-0.739***
	8	***-1.037***	***-1.385***	***-0.688***	***-1.165***	***-1.506***	***-0.825***	***-1.158***	***-1.498***	***-0.818***
	9	***-0.992***	***-1.368***	***-0.615***	***-1.127***	***-1.493***	***-0.762***	***-1.122***	***-1.488***	***-0.756***
	10	***-0.938***	***-1.322***	***-0.554***	***-1.082***	***-1.454***	***-0.711***	***-1.077***	***-1.448***	***-0.705***
	11	***-0.820***	***-1.229***	***-0.410***	***-0.978***	***-1.376***	***-0.580***	***-0.974***	***-1.373***	***-0.576***
	12	***-0.934***	***-1.373***	***-0.495***	***-1.108***	***-1.545***	***-0.671***	***-1.104***	***-1.542***	***-0.665***
Baseline MMSE					***0.185***	***0.160***	***0.209***	***0.184***	***0.160***	***0.207***
Occupation (vs. Teacher)	Domestic Worker				0.390	-0.099	0.879	***0.488***	***0.084***	***0.892***
	Nurses Aid/Other				-0.040	-0.676	0.596	0.053	-0.623	0.730
Education (vs. ≥ Masters Degree)	< High School				0.117	-0.348	0.583			
	High School				-0.130	-0.740	0.480			
	Bachelors Degree				0.056	-0.132	0.244			
Place of Birth (vs. US Born)	Not US Born				0.189	-0.303	0.682			
*Timepoint * SRF (vs. Timepoint 1 and Excellent SRF)*	2 / Poor	-0.450	-0.943	0.044	-0.450	-0.943	0.044	-0.450	-0.943	0.044
	2 / Fair	-0.549	-1.107	0.009	-0.549	-1.107	0.009	-0.549	-1.107	0.009
	2 / Good	***-0.380***	***-0.714***	***-0.046***	***-0.380***	***-0.714***	***-0.046***	***-0.380***	***-0.714***	***-0.046***
	2 / Very Good	***-0.272***	***-0.477***	***-0.066***	***-0.272***	***-0.477***	***-0.066***	***-0.272***	***-0.477***	***-0.066***
	3 / Poor	-0.552	-1.205	0.100	-0.145	-1.083	0.793	-0.176	-1.094	0.741
	3 / Fair	-0.214	-1.083	0.655	-0.485	-1.341	0.370	-0.482	-1.338	0.374
	3 / Good	-0.364	-0.791	0.063	***-0.472***	***-0.869***	***-0.076***	***-0.475***	***-0.873***	***-0.077***
	3 / Very Good	***-0.368***	***-0.619***	***-0.117***	***-0.418***	***-0.660***	***-0.176***	***-0.415***	***-0.658***	***-0.173***
	4 / Poor	-0.651	-1.385	0.084	***-1.462***	***-2.494***	***-0.429***	***-1.491***	***-2.497***	***-0.484***

Parameter	Level	Base Model			Full Model			Reduced Model		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
*Timepoint * SRF (vs. Timepoint 1 and Excellent SRF)*	4 / Fair	-0.416	-1.415	0.584	-0.638	-1.538	0.263	-0.644	-1.545	0.256
	4 / Good	-0.495	-1.001	0.010	***-0.604***	***-1.089***	***-0.119***	***-0.609***	***-1.095***	***-0.124***
	4 / Very Good	***-0.487***	***-0.857***	***-0.117***	***-0.590***	***-0.950***	***-0.230***	***-0.587***	***-0.947***	***-0.228***
	5 / Poor	-0.654	-1.393	0.084	***-1.412***	***-2.448***	***-0.376***	***-1.442***	***-2.451***	***-0.432***
	5 / Fair	-0.170	-1.374	1.033	-0.517	-1.596	0.562	-0.524	-1.602	0.554
	5 / Good	***-0.801***	***-1.421***	***-0.180***	***-0.907***	***-1.497***	***-0.317***	***-0.918***	***-1.508***	***-0.329***
	5 / Very Good	***-0.415***	***-0.818***	***-0.012***	***-0.558***	***-0.942***	***-0.174***	***-0.555***	***-0.940***	***-0.169***
	6 / Poor	-0.411	-1.168	0.347	***-1.144***	***-2.193***	***-0.095***	***-1.174***	***-2.197***	***-0.151***
	6 / Fair	0.608	-1.260	2.475	-0.089	-1.730	1.553	-0.096	-1.734	1.542
	6 / Good	***-0.794***	***-1.438***	***-0.150***	***-0.825***	***-1.424***	***-0.226***	***-0.830***	***-1.428***	***-0.231***
	6 / Very Good	***-0.567***	***-1.066***	***-0.068***	***-0.723***	***-1.205***	***-0.241***	***-0.714***	***-1.197***	***-0.231***
	7 / Fair	0.626	-1.371	2.623	0.077	-1.605	1.758	0.064	-1.622	1.749
	7 / Good	-0.766	-1.597	0.064	***-1.055***	***-1.810***	***-0.300***	***-1.061***	***-1.811***	***-0.310***
	7 / Very Good	***-0.595***	***-1.186***	***-0.004***	***-0.760***	***-1.336***	***-0.184***	***-0.753***	***-1.330***	***-0.176***
	8 / Fair	0.571	-0.979	2.121	-0.128	-1.454	1.197	-0.145	-1.465	1.174
	8 / Good	-0.710	-1.721	0.301	***-1.010***	***-1.939***	***-0.081***	***-1.023***	***-1.950***	***-0.095***
	8 / Very Good	***-0.708***	***-1.373***	***-0.044***	***-0.784***	***-1.422***	***-0.146***	***-0.781***	***-1.420***	***-0.142***
	9 / Fair	-1.128	-2.848	0.593	***-1.446***	***-2.556***	***-0.337***	***-1.502***	***-2.563***	***-0.441***
	9 / Good	-0.797	-2.023	0.429	***-1.049***	***-2.142***	***0.043***	-1.056	-2.149	0.037
	9 / Very Good	***-0.811***	***-1.564***	***-0.058***	***-0.877***	***-1.598***	***-0.156***	***-0.869***	***-1.591***	***-0.148***
	10 / Fair	***-1.564***	***-2.445***	***-0.683***	***-2.285***	***-3.153***	***-1.417***	***-2.367***	***-3.221***	***-1.514***
	10 / Good	***-1.389***	***-2.670***	***-0.108***	***-1.556***	***-2.707***	***-0.405***	***-1.565***	***-2.715***	***-0.414***
	10 / Very Good	-0.776	-1.588	0.036	***-0.882***	***-1.670***	***-0.093***	***-0.878***	***-1.669***	***-0.087***
	11 / Good	***-1.658***	***-3.100***	***-0.217***	***-1.883***	***-3.245***	***-0.521***	***-1.886***	***-3.244***	***-0.529***
	11 / Very Good	***-1.038***	***-1.884***	***-0.193***	***-1.136***	***-1.967***	***-0.306***	***-1.136***	***-1.964***	***-0.308***
	12 / Good	-1.267	-2.948	0.414	***-1.681***	***-3.353***	***-0.009***	***-1.673***	***-3.340***	***-0.007***
	12 / Very Good	***-1.624***	***-2.542***	***-0.706***	***-1.736***	***-2.645***	***-0.826***	***-1.733***	***-2.648***	***-0.818***

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRF, self-rated function.

Table 9A: The association between baseline self-rated health and subsequent instrumental activities of daily living with time interactions in the analytic sample (n=549)

Parameter	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
Intercept		***13.645***	***11.979***	***15.312***	***3.292***	***1.680***	***4.905***	***3.260***	***1.637***	***4.884***
	Poor	***-1.924***	***-2.764***	***-1.083***	***-0.748***	***-1.307***	***-0.190***	***-0.740***	***-1.293***	***-0.187***
Baseline SRH	Fair	***-0.823***	***-1.208***	***-0.438***	***-0.342***	***-0.613***	***-0.070***	***-0.340***	***-0.608***	***-0.071***
(vs. Excellent)	Good	***-0.406***	***-0.660***	***-0.152***	***-0.233***	***-0.440***	***-0.027***	***-0.229***	***-0.434***	***-0.025***
	Very Good	***-0.234***	***-0.464***	***-0.004***	***-0.236***	***-0.429***	***-0.044***	***-0.234***	***-0.425***	***-0.043***
Baseline Age		***-0.113***	***-0.133***	***-0.092***	***-0.056***	***-0.072***	***-0.039***	***-0.055***	***-0.072***	***-0.038***
	2	***-0.310***	***-0.521***	***-0.098***	***-0.310***	***-0.521***	***-0.098***	***-0.310***	***-0.521***	***-0.098***
	3	***-0.222***	***-0.440***	***-0.003***	***-0.236***	***-0.444***	***-0.028***	***-0.237***	***-0.445***	***-0.029***
	4	***-0.672***	***-0.995***	***-0.348***	***-0.671***	***-0.973***	***-0.368***	***-0.670***	***-0.972***	***-0.368***
	5	***-0.521***	***-0.866***	***-0.176***	***-0.709***	***-1.028***	***-0.390***	***-0.709***	***-1.028***	***-0.390***
Timepoint	6	***-0.710***	***-1.107***	***-0.313***	***-0.901***	***-1.271***	***-0.531***	***-0.902***	***-1.272***	***-0.532***
	7	***-0.751***	***-1.138***	***-0.365***	***-0.963***	***-1.319***	***-0.608***	***-0.965***	***-1.320***	***-0.609***
(vs. Timepoint 1)	8	***-1.196***	***-1.728***	***-0.664***	***-1.442***	***-1.946***	***-0.939***	***-1.444***	***-1.948***	***-0.941***
	9	***-1.293***	***-1.911***	***-0.675***	***-1.548***	***-2.145***	***-0.951***	***-1.551***	***-2.148***	***-0.953***
	10	***-1.373***	***-1.969***	***-0.777***	***-1.654***	***-2.237***	***-1.071***	***-1.657***	***-2.240***	***-1.075***
	11	***-1.128***	***-1.771***	***-0.486***	***-1.415***	***-2.038***	***-0.792***	***-1.419***	***-2.043***	***-0.795***
	12	***-1.382***	***-2.135***	***-0.630***	***-1.693***	***-2.454***	***-0.932***	***-1.700***	***-2.462***	***-0.938***
Baseline MMSE					***0.212***	***0.193***	***0.231***	***0.212***	***0.194***	***0.230***
Occupation	Domestic Worker				-0.369	-0.905	0.166	-0.298	-0.627	0.030
(vs. Teacher)	Nurses Aid/Other				***-0.734***	***-1.377***	***-0.090***	***-0.683***	***-1.213***	***-0.153***
Education	< High School				0.089	-0.456	0.634			
(vs. ≥ Masters	High School				-0.061	-0.488	0.366			
Degree)	Bachelors Degree				0.017	-0.159	0.192			
Place of Birth (vs. US Born)	Not US Born				0.047	-0.313	0.406			
	2 / Poor	-0.306	-0.891	0.279	-0.306	-0.891	0.279	-0.306	-0.891	0.279
	2 / Fair	-0.062	-0.371	0.246	-0.062	-0.371	0.246	-0.062	-0.371	0.246
	2 / Good	-0.140	-0.411	0.131	-0.140	-0.411	0.131	-0.140	-0.411	0.131
*Timepoint * SRH*	2 / Very Good	0.004	-0.246	0.253	0.004	-0.246	0.253	0.004	-0.246	0.253
(vs. Timepoint 1 and	3 / Poor	0.383	-0.480	1.245	0.162	-0.466	0.790	0.162	-0.464	0.787
Excellent SRH)	3 / Fair	-0.010	-0.463	0.443	-0.249	-0.638	0.141	-0.246	-0.634	0.143
	3 / Good	-0.244	-0.525	0.037	***-0.273***	***-0.541***	***-0.004***	***-0.271***	***-0.539***	***-0.003***
	3 / Very Good	-0.169	-0.437	0.099	-0.161	-0.416	0.095	-0.160	-0.415	0.096
	4 / Poor	0.787	-0.236	1.809	0.238	-0.462	0.938	0.236	-0.462	0.935

Parameter	Level	Base Model			Full Model			Reduced Model		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
*Timepoint * SRH (vs. Timepoint 1 and Excellent SRH)*	4 / Fair	0.385	-0.176	0.947	-0.021	-0.497	0.455	-0.021	-0.496	0.454
	4 / Good	-0.187	-0.616	0.243	-0.252	-0.660	0.156	-0.251	-0.658	0.156
	4 / Very Good	0.140	-0.245	0.526	0.026	-0.332	0.383	0.025	-0.332	0.382
	5 / Poor	0.859	-0.320	2.039	0.122	-0.807	1.051	0.121	-0.806	1.049
	5 / Fair	0.334	-0.248	0.916	-0.072	-0.575	0.431	-0.070	-0.573	0.432
	5 / Good	-0.255	-0.716	0.205	-0.166	-0.592	0.259	-0.164	-0.590	0.261
	5 / Very Good	-0.225	-0.654	0.204	-0.172	-0.568	0.224	-0.172	-0.567	0.223
	6 / Poor	0.560	-0.867	1.987	0.044	-1.025	1.113	0.044	-1.026	1.113
	6 / Fair	-0.003	-0.624	0.618	-0.409	-0.960	0.141	-0.407	-0.956	0.142
	6 / Good	-0.224	-0.758	0.311	-0.180	-0.679	0.320	-0.175	-0.674	0.325
	6 / Very Good	-0.155	-0.650	0.340	-0.155	-0.614	0.304	-0.152	-0.610	0.305
	7 / Poor	0.734	-0.967	2.435	0.192	-1.021	1.405	0.189	-1.025	1.402
	7 / Fair	-0.088	-0.854	0.678	-0.411	-1.104	0.281	-0.409	-1.099	0.280
	7 / Good	-0.265	-0.857	0.327	-0.295	-0.849	0.258	-0.289	-0.842	0.264
	7 / Very Good	-0.284	-0.799	0.232	-0.274	-0.747	0.201	-0.269	-0.742	0.204
	8 / Poor	1.512	-1.186	4.209	1.004	-1.223	3.231	1.001	-1.228	3.230
	8 / Fair	0.975	0.104	1.846	0.689	-0.098	1.475	0.695	-0.089	1.479
	8 / Good	0.070	-0.661	0.800	0.058	-0.628	0.744	0.064	-0.624	0.752
	8 / Very Good	0.125	-0.529	0.779	0.162	-0.452	0.776	0.168	-0.445	0.781
	9 / Poor	-0.391	-2.737	1.955	-0.890	-3.002	1.222	-0.892	-3.007	1.223
	9 / Fair	0.715	-0.364	1.795	0.495	-0.453	1.443	0.493	-0.455	1.440
	9 / Good	-0.136	-0.983	0.710	-0.141	-0.955	0.673	-0.132	-0.945	0.681
	9 / Very Good	0.416	-0.333	1.165	0.489	-0.217	1.196	0.498	-0.208	1.203
	10 / Poor	***-1.725***	***-2.741***	***-0.708***	***-1.515***	***-2.313***	***-0.717***	***-1.523***	***-2.311***	***-0.735***
	10 / Fair	0.051	-0.969	1.072	-0.146	-1.067	0.775	-0.152	-1.067	0.764
	10 / Good	-0.153	-0.977	0.671	-0.129	-0.913	0.654	-0.121	-0.904	0.661
	10 / Very Good	0.391	-0.345	1.126	0.414	-0.297	1.126	0.423	-0.287	1.132
	11 / Poor	***-1.970***	***-3.015***	***-0.924***	***-1.754***	***-2.587***	***-0.922***	***-1.761***	***-2.584***	***-0.938***
	11 / Fair	-0.100	-1.726	1.527	-0.479	-2.055	1.098	-0.472	-2.049	1.105
	11 / Good	-0.129	-1.074	0.815	-0.202	-1.152	0.748	-0.191	-1.142	0.760
	11 / Very Good	0.315	-0.512	1.142	0.353	-0.438	1.143	0.361	-0.426	1.148
	12 / Fair	-0.095	-2.303	2.114	-0.502	-2.694	1.689	-0.492	-2.684	1.699
	12 / Good	-0.282	-1.262	0.698	-0.336	-1.306	0.634	-0.321	-1.292	0.650
	12 / Very Good	0.399	-0.557	1.354	0.436	-0.519	1.390	0.448	-0.508	1.404

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRH, self-rated health.

Table 9B: The association between baseline self-rated function and subsequent instrumental activities of daily living with time interactions in the analytic sample (n=549)

Parameter	Level	Base Model			Full Model			Reduced Model		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Intercept		***11.945***	***10.242***	***13.648***	***2.944***	***1.308***	***4.579***	***2.930***	***1.281***	***4.578***
	Poor	***-2.571***	***-3.434***	***-1.709***	-0.625	-1.589	0.339	-0.614	-1.570	0.342
Baseline SRF	Fair	***-1.936***	***-2.585***	***-1.287***	***-0.609***	***-1.098***	***-0.120***	***-0.612***	***-1.094***	***-0.130***
(vs. Excellent)	Good	***-0.780***	***-1.114***	***-0.447***	-0.185	-0.415	0.044	-0.182	-0.409	0.045
	Very Good	***-0.401***	***-0.588***	***-0.215***	-0.142	-0.295	0.012	-0.137	-0.285	0.011
Baseline Age		***-0.092***	***-0.113***	***-0.071***	***-0.050***	***-0.067***	***-0.033***	***-0.050***	***-0.067***	***-0.032***
	2	***-0.295***	***-0.413***	***-0.176***	***-0.295***	***-0.413***	***-0.176***	***-0.295***	***-0.413***	***-0.176***
	3	***-0.390***	***-0.518***	***-0.262***	***-0.393***	***-0.519***	***-0.267***	***-0.394***	***-0.519***	***-0.268***
	4	***-0.608***	***-0.776***	***-0.441***	***-0.643***	***-0.806***	***-0.480***	***-0.643***	***-0.806***	***-0.480***
	5	***-0.711***	***-0.916***	***-0.505***	***-0.805***	***-1.002***	***-0.608***	***-0.805***	***-1.002***	***-0.608***
Timepoint	6	***-0.792***	***-1.027***	***-0.557***	***-0.914***	***-1.136***	***-0.692***	***-0.914***	***-1.137***	***-0.692***
	7	***-0.923***	***-1.183***	***-0.664***	***-1.044***	***-1.289***	***-0.798***	***-1.043***	***-1.287***	***-0.798***
(vs. Timepoint 1)	8	***-1.086***	***-1.391***	***-0.781***	***-1.248***	***-1.543***	***-0.953***	***-1.246***	***-1.540***	***-0.952***
	9	***-1.069***	***-1.413***	***-0.726***	***-1.240***	***-1.572***	***-0.907***	***-1.238***	***-1.570***	***-0.907***
	10	***-1.143***	***-1.480***	***-0.807***	***-1.322***	***-1.650***	***-0.993***	***-1.320***	***-1.648***	***-0.992***
	11	***-0.997***	***-1.409***	***-0.584***	***-1.189***	***-1.590***	***-0.787***	***-1.188***	***-1.590***	***-0.786***
	12	***-1.149***	***-1.583***	***-0.715***	***-1.354***	***-1.784***	***-0.924***	***-1.354***	***-1.783***	***-0.924***
Baseline MMSE					***0.203***	***0.184***	***0.223***	***0.203***	***0.184***	***0.222***
Occupation	Domestic Worker				-0.176	-0.688	0.336	-0.202	-0.525	0.121
(vs. Teacher)	Nurses Aid/Other				***-0.708***	***-1.382***	***-0.034***	***-0.719***	***-1.287***	***-0.150***
Education	< High School				-0.031	-0.557	0.495			
(vs. ≥ Masters	High School				-0.069	-0.509	0.371			
Degree)	Bachelors Degree				0.022	-0.156	0.200			
Place of Birth (vs. US Born)	Not US Born				0.073	-0.310	0.456			
	2 / Poor	-0.205	-0.709	0.299	-0.205	-0.709	0.299	-0.205	-0.709	0.299
	2 / Fair	-0.326	-0.753	0.101	-0.326	-0.753	0.101	-0.326	-0.753	0.101
	2 / Good	-0.122	-0.411	0.167	-0.122	-0.411	0.167	-0.122	-0.411	0.167
*Timepoint * SRF*	2 / Very Good	-0.104	-0.298	0.089	-0.104	-0.298	0.089	-0.104	-0.298	0.089
(vs. Timepoint 1 and	3 / Poor	-0.734	-1.645	0.177	-0.089	-1.254	1.077	-0.103	-1.269	1.064
Excellent SRF)	3 / Fair	-0.094	-0.689	0.501	-0.358	-0.855	0.139	-0.357	-0.854	0.140
	3 / Good	0.125	-0.234	0.484	0.019	-0.297	0.335	0.017	-0.298	0.332
	3 / Very Good	0.043	-0.177	0.263	-0.011	-0.223	0.200	-0.010	-0.221	0.201
	4 / Poor	***-1.182***	***-2.049***	***-0.315***	***-1.615***	***-2.583***	***-0.646***	***-1.638***	***-2.597***	***-0.678***

Parameter	Level	Base Model			Full Model			Reduced Model		
		Estimate	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*		*Estimate*	*95% Confidence Limits*	
*Timepoint * SRF (vs. Timepoint 1 and Excellent SRF)*	4 / Fair	0.138	-0.595	0.870	0.036	-0.442	0.515	0.032	-0.445	0.508
	4 / Good	-0.089	-0.545	0.366	-0.211	-0.621	0.200	-0.214	-0.622	0.195
	4 / Very Good	-0.100	-0.435	0.236	-0.205	-0.521	0.110	-0.204	-0.519	0.111
	5 / Poor	***-1.080***	***-1.954***	***-0.205***	***-1.452***	***-2.428***	***-0.477***	***-1.475***	***-2.440***	***-0.510***
	5 / Fair	0.386	-0.509	1.280	0.131	-0.466	0.728	0.125	-0.473	0.722
	5 / Good	0.045	-0.433	0.524	-0.086	-0.503	0.332	-0.092	-0.506	0.323
	5 / Very Good	0.090	-0.290	0.469	-0.054	-0.402	0.294	-0.053	-0.401	0.296
	6 / Poor	***-0.998***	***-1.880***	***-0.116***	***-1.343***	***-2.325***	***-0.361***	***-1.366***	***-2.338***	***-0.394***
	6 / Fair	0.495	-0.726	1.715	-0.019	-0.819	0.781	-0.029	-0.829	0.772
	6 / Good	-0.197	-0.730	0.337	-0.264	-0.743	0.214	-0.269	-0.744	0.207
	6 / Very Good	-0.156	-0.583	0.270	-0.323	-0.721	0.075	-0.319	-0.718	0.079
	7 / Fair	0.257	-1.315	1.829	-0.215	-1.256	0.827	-0.225	-1.260	0.809
	7 / Good	-0.116	-0.861	0.630	-0.427	-1.067	0.212	-0.431	-1.067	0.205
	7 / Very Good	-0.128	-0.618	0.362	-0.294	-0.760	0.172	-0.292	-0.758	0.175
	8 / Fair	1.475	-0.377	3.327	0.891	-0.141	1.922	0.877	-0.154	1.909
	8 / Good	0.269	-0.602	1.140	-0.041	-0.773	0.691	-0.047	-0.777	0.683
	8 / Very Good	-0.046	-0.611	0.519	-0.112	-0.642	0.419	-0.111	-0.642	0.420
	9 / Fair	0.598	-1.939	3.134	0.608	-0.744	1.959	0.575	-0.761	1.911
	9 / Good	0.145	-0.871	1.160	-0.086	-0.950	0.778	-0.091	-0.953	0.772
	9 / Very Good	-0.302	-0.961	0.357	-0.355	-0.973	0.263	-0.352	-0.970	0.266
	10 / Fair	1.223	-0.992	3.439	0.644	-0.282	1.570	0.600	-0.301	1.501
	10 / Good	-0.432	-1.524	0.660	-0.608	-1.533	0.316	-0.613	-1.535	0.309
	10 / Very Good	-0.403	-1.059	0.253	-0.527	-1.144	0.091	-0.525	-1.144	0.094
	11 / Good	-0.276	-1.568	1.015	-0.569	-1.736	0.599	-0.571	-1.736	0.595
	11 / Very Good	-0.215	-1.020	0.589	-0.351	-1.131	0.429	-0.352	-1.133	0.430
	12 / Good	0.298	-1.630	2.225	-0.132	-1.851	1.587	-0.131	-1.847	1.585
	12 / Very Good	-0.688	-1.529	0.152	-0.834	-1.673	0.006	-0.834	-1.677	0.009

Significant values are bolded and italicized. Abbreviations: MMSE, Mini-mental State Examination; SRF, self-rated function.

5.2.3 Change in Association between Subjective Health and Subsequent Physical Function based on Measures of Subjective Health

The results summarized for research question one (see section 5.2.1) are also applicable to address research question three: "Does the association between subjective health and subsequent physical function change with measure of subjective health in older women?" The results from the GEEs presented in Tables 6 and 7 are summarized in Table 10. Across all base models, both subjective health measures (SRH and SRF) were independent significant predictors of physical function (bADLs and iADLs). In the reduced models, SRH was not a significant predictor of bADLs, although SRF was. Further, in all models, SRF was a stronger estimator of physical function than SRH; however, poor SRF was not a significant predictor of iADLs while poor SRH was (Table 10).

Further, the association of subjective health with physical function may be impacted by time effects. When considering time interaction models (Tables 8 and 9), SRH did not show significant interactions with time when predicting either bADLs (Table 8A) or iADLs (Table 9A). Further, SRF also did not have significant interactions with time when predicting iADLs (Table 9B). However, the association between SRF and bADLs was modified by timepoint (Table 8B). Therefore, it is important to take into consideration the effect of time interactions with subjective health when discussing differences in the association of subjective health and subsequent physical function based on measure of subjective health.

Table 10: Summary of GEE estimates between baseline subjective health and subsequent physical function without time interactions in the analytic sample (n=549)

Measure	*Level*	*Base Model*			*Full Model*			*Reduced Model*		
		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits		Estimate	95% Confidence Limits	
Basic Activities of Daily Living										
Baseline SRH (vs. Excellent)	Poor	***-1.561***	***-2.676***	***-0.447***	-0.755	-1.581	0.071	-0.740	-1.564	0.085
	Fair	***-0.504***	***-0.883***	***-0.125***	-0.303	-0.627	0.021	-0.295	-0.617	0.027
	Good	***-0.393***	***-0.732***	***-0.054***	-0.280	-0.573	0.013	-0.261	-0.554	0.033
	Very Good	-0.044	-0.350	0.262	-0.050	-0.307	0.208	-0.038	-0.296	0.220
Baseline SRF (vs. Excellent)	Poor	***-4.104***	***-4.541***	***-3.667***	***-2.684***	***-3.609***	***-1.760***	***-2.674***	***-3.587***	***-1.761***
	Fair	***-1.800***	***-2.518***	***-1.083***	***-0.921***	***-1.432***	***-0.411***	***-0.939***	***-1.442***	***-0.436***
	Good	***-0.921***	***-1.304***	***-0.538***	***-0.593***	***-0.920***	***-0.267***	***-0.590***	***-0.913***	***-0.267***
	Very Good	***-0.535***	***-0.771***	***-0.300***	***-0.424***	***-0.639***	***-0.210***	***-0.409***	***-0.623***	***-0.195***
Instrumental Activities of Daily Living										
Baseline SRH (vs. Excellent)	Poor	***-1.681***	***-2.762***	***-0.599***	***-0.777***	***-1.480***	***-0.075***	***-0.769***	***-1.474***	***-0.064***
	Fair	***-0.691***	***-1.053***	***-0.329***	***-0.412***	***-0.699***	***-0.125***	***-0.408***	***-0.690***	***-0.125***
	Good	***-0.547***	***-0.851***	***-0.243***	***-0.379***	***-0.629***	***-0.130***	***-0.371***	***-0.619***	***-0.124***
	Very Good	-0.227	-0.508	0.055	-0.226	-0.454	0.002	-0.221	-0.449	0.008
Baseline SRF (vs. Excellent)	Poor	***-2.905***	***-3.642***	***-2.169***	-0.971	-1.966	0.025	-0.966	-1.960	0.027
	Fair	***-1.858***	***-2.616***	***-1.099***	***-0.718***	***-1.210***	***-0.227***	***-0.724***	***-1.211***	***-0.238***
	Good	***-0.820***	***-1.194***	***-0.445***	***-0.338***	***-0.603***	***-0.073***	***-0.337***	***-0.599***	***-0.074***
	Very Good	***-0.487***	***-0.722***	***-0.252***	***-0.306***	***-0.513***	***-0.099***	***-0.300***	***-0.502***	***-0.098***

Cells which are significant are bolded and italicized.

Abbreviations: GEE, generalized estimating equations; SRF, self-rated function; SRH, self-rated health

Chapter Six: Discussion

The focus of this study was to explore the association between subjective health and subsequent physical function in older women, given the need to better predict function in the context of increased rates of disability seen in ageing populations. Briefly, the results suggested a positive dose-response between baseline subjective health and subsequent physical function. Even after adjusting for baseline age, MMSE, education, occupation and place of birth, the positive dose-response association of SRH with iADLs and of SRF with bADLs and iADLs remained significant. Further, the association between baseline SRF and subsequent bADLs was modified by time, such that the association became stronger with time. However, other associations (SRH with bADLs and iADLs, and SRF with iADLs) were not modified by time. Finally, SRF was shown to be a stronger predictor of bADLs and iADLs than was SRH. Results for research questions 1 to 3 are discussed and compared to previous literature in sections 6.1, 6.2 and 6.3, respectively.

6.1 Associations between Subjective Health and Subsequent Physical Function

This study found that generally subjective health was a significant positive predictor of physical function in older women. This is consistent with literature that has typically shown subjective health to be a significant predictor of independence in both specific individual ADLs and the total number of independent ADLs in older women (Greiner et al., 1996; Lee, 2000; Tomioka et al., 2017). Furthermore, while this association was generally significant in the current study, SRH was not a significant predictor of subsequent bADLs, which is also consistent with some literature (Idland et al., 2014). The discussion will first focus on the associations of SRH (section 6.1.1) and SRF (6.1.2) with physical function.

The current study examined independence in bADLs and iADLs as two separate measures, which has not commonly been studied. The current findings suggested that generally SRH was a stronger predictor of iADLs than bADLs, while SRF was a stronger predictor of bADLs than iADLs. (Specific differences between SRH and SRF will be discussed in section 6.3.) These findings are consistent with previous literature, which has focused on SRH and shown that SRH is a more significant predictor of iADLs than of bADLs, regardless of study variation in levels of SRH, definition of physical function disability, and study populations (Fong & Kok, 2020; Sang Hyuck Kim et al., 2017; Storeng et al., 2018). Sang Hyuck Kim et al. (2017) suggested that SRH might be a more significant predictor of iADLs than bADLs because of the higher prevalence of loss of function in iADLs than bADLs in older adults. To the author's knowledge, differences in the ability to predict iADLs vs bADLs with SRF have not been previously studied.

6.1.1 Associations Between Baseline Self-Rated Health and Subsequent Physical Function

First, the current study and those by Greiner et al. (1996) and Idland et al. (2014) suggest that SRH is not a significant predictor of bADLs in older women. Greiner et al. (1996) found that in the same population as this study, SRH was a borderline significant predictor of the number of bADLs in which independence was lost, one year from baseline. These results differ from the current study, which showed that SRH was not a significant predictor of the number of independent bADLs. However, Greiner et al. (1996) only adjusted for age and SRF, which would be similar to the results found in the base model, rather than the reduced model in this study. Although the study by Greiner et al. (1996) looked at the number of bADLs in which independence was lost and the current study examined the number of independent bADLs, both studies show positive associations between SRH and bADLs. Differences between the strength of the association in this study's base models and the models of Greiner et al. (1996) may be due to the impact of examining and

controlling for multiple follow-up timepoints. Differences in significance of associations in this study's final models and the models of Greiner et al. may be due to the additional covariates in this study compared to that of Greiner et al. The results from the current study are more consistent with those from Idland et al. (2014), who examined the association between SRH and disability in bADLs four years from baseline in a community-dwelling population of older women (n=41). They found that SRH was not a significant predictor of physical function in their crude analysis, and therefore did not include SRH in the final model. While the base model from the current study found that SRH was a significant predictor of bADLs, the sample size was much larger (n=549) and the base model adjusted for age. The current findings and those of Greiner et al. (1996) and Idland et al. (2014) appear to be broadly consistent despite study differences.

Second, both the current study and Tomioka et al. (2017) have found that SRH is a significant predictor of iADLs in older women. Tomioka et al. (2017) showed that in a population of community-dwelling adults over the age of 65, SRH was a significant predictor of independence in iADLs. They further stratified their results by sex and found that this relationship remained significant in both men and women. These results are consistent with this study, which showed that SRH remained a significant predictor of iADLs even after adjusting for covariates. Despite consistent results, there are some differences between these studies regarding measures of subjective health, length of follow-up and population characteristics. Tomioka et al. (2017) specifically looked at the impact of a four-point general SRH scale compared to a five-point peer-comparative SRH scale in the current study. Further, Tomioka et al. (2017) examined physical function at a single follow-up period of three years while the current study examined 12 follow-up periods, which span approximately 14 years. Finally, Tomioka et al. (2017) excluded participants who were not independent in all iADLs at baseline, while the current study did not

exclude participants based on level of independence in iADLs. The consistency in these findings regardless of differences in populations and measures further supports SRH as a significant predictor of iADLs in older women.

Third, the association between SRH and a combined bADL and iADL measure of physical function was found to be not significant in older women (Lee, 2000). Lee et al. (2000) showed that in a population of community-dwelling adults over the age of 70, SRH was a significant predictor of disability level using a combined score of bADLs and iADLs six years from baseline. However, when Lee (2000) stratified by sex, they showed that significance was lost for women, but not men. As Lee (2000) used a composite ADL score, it is challenging to directly compare their results with those of this study. Previous studies and this study have shown that in older women generally SRH is not a significant predictor of bADLs but is a significant predictor of iADLs (Greiner et al., 1996; Idland et al., 2014; Tomioka et al., 2017). When combining those findings with that of Lee (2000), it could be hypothesized that the association between SRH and bADLs dominated results for the composite score of bADLs and iADLs in older women, which may have led to the lack of significant findings in studies using a composite score, as seen by Lee.

6.1.2 Associations Between Baseline Self-Rated Function and Subsequent Physical Function

First, both the current study and Greiner et al. (1996) have shown that SRF was a significant predictor of bADLs in older women. Using the same population as this study, Greiner et al. (1996) found that SRF was a significant predictor of bADLs. However, there were differences in the studies. Greiner et al. (1996) examined the number of bADLs in which independence was lost while the current study examined the number of independent bADLs. Additionally, Greiner et al. (1996) studied only 1 follow-up assessment compared to the 11 follow-up assessments in the

current study. The similarity of these results regardless of study differences suggest that SRF is a significant predictor of iADLs.

Second, SRF has been shown to be a significant predictor of a combined bADL and iADL measure of physical function in older women (Lee, 2000). Lee et al. (2000) showed that in a population of community-dwelling adults over the age of 70, general SRF was a significant predictor of disability level six years from baseline. This association remained significant in women, but not men (Lee, 2000). As Lee (2000) used a composite ADL score, it is challenging to directly compare studies; however, their results are broadly consistent with the current findings. Combining the findings from Greiner et al. (1996) and Lee et al. (2000) with the current study suggests that generally SRF is a significant predictor of bADLs and iADLs in older women.

6.1.3 Additional Findings in the Association Between Subjective Health and Subsequent Physical Function

In addition to examining the overall association between subjective health and physical function in older women, this study suggests that there is a dose-response between subjective health and physical function, consistent with previous literature (Idler et al., 2000; Idler & Kasl, 1995; Sang Hyuck Kim et al., 2017; Lee, 2000). The evidence of a dose-response is important because it suggests that there are meaningful impacts of the different levels of subjective health on an individual's subsequent physical function. Therefore, when examining the impact of subjective health on subsequent physical function it may be useful to assess levels of subjective health rather than using a dichotomous measure.

Finally, the association between subjective health and physical function is also impacted by cognition. The impact of baseline MMSE score on the association between baseline subjective health and subsequent physical function observed in this study is not unexpected as cognition is

known to be associated with both subjective health (Farias et al., 2005; Waldorff et al., 2010) and physical function (Cress et al., 1995; Hoeymans et al., 1997). Further, it has been shown that both baseline MMSE and subjective health are independent significant predictors of subsequent physical function while taking the other measure into account (Fujiwara et al., 2008). Fujiwara et al. (2008) found that SRH was a significant predictor of iADLs; however, the association weakened when considering additional covariates including baseline MMSE. Additional research is needed to determine whether cognition confounds, moderates or mediates the association between subjective health and physical function; however, that is beyond the scope of this study and further exploration is left for future work.

6.2 Change in Association Between Subjective Health and Subsequent Physical Function with Time

Although other studies examining subjective health as a predictor of physical function have not examined the impact of time on physical function, this study's findings that physical function decreases with both time and age was not unexpected. This is consistent with literature that shows that increased age is associated with decreased levels of physical function (Alcock et al., 2015; Berlau et al., 2009). Further, age has been shown to be a significant confounder in associations between subjective health and subsequent physical function (Fujiwara et al., 2008; Hirosaki et al., 2017; Idler et al., 2000; Idler & Kasl, 1995; Kempen et al., 2006; Nogueira et al., 2010). It is important to remember that although physical function decreases with time as individuals age, this effect is distinct from the question of whether the association between subjective health and physical function changes with time.

First, previous literature has not examined time from baseline as an effect modifier of the association between baseline subjective health and subsequent physical function. However, two

studies have explored this relationship at more than one follow-up timepoint (Femia et al., 1997; Idler & Kasl, 1995). This makes it challenging to compare previous findings with those from this study, which found that the association between SRF and bADLs was modified by time, although other associations between subjective health and physical function were not. Both Femia et al. (1997) and Idler & Kasl (1995) studied SRH as a predictor of stability in independence using a composite score of bADLs and iADLs. Femia et al. (1997) found that SRH was a significant predictor of physical function at two years but not four, while Idler et al. (1995) found that SRH remained a significant predictor of decline in physical function at one, two, four and six years. Specifically, Idler & Kasl (1995) showed that at each follow-up timepoint, SRH showed a dose-response with decline in physical function, with increasingly lower levels of SRH associated with correspondingly greater declines. These associations became stronger and more significant at later follow-up timepoints compared to earlier ones.

The results by Femia et al. (1997) and Idler & Kasl (1995) are inconsistent, which may be due to differences in population size and age of participants. At the final timepoint assessments, Femia et al. (1997) studied 89 adults aged 84 to 90 compared to 1455 adults aged 65 to 99 by Idler & Kasl (1995). The opposite direction of their findings could be due to that small sample in the final timepoint in the study by Femia et al. (1997), which may not have had sufficient power to detect the effect of SRH on physical function. Additionally, differences could have arisen due to the wider age range used by Idler & Kasl (1995) than by Femia et al. (1997), as the association between subjective health and physical function appears to be stronger in younger adults (aged 65-75) than older adults (aged 75-96) (Tomioka et al., 2017).

Further, the results by Femia et al. (1997) and Ilder & Kasl (1995) differ from those of the current study. This could be caused by differences in measures of physical function, inclusion of

both men and women in the study population, or analytic methods. Both studies suggested that time from baseline impacts the significance of the association between SRH and physical function (Femia et al., 1997; Idler & Kasl, 1995); however, the current study's findings suggest that SRH as a predictor of either bADLs or iADLs is not modified by time. Femia et al. (1997) and Idler & Kasl (1995) used a composite physical function score while the current study examined bADLs and iADLs separately. The use of a composite score may modify the effect of time, as this study found that the patterns of SRH as a predictor of physical function varied by measure of physical function. Further, these differences could have arisen from sex/gender differences, as these terms have been used inconsistently in the literature. Analyses in both Femia et al. (1997) and Idler & Kasl (1995) were not stratified by sex although their study populations included both men and women. In contrast, this study examined only women. The results reported by Femia et al. (1997) and Idler & Kasl (1995) may have been modified by sex, as the association between subjective health and subsequent physical function appears to differ in men and women (Lee, 2000; Tomioka et al., 2017). A final explanation for the inconsistent findings between the current study and those from both Femia et al. (1997) and Ilder & Kasl (1995) is that those studies assessed the association between subjective health and physical function stratified by time, whereas the current study examined time as an effect modifier.

To the author's knowledge, no previous studies have specifically examined the impact of time on the association between SRF and physical function. This study has shown that SRF as a predictor of bADLs is modified by time in older women, even after adjusting for covariates. Idler & Kasl (1995) showed that there was a positive dose-response between SRH and subsequent physical function, and that the relationship strengthened and was more likely to be significant with time. The effect with time seen by Idler & Kasl (1995) for SRH and a combined iADL/bADL

score is similar to that seen with time in the association between SRF and bADLs in the current study.

While it is not clear why the association between SRF and bADLs becomes stronger with time, it is an interesting phenomenon to consider. SRF could be a more sensitive measure of function than the objective, performance-based measure of bADLs: individuals with worse SRF could thus be recognizing a small decline in function that takes time to develop to the point that it is reflected in objective measures. As physical function declines with age and time (Alcock et al., 2015; Brown et al., 2017), it would be logical that baseline SRF is able to capture an early small change which is predictive of future decline with time. Further, due to the cognitive component of iADLs compared to bADLs, iADLs typically decline faster than bADLs in older adults (Brown et al., 2017). Therefore, the stronger association between SRF and bADLs than between SRF and iADLs could be in part due to the speed in which independence in these measures declines, specifically, the delayed decline of bADLs. More research is needed that examines bADLs and iADLs separately when investigating time as an effect modifier of the association of SRF with physical function.

Second, although this study showed that the effect of time as a modifier of the association between subjective health and physical function was dependent on the measure of subjective health and physical function, this study also suggested that subjective health is a significant predictor of physical function across long follow-up periods. This is consistent with literature that has shown subjective health to be a predictor of subsequent physical function at one year (Greiner et al., 1996), two years (Femia et al., 1997; Fujiwara et al., 2008; Sang Hyuck Kim et al., 2017), three years (Hirosaki et al., 2017; Tomioka et al., 2017), six years (Idler & Kasl, 1995; Kaplan et al., 1993; Lee, 2000), eight years (Kempen et al., 2006), ten years (Idler et al., 2000) and eleven years

(Storeng et al., 2018) from baseline. Although it is hard to compare the effect sizes between studies because of differences in measures and analyses, these studies support the results found in the current study that subjective health can be used as a predictor of subsequent physical function across over a decade of follow-up in older women. Thus, subjective health can be used to predict who may be at greater risk of decline in bADLs or iADLs over a large span of time.

6.3 Change in Association Between Subjective Health and Subsequent Physical Function Based on Measures of Subjective Health

The finding of this study that SRF was a stronger predictor of physical function than SRH is consistent with previous literature. It has been shown that SRF is a stronger predictor than SRH in subsequent bADLs (Greiner et al., 1996) and a combined bADL and iADL measure (Lee, 2000). Greiner et al. (1996) showed that in older women, SRH was a borderline significant predictor of bADLs while SRF was a stronger significant predictor of bADLs. Further, Lee (2000) showed that SRF, but not SRH, was a significant predictor of decline in a combined measure of bADLs and iADLs in older women. The results from these two studies and the current study show that there is a difference in the association between subjective health and physical function based on the measure of subjective health (Greiner et al., 1996; Lee, 2000). These results suggest that in addition to assessing SRH in older women as an indirect method of examining overall health, SRF, a less common measure of subjective health, should also be assessed, as SRF appears to be more strongly associated with physical function than SRH.

Further, to the author's knowledge, there have not been any studies that examined the association of subjective health and subsequent physical function where SRH, SRF, bADLs and iADLs have all been assessed separately. This study has shown that SRH is a significant predictor of iADLs but not bADLs, while SRF is a stronger predictor of bADLs than iADLs. These

differences may suggest that older women measure their health more broadly on daily capabilities, such as the ability to go shopping, while they measure their function on more narrow self-care activities. It would be useful to explore in further studies the implications of SRH and SRF in different populations and with additional measures of physical function.

Finally, it is important to note that this study found significant associations between subjective health and physical function using measures of peer-comparative subjective health. As noted previously, peer-comparative subjective health is prone to bias, with individuals tending to rate their health as better than their peers (Vuorisalmi et al., 2006). Further, the association between subjective health and physical function has been reported as stronger for measures of general subjective health than peer-comparative subjective health (Vuorisalmi et al., 2006). Thus, the current study may have shown even stronger relationships between subjective health and physical function if measures of general subjective health were used. The importance of the specific measures of subjective health investigated is supported by the different results found for SRH and SRF in this study.

6.4 Strengths, Limitations and Mitigation Strategies

6.4.1 Strengths

A major strength of the study was the advancement of analytic methods within the field of study to examine subjective health and physical function using longitudinal analysis developed for populations with high mortality rates. This design is important in the study of longitudinal associations in older populations, where mortality rates are likely to be high. Further, this analysis has addressed gaps in the literature surrounding whether subjective health is a significant predictor of physical function in older adults at different time points and how those associations change with time, as previous literature did not account for repeated measures.

An additional strength of the current study is the measures used. The current study expanded on previous literature by including both SRH and SRF as measures of subjective health. This is important because while it is known that the frame of reference for subjective health has implications for health and wellbeing in older adults, this has not been well studied in the literature on physical function. Additionally, this study examined both bADLs and iADLs independently from each other, and these have not been commonly studied as independent outcomes of subjective health. Further, measures of ADLs were performance-based rather than self-reported. Performance-based measures provide insight into an individual's actual physical function, which is not always accurately represented by self-report. Finally, this study spanned approximately 14 years, which extended the previous follow-up periods that examined subjective health as a predictor of physical function.

A final major strength of the study is the population, specifically the lack of attrition and the homogeneity of the study sample. The Nun Study has a long follow-up period with low attrition aside from mortality. In longitudinal studies with long follow-up periods, dropout rates are typically higher than in the Nun Study. Further, it was seen that the impact of dropout was not significantly related to the variables of interest in this study. Additionally, participants have very similar lifestyles, diets, levels of social engagement, religious activities, etc. Therefore, unlike other studies, many potential confounders of the relationship between subjective health and physical function are inherently controlled for through restriction.

6.4.2 Limitations and Mitigation Strategies

A parallel limitation to the strength of the homogeneous sample is generalizability. This study analyzed a special population of older religious sisters. As such, the results of this study may not be generalizable to other populations, who may have different characteristics and lifestyles.

For example, in this study all participants were women with high levels of engagement with life, which may affect the association between subjective health and physical function. While the effect of sex and level of engagement with life cannot examined, their effects were controlled for in this study by the restricted sample.

A second limitation of this study is the inability to study or control for the effect of depression. Data on depression were not collected in the Nun Study, and therefore cannot be examined in this population. However, previous literature has not consistently shown a significant impact of depression on the relationship between subjective health and physical function.

Finally, the Nun Study participants had a high mortality rate, as would be expected in a sample comprised of older women 75 years of age and older. Only 13% of participants who were alive at assessment 2 survived to assessment 12. This resulted in a much smaller population at final assessment and may have introduced attrition bias, as individuals who do not survive to later follow-up time points are more likely to have worse physical function. This was addressed with an analytic plan that was conditional on survival at each timepoint.

6.5 Implications and Future Directions

The results from this study are supported by previous evidence of a positive dose-response relationship between subjective health and subsequent physical function in older women. The findings from this study have implications for health researchers and for clinicians. Given the strength and significance of the association of SRF with bADLs and iADLs, SRF should be assessed in addition to the more standard SRH measure when clinicians are examining the health of older adults. Further, measures of SRH and SRF could be used to help identify populations at risk for decline in physical function in order to develop and implement interventions to maintain level of independence and prevent decline in physical function. Further, as physical function is

associated with quality of life and level of independence, knowledge of subjective health could be used to inform projections of future care needs. Finally, this study suggests that older adults should value their own assessment of their health and function, and advocate for care and treatment based on these subjective assessments, given the association between poor subjective health and decline in independence in bADLs and iADLs. Therefore, this study's findings have specific implications for the health and well-being of older adults.

An important area of future research is to expand the generalizability of this study. Examining the impact of multiple cultures, genders and lifestyles on subjective health as a predictor of both physical and cognitive function while adjusting for additional covariates would improve generalizability and potentially further highlight the importance of subjective health. In addition to expanding the diversity of study populations, it would be beneficial to assess additional covariates that may modify, mediate or confound the association between subjective health and subsequent physical function, such as engagement with life, depression, health conditions and cognition. Further research on time as an effect modifier between subjective health and physical function as well as the differences seen in measures of subjective health in other populations would be useful to confirm the findings of this study.

Future research could build on the current research by examining the reciprocal impact of subjective health and physical function on each other. Currently, research has either studied subjective health as a predictor of physical function or physical function as a predictor of subjective health, but has not ascertained whether this association is uni- or bi-directional. Such studies would help to clarify the direction of association between subjective health and physical function, and deepen the understanding of subjective health measures and their relationship to physical function in older adults.

6.6 Conclusion

With ageing populations, it is increasingly important to understand the changes in health and well-being that occur in older adults. As individuals age, they experience higher levels of disease and disability; however, it appears that older adults place a higher emphasis on functional limitations than disease when considering their health. Therefore, it is important to research factors associated with functional limitations and decline in older adults. As such, examining the association of subjective health, a non-invasive quick measure, on subsequent physical function may have implications in supporting the health of older adults. By studying measures of subjective health as a predictor of physical function using a longitudinal analysis, this study contributes to an understanding of how the association between subjective health and subsequent physical function changes with time and with the measure of subjective health. Both SRH and SRF should be assessed in older adults as they have unique and distinct associations with subsequent physical function. These associations could be used to develop care plans aimed at maintaining levels of independence in physical function in populations at risk for decline in physical function, as well as to predict future levels of health care that will be required. In conclusion, subjective health is an important tool for assessing physical function in older women and can be used to support their health and wellbeing.

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Appendix A: Systematic Literature Search Strategy

Table A1: Literature search strategy

Concept	***Self rated health/function***	***Functional Ability***	***Older Adults***
Author Keywords:	Self rated health Self rated function Subjective health Subjective function Perceived health Perceived function	Functional ability (CINAHL)/ Functional abilit* (PubMed) Activities of daily living Daily function* Everyday function* Functional improvement* Functional decline ADL iADL	Elderly Old old Old adult* Older adult* Geriatric* Aged adult* Aged Population*
PubMed MeSH	Self concept Self report Diagnostic self evaluation Self-assessment	Activities of daily living	Aged
CINAHL Major Subject Heading	Self reported Self assessment Self evaluation Health status	Activities of daily living Functional status	Aged Aged, 80 and over

All keywords were included in both PubMed and CINAHL searches. In PubMed an * was used to identify keywords that may have been truncated and could be expanded. For example, the keyword "functional abilit*" will return results for both functional ability and functional abilities.

Overall search strategy: #1 AND #2 AND #3

PubMed:

1. ("self rated health"[All Fields] OR "self rated function"[All Fields] OR "subjective health"[All Fields] OR "subjective function"[All Fields] OR "perceived health"[All Fields] OR "perceived function"[All Fields] OR "self concept"[MeSH Terms] OR "self report"[MeSH Terms] OR "diagnostic self evaluation"[MeSH Terms] OR "self-assessment*"[MeSH Terms])
2. ("functional abilit*"[All Fields] OR "activities of daily living"[All Fields] OR "daily function*"[All Fields] OR "everyday function*"[All Fields] OR "functional improvement*"[All Fields] OR "functional decline"[All Fields] OR "IADL"[all fields] OR "ADL"[all fields] OR "activities of daily living"[MeSH Terms])
3. ("elderly"[All Fields] OR "old old"[All Fields] OR "old adult*"[All Fields] OR "older adult*"[All Fields] OR "geriatric*"[All Fields] OR "Aged adult*"[All fields] OR "Aged population*"[All fields] OR "Aged"[MeSH Terms])

CINAHL

1. ((self rated health OR self rated function OR subjective health OR subjective function OR perceived function OR perceived health) OR MJ (self report OR self assessment OR self evaluation OR health status))
2. ((functional ability OR activities of daily living OR daily function OR everyday function OR functional improvement OR functional decline) OR MJ (activities of daily living OR functional status))
3. ((elderly OR old old OR old adult OR older adult OR geriatric OR aged adult OR aged population OR aged) OR MJ (aged OR aged, 80 and over))

Search performed July 2020 and updated in November 2020. A total of 7087 articles were retrieved.

Appendix B: Summary of Literature Search Results

Study	*Population and Study Design*	*Exposure (Subjective Health) and Covariates*	*Outcome (Physical Function)*	*Analysis*	*Results*
Cross-Sectional Studies					
Ailinger (1989) Self-assessed health of Hispanic elderly persons	This population includes 152 Hispanic community-dwelling older (55+) adults. Data was collected via home interviews.	Subjective health was measured through the subjective health assessment score. Covariates include age, education and income.	Physical function was measured through self-report of instrumental dimension and physical dimension of the ADLs scale.	Correlations of subjective health and covariates with physical function were calculated.	Education is a significant predictor of subjective health. Income, education and age were all significant predictors of iADLs, although none were significant predictors of physical ADLs. Subjective health was not significantly correlated with either physical ADLs or iADLs.
Gama et al. (2000) Association of individual activities of daily living with self-rated health in older people	This population includes 781 community-dwelling, older adults (65+) from rural Spain.	Subjective health was measured through global SRH. Covariates include age and sex.	Physical function was a measure of participants' ability to perform individual bADLs and iADLs.	Logistic regressions were used to determine the associations between subjective health and individual bADLs and iADLs.	Subjective health was a significant predictor of 15 out of 17 individual bADLs and iADLs.
Nogueira et al. (2010) Determinant factors of functional status among the oldest old	This population includes 129 non-institutionalized older (80+) adults from urban Brazil. Data was collected using questionnaires.	Subjective health was measured through general and comparative SRH. Covariates include age, sex, marital status, education,	Physical function was derived from 40 questions concerning ADLs and iADLs. Physical function was dichotomized into	A multiple logistic regression with hierarchical selection was used to determine the association of subjective health and	Worse subjective health was significant predictor of worse physical function (OR: 4.26, 1.55-11.69) when examined alone.

		number of medications, disease, depression, falls, self-rated vision, self-rated hearing, social relations and religions status.	better and worse function.	covariates with physical function.	After adjusting for covariates worse subjective health remained a significant predictor of worse physical function (OR: 4.40, 1.09-17.76)
Sebastiao (2016) Perceived poor health is positively associated with physical limitations and chronic disease in Brazilian nonagenarians and centenarians	This population included 819 older (90+) adults from the 2008 Brazilian Household Survey. Data was collected through in-person interviews.	Subjective health was measured through global SRH and dichotomized into good (very good and good) and poor (fair, poor and very poor). Covariates include age, sex, education, race, and health conditions.	Physical function was measured with self-report ability to perform eight ADLs.	For each ADL, a logistic regression was used to determine the association between subjective health and physical function.	For six of eight ADLs poor subjective health was a significant predictor of difficulties in performing the ADL in both crude and adjusted analyses.
Longitudinal Studies					
Kaplan et al. (1993) Factors associated with change in physical functioning in the elderly: a six-year prospective study	This population includes 356 non-institutionalized older (65+) adults from the Human Population Laboratory's Alameda Country study. This study has a six-year follow-up period.	Subjective health was dichotomized into excellent perceived health and poor perceived health. Covariates include age, ethnicity, income, exercise, smoking, going out, weight, marital status, social network, depression and locus of control.	Physical function was a combined summary score from ADLs, iADLs, physical mobility, physical performance and the ability to get around. The change in function from baseline was then calculated.	Multiple regression was used to determine the association of baseline subjective health and covariates with change in physical function.	Excellent perceived health was a strong predictor against decline in physical function (-3.32, p=0.02) compared to worse subjective health prior to adjusting for chronic conditions, and borderline non-significant after adjustments (p=0.06).
Idler and Kasl (1995)	This population included 2812 older	Subjective health was measured through	Physical function was self-reported and	Multivariate regression was used	Poor SRH, compared to excellent SRH,

Self-ratings of health: do they also predict change in functional ability?	adults from the New Haven Established Populations for Epidemiologic Studies of the Elderly. This study has follow-up periods of one, two, four and six years.	SRH. Bad, poor and fair SRH were combined into one level. Covariates include age, sex, baseline physical function and chronic conditions.	measured through a combined functional disability score based on the three functional ability scales: Katz, Rosow and Breslau, and Nagi.	to determine the association between baseline subjective health and physical function at follow-up assessments. Covariates which remained significant in multiple follow-up time points remained in the models. Independent models were developed for each time point, using the surviving population.	was a significant predictor of decline in physical function for follow-up periods at one, two, four and six years, after adjusting for covariates. Good SRH, compared to excellent SRH, was not a significant predictor of decline in physical function at any follow-up period.
Greiner et al. (1996) The relationship of self-rated health and self-rated function to concurrent functional ability, functional decline and mortality: findings from the Nun Study	This population included 629 older (75+) Nuns from the Nun Study. This study has a one-year follow-up period.	Subjective health was measured through SRH and SRF. Covariates include age and MMSE.	Physical function was based on performance of six ADLs.	Cox proportional hazards regression was used to determine the association between baseline subjective health and increase in number of dependent ADLs.	SRH and SRF are correlated (0.52). Individuals with excellent SRH have on average an annual gain in 1.0 dependent ADLs while individuals with poor SRH have an average annual gain in 1.9 dependent ADLs. For SRF, those with excellent have an average gain of 0.9 dependent ADLs compared to an annual gain of 3.2 dependent ADLs in those with poor SRF.

Femia et al. (1997) Predicting change in activities of daily living: a longitudinal study of the oldest old in Sweden	This population includes 400 individuals (aged 84, 86, 88 & 90) from the OCTO study. This study has a two- and a four-year follow-up period. Study size was reduced to 147 and 95 from the first to second follow-up period.	Subjective health was measured through a global health assessment using a seven-point Likert scale. Covariates include age, gender, marital status, education, blood pressure, pulmonary function, pulse, grip strength, mastery and depression.	Physical function was a combined score of self-reported ADLs and iADLs. Physical function was then dichotomized into stable and decline.	The associations between baseline subjective health and change in physical function at two and four years was determined with logistic regressions. Models were made independently for two-year and four-year follow-up periods.	At a follow-up of two years good subjective health was a predictor of stable physical function (2.04, p=0.003), while this significance was lost at four years. However, the direction of association between subjective health was the same at both follow up periods.
Idler et al. (2000) Survival, functional limitations, and self-rated health in NHANES I epidemiologic follow-up study, 1992	This population includes 4136 adults aged 25-74 from the NHANES I epidemiologic follow-up study. This study has a 10-year follow-up period.	Subjective health was measured through SRH. Other covariates include age, obesity, disease of circulatory and musculoskeletal system, co-morbidities and alcohol consumption.	Physical function was measured 23 activities from the Stanford Health Assessment Questionnaire. A summary score was created for all activities.	A weighted ordinary least squares regression was used to determine the associations between subjective health and covariates with physical function. Regressions were stratified by gender.	Compared to poor subjective health, excellent subjective health had significant parameter estimates of −9.52 in males and −8.09 in females as a predictor against functional limitations at a ten-year follow-up without adjusting for baseline function. When adjusting for baseline function these associations loss significance although the direction of association remains the same.
Lee (2000)	This population included 4349	Subjective health was measured in a variety	Physical function was measured with five	For each baseline subjective health	Global health (OR1.56, 1.20-2.03),

The predictive value of self assessed general, physical and mental health on functional decline and mortality in older adults.	community-dwelling older (70+) adults from the US Longitudinal Study of Aging. This study has a six-year follow-up period. Data was collected using computer assisted telephone interviewing and mail questionnaires.	of ways. All forms of subjective health use 5-point scale. Global health, taking care of health, worry over health, control over future health, physical activity relative to peers, getting exercise, trouble remembering things and frequently getting confused were all assessed. Covariates include age, gender, race marital status, education, income, living arrangements, Medicaid insurance status, functional status, medical conditions and utilization of health services.	bADLs and six iADLs. Function was then categorized into no disability, mild disability (dependence in iADLs only), moderate disability (dependence in 1-2 ADLs) and severe disability. Additionally, change in function was categorized into decline in function and no change/stable function.	measurement, a logistic regression was used to determine the association for subjective health and change in physical function. A logistic regression was then used to determine the impact each subjective health measure had in predicting change in physical function relative to each other. Regressions were stratified by gender.	taking care of health (OR:1.67, 1.20-2.33), physical activity (OR:1.65, 1.14-2.39), getting confused (OR: 1.35, 1.09-1.66) were all independently significant baseline subjective health measures in predicting decline in physical function. In females, taking care of health, physical activity and getting confused all remained significant predictors of decline in function. Poor global health, physical activity and getting confused remained significant predictors of decline in function in males.
Kempen et al. (2006) Risk and protective factors of different functional trajectories in older persons: Are these the same?	This population includes 1765 independent older (57+) adults from the Groningen Longitudinal Aging Study. This study has an eight-year follow-up period. Data was	Subjective health was measured through the MOS Short-Form General Healthy Survey health perception subscale. Covariates include age, sex, level of education, number of chronic conditions,	Physical function was a based on a combination of 18 bADLs and iADLs. Change in physical function was recorded as substantial poorer functioning, somewhat poorer	A multinomial logistic regression was used to assess to association between baseline subjective health and covariates with change in physical function at follow-up.	Better subjective health was both a predictor of no change/improvement in function (OR: 1.02, 1.01-1.03) and protective against decline (OR: 0.99, 0.98-0.99) when examined alone.

	collected during at home or telephone interviews at baseline, and mailed questionnaires are follow-up.	depressive symptoms, social support, neuroticism, mastery and self-efficacy expectancies.	functioning and no change/improvement in functioning.		When adjusting for all covariates, good subjective health was only a significant predictor of no change/improvement in function (OR: 1.01, 1.01-1.02).
Fujiwara et al. (2008) Predictors of improvement or decline in instrumental activities of daily living among community dwelling older Japanese	This population included 1274 community-dwelling, older adults (65+) from rural Japan. This study has a two-year follow-up period.	Subjective health was measured through SRH. Covariates include age, gender, education, living status, medical variables, MMSE, depression, smoking status and drinking status.	Physical function was measured through a self-rated iADL questionnaire. Change in physical function was categorized into improvement, stability and decline.	Stepwise logistic regressions were used to determine the association between subjective health and both improvement and decline in physical function.	Good baseline subjective health is a protective factor against decline in physical function (OR 0.39, p<0.00) and a predictor of improvement in physical function (OR 2.93, P=0.001).
Idland et al. (2014) Functioning and self-rated health in the oldest old community-dwelling women: A four-year longitudinal study.	This population is derived from 41 community-dwelling older women. This study has a four-year follow-up period. Data was collected via home interviews.	Subjective health was measured through SRH. Covariates include age, living alone/with someone, and education.	Physical function was measured using the Katz ADL index via self-report. Physical function was then dichotomized into no disability and disability (dependence in one or more ADL)	Simple logistic regressions were used to determine the relationship between baseline subjective health and covariates with follow-up physical function. Significant predictors were then added into a multiple logistic regression.	Poor baseline subjective health was not a significant predictor of disability at four years (OR: 0.88, 0.43-1.76), although higher education and better MMSE scores were significant predictors of no disability.
Kim et al. (2017) Self-rated health status as a predictor	This population includes 2824 community-dwelling older (65+) adults	Subjective health was measured through global health. Covariates include	Physical function was measured through self-report of seven bADLs and ten	Multiple logistic regressions were used to determine the association between	Poor subjective health (compared to excellent subjective health) was a

of functional decline in a community-dwelling elderly population: Nationwide longitudinal survey in Korea	from the Korean Longitudinal Study of Aging. This study has a two-year follow-up period. Data was collected through computer assisted interviews.	age, sex, marital status, education, working status, alcohol consumption, smoking status, physical function and history of acute/ chronic disease	iADLs. bADL and iADL decline were defined as an impairment of at least one bADL and iADL at follow-up.	baseline subjective health and covariates with bADL decline, iADL decline as well as decline in individual bADLs and iADLs.	significant predictor of decline in bADLs (OR: 4.75, 2.12-10.66) and decline iADLs (OR: 2.81, 1.51-5.25). In addition, poor subjective health was a significant predictor of decline in each bADL and nine iADLs.
Tomioka et al. (2017) Self-rated health predicts decline in instrumental activities of daily live among high-functioning community-dwelling older people	This population includes 5984 functionally independent, community-dwelling older (65+) adults. This study has a three-year follow-up period. Data was collected through mail questionnaires.	Subjective health was measured through global SRH. Covariates include age, family structure, BMI, subjective economic status, medical conditions, number of medications, alcohol consumption, smoking consumption, depression, cognition and social participation.	Physical function was assessed through iADLs measured with the Tokyo Metropolitan Institute of Gerontology Index of Competence. Physical function was dichotomized stable and decline.	Multiple logistic regression with forced variable entry was used to determine the association between subjective health and change in physical function, stratified by gender.	Poor subjective health was a significant predictor of decline in physical function in males (Crude OR: 4.30, 2.22-8.30; Adjusted OR: 2.94, 1.41-6.13) and females (Crude OR: 6.73, 3.90-12.93; Adjusted OR: 3.05, 1.40-6.67).
Hirosaki et al. (2018) Self-rated is associated with subsequent function decline among older adults in Japan.	This population includes 654 community-dwelling older (65+) adults from Japan. This study has a	Subjective health was measured using a 100mm horizontal visual analog scale. Covariates include age, gender, marital status, living	Physical function was measured through seven bADLs. Physical function was dichotomized into fully functional or having one or more	A logistic regression was used to assess the relationship between baseline subjective health and follow-up physical function. A linear	Low baseline subjective health was a significant predictor of having one or more functional impairments at follow-up (Crude

	three-year follow-up period.	conditions, smoking status, alcohol habits, depression, and comorbidities.	functional impairments.	regression was also performed for raw physical function scores.	OR: 2.95, 1.87-4.67; Adjusted OR: 2.35, 1.27-4.36).
Storeng et al. (2018) Factors associated with basic and instrumental activities of daily living in elderly participants of a population-based survey: the Nord-Trondelag Health Study, Norway	This population includes 5050 older (aged 60-69) adults. This study has an eleven-year follow-up period. Data was collected through questionnaires and clinical examinations.	Subjective health was measured through SRH and dichotomized into poor and good. Covariates include age, gender, education, marital status and chronic illness.	Physical function was assessed through self-report of 7 bADLs and 9 iADLs. Physical function was dichotomized into no disability (fully independent) or disability (dependent in one activity or more). Physical function was not assessed at baseline.	Multinomial logistic regression was used to determine the association between subjective health and disability in bADLs and iADLs.	After adjusting for covariates poor baseline subjective health was a significant predictor of disability in bADLs (OR:2.13, 1.35-3.38) and iADLs (OR: 2.30, 1.93-2.74) at follow-up assessment.
Fong and Kok (2020) Does subjective health matter? Predicting overall and specific ADL disability incidence	This population includes 3431 non-disabled older (65+) adults from the Korean Longitudinal Study of Aging. This study has a two-year follow-up period. Data was collected through computer assisted interviews.	Subjective health was measured through SRH. Very good and good were collapsed into a reference category. Covariates include age, gender, marital status, education, place of residence, number of living children, measures of social economic status, chronic conditions, lifestyle choices, cognition and depression.	Physical function was assessed through self-report of 5 bADLs and 10 iADLs. Independence was recorded for each ADL. At the assessment follow-up period, loss of independence in at least one bADLs or iADL was recorded as decline in function.	Logistic regressions were used to determine the association between subjective health and subsequent functional decline (both decline in total bADLs and iADLs as well as individual bADLs and iADLs), while controlling for covariates.	After adjusting for covariates, bad (OR: 2.86) and very bad (OR: 4.28) SRH were significant predictors for decline in bADLs, while moderate (OR: 2.01), bad (OR: 2.45) and very bad (OR: 3.39) were significant predictors of iADLs.

Abbreviations: ADLs, activities of daily living; bADLs, basic activities in daily living; iADLs, instrumental activities of daily living; MMSE, Mini-mental State Examination; OR, odds ratio; SRF, self-rated function; SRH, self-rated health.

Appendix C: Analysis of Excluded Participants

Appendix C shows the analysis of differences between the analytic sample and the excluded sample. Table C1 provides an overview of dropout and mortality rates of the excluded sample from timepoints 1 to 12. Table C2 shows an analysis of the differences in characteristics between the analytic and excluded samples. This table shows that the excluded sample did not differ significantly in occupation or place of birth from the analytic sample. However, the excluded sample tended to be older, and have lower levels of subjective health, education and baseline MMSE in addition to being independent in fewer bADLs and iADLs than the analytic sample.

Table C3 summarizes differences between the analytic and excluded sample stratified by exclusion criteria. Similar trends exist between the overall excluded sample and the stratified excluded sample. However, individuals who were excluded due to missing baseline measures were more likely to be domestic workers than individuals in the analytic sample. Further, the excluded sample for missing follow-up data and the analytic sample did not differ significantly in level of education. Finally, Table C4 displays the analysis stratified by reason for missing follow-up data. Individuals who did not survive to the second timepoint had significantly lower baseline subjective health, baseline MMSE , baseline bADLs and baseline iADLs in addition to being older than the analytic sample. Individuals who withdrew from the study prior to the second timepoint were more educated, had higher baseline MMSE, were younger and had better baseline iADLs than the analytic sample but did not significantly differ in baseline subjective health or bADLs.

Table C1: Description of dropout and mortality in the excluded participants (n=129)

Timepoint	*Excluded from Analysis*	*Withdrew Previous/Total*	*Deceased Previous/Total*
T1	129		
T1-T2		14/14	88/88
T2	27		
T2-T3		0/14	7/95
T3	20		
T3-T4		0/14	12/107
T4	8		
T4-T5		0/14	5/112
T5	3		
T5-T6		0/14	1/113
T6	2		
T6-T7		0/14	0/113
T7	2		
T7-T8		0/14	1/114
T8	1		
T8-T9		0/14	0/114
T9	1		
T9-T10		0/14	1/115
T10	0		
T10-T11		0/14	0/115
T11	0		
T11-12		0/14	0/115
T12	0		

For each timepoint the sample size of participants who were originally excluded from the analysis is shown. Participants were excluded who were missing any of the baseline measures or a follow-up assessment.

The withdrew column represents the number of participants who withdrew between the two specified timepoints. This column also shows the total number of participants who withdrew since baseline (timepoint 1).

This deceased column represents the number of participants who died between the specified timepoints. This column also shows the total number of participants who died since baseline (timepoint 1).

Abbreviations: T, timepoint

Table C2: Summary of subjective health, physical function and covariates from timepoint 1 to 12 in the analytic sample (n=549) and excluded sample (n=129)

		Included in Analysis		***Excluded from Analysis***		***P-Value***
Categorical Variables	***Category***	***Count***	***%***	***Count***	***%***	
Baseline SRH	Excellent	85	15.48	6	7.23	**0.0002**
	Very Good	206	37.52	23	27.71	
	Good	167	30.42	31	37.35	
	Fair	78	14.21	14	15.66	
	Poor	13	2.37	9	10.81	
Baseline SRF	Excellent	252	45.90	26	32.10	**<0.0001**
	Very Good	188	34.24	19	23.46	
	Good	72	13.11	22	27.16	
	Fair	29	5.28	10	12.35	
	Poor	8	1.46	4	4.94	
Educational Attainment	< High School	47	8.56	21	16.28	**0.0432**
	High School	28	5.10	9	6.98	
	BSc	225	40.98	45	34.88	
	≥ MSc	249	45.36	54	41.86	
Occupation	Teacher	497	90.53	108	85.04	0.1819
	Domestic Worker	40	7.29	14	11.02	
	Other	12	2.19	5	3.94	
Place of Birth	US Born	514	93.62	123	95.35	0.4598
	Not US Born	35	6.38	7	4.65	
Continuous Variables		***M***	***SD***	***M***	***SD***	
Baseline Age		82.7	5.1	85.9	6.2	**<0.0001**
Baseline MMSE		26.0	4.9	16.0	12.3	**<0.0001**
bADL	Timepoint 1	4.60	1.09	2.65	2.25	**<0.0001**
	Timepoint 2	4.25	1.54	0.65	1.54	**<0.0001**
	Timepoint 3	4.21	1.56	0.75	1.62	**<0.0001**
	Timepoint 4	3.96	1.77	1.00	1.85	**<0.0001**
	Timepoint 5	3.99	1.71	0.67	1.15	**0.0037**
	Timepoint 6	3.75	1.87	1.00	1.41	**0.0467**
	Timepoint 7	3.63	1.90	0.50	0.71	**0.0401**
	Timepoint 8	3.53	1.97	0.00	N/A	0.1229
	Timepoint 9	3.54	2.05	0.00	N/A	0.1259
	Timepoint 10	3.56	1.97	N/A	N/A	N/A
	Timepoint 11	3.62	1.91	N/A	N/A	N/A
	Timepoint 12	3.40	1.91	N/A	N/A	N/A
iADL	Timepoint 1	3.96	1.26	2.39	2.09	**<0.0001**
	Timepoint 2	3.59	1.56	0.27	0.72	**<0.0001**
	Timepoint 3	3.65	1.49	0.35	0.98	**<0.0001**
	Timepoint 4	3.45	1.67	0.63	1.06	**<0.0001**
	Timepoint 5	3.48	1.64	0.00	0.00	**0.0049**
	Timepoint 6	3.34	1.64	0.00	0.00	**0.0223**
	Timepoint 7	3.30	1.70	0.00	0.00	**0.0259**
	Timepoint 8	3.27	1.73	0.00	N/A	0.1191
	Timepoint 9	3.23	1.84	0.00	N/A	0.1346
	Timepoint 10	3.10	1.69	N/A	N/A	N/A
	Timepoint 11	3.34	1.80	N/A	N/A	N/A
	Timepoint 12	3.11	1.80	N/A	N/A	N/A

P-values for categorical measures were determined using χ^2 and p-values for continuous measures were determined used Mann-Whitney tests. Mann-Whitney tests may not be accurate for ADL scores and iADL scores from timepoint 4 to 9 due to insufficient participants (<10). Significant p-values are bolded.

Abbreviations: bADLs, basic activities of daily living; C, count; iADLs, instrumental activities of daily living; M, mean; MMSE, Mini-mental State Examination; SD, standard deviation; SRF, self-rated function; SRH, self-rated health; T, timepoint.

Table C3: Summary of subjective health, physical function and covariates at baseline in the analytic sample (n=549) and excluded sample (n=129), stratified by reason for exclusion

		Included in Analysis		***Excluded – Missing Baseline Measures***			***Excluded – No Follow-up Measures***		
Categorical Variables	***Category***	***Count***	***%***	***Count***	***%***	***p-value***	***Count***	***%***	***p-value***
Baseline SRH	Excellent	85	15.48%	0	0.00%	**0.0116**	6	7.59%	**0.0025**
	Very Good	206	37.52%	1	20.00%		22	27.85%	
	Good	167	30.42%	2	40.00%		29	36.71%	
	Fair	78	14.21%	0	0.00%		14	17.72%	
	Poor	13	2.37%	2	40.00%		8	10.13%	
Baseline SRF	Excellent	252	45.90%	2	66.67%	**0.0452**	24	30.77%	**0.0001**
	Very Good	188	34.24%	0	0.00%		19	24.36%	
	Good	72	13.11%	0	0.00%		22	28.21%	
	Fair	29	5.28%	0	0.00%		10	12.82%	
	Poor	8	1.46%	1	33.3%		3	3.85%	
Educational Attainment	< High School	47	8.56%	14	27.45%	**<0.0001**	14	13.59%	0.2526
	High School	28	5.10%	6	11.76%		7	6.80%	
	BSc	225	40.98%	19	37.25%		35	33.98%	
	≥ MSc	249	45.36%	12	23.53%		47	45.63%	
Occupation	Teacher	497	90.53%	37	75.51%	**0.0056**	89	86.41%	0.3813
	Domestic Worker	40	7.29%	10	20.41%		11	10.68%	
	Other	12	2.19%	2	4.08%		3	2.91%	
Place of Birth	US Born	514	93.62%	48	94.12%	1.0000	98	95.15%	0.6601
	Not US Born	35	6.38%	3	5.88%		5	4.85%	
Continuous Variables		***M***	***SD***	***M***	***SD***	***p-value***	***M***	***SD***	***p-value***
Baseline Age		82.7	5.1	88.5	6.0	**<0.0001**	85.9	6.4	**<0.0001**
Baseline MMSE		26.0	4.8	2.2	5.5	**<0.0001**	19.2	11.4	**<0.0001**
Baseline bADL		4.60	1.09	0.35	0.90	**<0.0001**	3.11	2.19	**<0.0001**
Baseline iADL		3.96	1.26	0.16	0.47	**<0.0001**	2.87	2.01	**<0.0001**

P-values for categorical measures were determined using Fisher's exact test due to small cell size and p-values for continuous measures were determined used Mann-Whitney tests. Significant p-values are bolded.

Abbreviations: bADLs, basic activities of daily living; C, count; iADLs, instrumental activities of daily living; M, mean; MMSE, Mini-mental State Examination; SD, standard deviation; SRF, self-rated function; SRH, self-rated health; T, timepoint

Table C4: Summary of subjective health, physical function and covariates at baseline in the analytic sample (n=549) and excluded sample missing follow-up assessments (n=102), stratified by reason for missing follow-up assessments

		Included in Analysis		***Excluded – Did Not Survive to Follow-Up***			***Excluded – Withdrew Prior to Follow-Up***		
Categorical Variables	***Category***	***Count***	***%***	***Count***	***%***	***p-value***	***Count***	***%***	***p-value***
Baseline SRH	Excellent	85	15.48%	3	4.69%	**0.0002**	3	21.43%	0.6648
	Very Good	206	37.52%	15	23.44%		7	50.00%	
	Good	167	30.42%	27	42.19%		2	14.29%	
	Fair	78	14.21%	12	18.75%		2	14.29%	
	Poor	13	2.37%	7	10.94%		0	0.00%	
Baseline SRF	Excellent	252	45.90%	14	22.22%	**<0.0001**	10	71.43%	0.3225
	Very Good	188	34.24%	16	25.40%		2	14.29%	
	Good	72	13.11%	21	33.33%		1	7.14%	
	Fair	29	5.28%	9	14.29%		1	7.14%	
	Poor	8	1.46%	3	4.76%		0	0.00%	
Educational Attainment	< High School	47	8.56%	12	13.64%	0.2601	2	14.29%	**0.0238**
	High School	28	5.10%	7	7.95%		0	0.00%	
	BSc	225	40.98%	33	37.50%		1	7.14%	
	≥ MSc	249	45.36%	36	40.91%		11	78.57	
Occupation	Teacher	497	90.53%	74	84.09%	0.1333	14	100.00%	0.7152
	Domestic Worker	40	7.29%	11	12.50%		0	0.00%	
	Other	12	2.19%	3	3.41%		0	0.00%	
Place of Birth	US Born	514	93.62%	83	94.32%	1.0000	14	100.00%	1.0000
	Not US Born	35	6.38%	5	5.68%		0	0.00%	
Continuous Variables		***M***	***SD***	***M***	***SD***	***p-value***	***M***	***SD***	***p-value***
Baseline Age		82.7	5.1	87.1	6.0	**<0.0001**	78.5	2.6	**0.0008**
Baseline MMSE		26.0	4.8	17.7	11.6	**<0.0001**	28.1	2.4	**0.0296**
Baseline bADL Score		4.60	1.09	2.80	2.21	**<0.0001**	5.00	0.00	0.0983
Baseline iADL Score		3.96	1.26	2.56	2.00	**<0.0001**	4.79	0.43	**0.0054**

P-values for categorical measures were determined using Fisher's exact test due to small cell size and p-values for continuous measures were determined used Mann-Whitney tests. Significant p-values are bolded.

Abbreviations: bADLs, basic activities of daily living; C, count; iADLs, instrumental activities of daily living; M, mean; MMSE, Mini-mental State Examination; SD, standard deviation; SRF, self-rated function; SRH, self-rated health; T, timepoint

Appendix D: Analysis of Missing Outcomes due to Intermittent Missingness or Withdrawal

Appendix D addresses the question of missing follow-up measures and whether dropout rates after the second timepoint were random. Tables D1 and D2 summarize differences between participants with vs without missing data. Individuals with missing data were not significantly different in baseline subjective health; however, they were less educated, less likely to be a teacher, and were younger and more independent in iADLs than those without missing data (Table D1). Individuals who were intermittently missing data were more likely to not be born in the United States but did not differ in any other measure from individuals who were not missing data (Table D2). Individuals who dropped out of the study were younger, had higher baseline MMSE, had less education and were less likely to be teachers than individuals who were not missing any data, but did not significantly differ on any other measure (Table D2).

To determine whether intermittent missingness and dropout was random, a logistic regression was developed, that used measures from the assessment prior to the dropout (Table D3). A second regression was developed using backwards selection (Table D4). These tables show that the missingness was not dependent on previous subjective health scores, previous physical scores or previous MMSE scores. Age at prior assessment was a significant predictor of missingness, as was the assessment timepoint and occupation of an individual. Therefore, missingness does not appear to be dependent on prior responses and can be considered random.

Table D1: Differences in subjective health, physical function and covariates at baseline in the analytic sample, stratified by missingness (n=549)

		No Missing Outcome		***Missing Outcome***		
N		506		43		
Categorical Variables	***Category***	***Count***	***%***	***Count***	***%***	***p-value***
Baseline SRH	Excellent	77	15.22%	8	18.60%	0.9414
	Very Good	190	37.55%	16	37.21%	
	Good	154	30.43%	13	30.23%	
	Fair	72	14.23%	6	13.95%	
	Poor	13	2.57%	0	0.00%	
Baseline SRF	Excellent	230	45.45%	22	51.16%	0.9821
	Very Good	174	34.39%	14	32.56%	
	Good	67	13.24%	5	11.63%	
	Fair	27	5.34%	2	4.65%	
	Poor	8	1.58%	0	0.00%	
Educational Attainment	< High School	38	7.51%	9	20.93%	**0.0196**
	High School	28	5.53%	0	0.00%	
	BSc	210	41.50%	15	34.88%	
	≥ MSc	230	45.45	19	44.19%	
Occupation	Teacher	463	91.50%	34	79.07%	**0.0209**
	Domestic Worker	32	6.32%	8	18.60%	
	Other	11	2.17%	1	2.33%	
Place of Birth	US Born	477	94.27%	37	86.05%	**0.0466**
	Not US Born	29	5.73%	6	13.95%	
Continuous Variables		***M***	***SD***	***M***	***SD***	***p-value***
Baseline Age		82.9	5.2	80.0	3.4	**0.0002**
Baseline MMSE		25.9	5.0	27.6	2.2	0.0626
Baseline bADL		4.56	1.12	4.93	0.26	0.0614
Baseline iADL		3.93	1.29	4.37	0.82	**0.0467**

P-values for categorical measures were determined using Fisher's exact test due to small cell size and p-values for continuous measures were determined used Mann-Whitney tests. Significant p-values are bolded.

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; M, mean; MMSE, Mini-mental State Examination; SD, standard deviation; SRF, self-rated function; SRH, self-rated health; T, timepoint

Table D2: Differences in subjective health, physical function and covariates at baseline in the analytic sample by missingness, stratified by type of missingness (n=549)

		No Missing Outcomes		***Intermittent Missing Outcomes***			***Missing Outcome due to Withdrawal***		
N		506		6			38		
Categorical Variables	***Category***	***Count***	***%***	***Count***	***%***	***p-value***	***Count***	***%***	***p-value***
Baseline SRH	Excellent	77	15.22%	1	16.67%	0.4669	7	18.42%	0.9584
	Very Good	190	37.55%	1	16.67%		15	39.47%	
	Good	154	30.43%	2	33.33%		11	28.95%	
	Fair	72	14.23%	2	33.33%		5	13.16%	
	Poor	13	2.57%	0	0.00%		0	0.00%	
Baseline SRF	Excellent	230	45.45%	2	33.33%	0.4459	20	52.63%	0.9389
	Very Good	174	34.39%	2	33.33%		12	31.58%	
	Good	67	13.24%	1	16.67%		5	13.16%	
	Fair	27	5.34%	1	16.67%		1	2.63%	
	Poor	8	1.58%	0	0.00%		0	0.00%	
Educational Attainment	< High School	38	7.51%	1	16.67%	0.6647	9	23.68%	**0.0115**
	High School	28	5.53%	0	0.00%		0	0.00%	
	BSc	210	41.50%	2	33.33%		13	34.21%	
	≥ MSc	230	45.45	3	50.00%		16	42.11%	
Occupation	Teacher	463	91.50%	5	83.33%	0.4184	29	76.32%	**0.0076**
	Domestic Worker	32	6.32%	1	16.67%		8	21.05%	
	Other	11	2.17%	0	0.00%		1	2.63%	
Place of Birth	US Born	477	94.27%	4	66.67%	**0.0457**	34	89.47%	0.2762
	Not US Born	29	5.73%	2	33.33%		4	10.53%	
Continuous Variables		***M***	***SD***	***M***	***SD***	***p-value***	***M***	***SD***	***p-value***
Baseline Age		82.9	5.2	81.7	4.3	0.7172	79.9	3.3	**0.0003**
Baseline MMSE		25.9	5.0	26.7	3.4	0.8997	27.8	1.9	**0.0468**
Baseline bADL		4.56	1.12	5.00	0.00	0.2656	4.92	0.27	0.1033
Baseline iADL		3.93	1.29	4.33	0.82	0.5607	4.37	0.82	0.0641

P-values for categorical measures were determined using Fisher's exact test due to small cell size and p-values for continuous measures were determined used Mann-Whitney tests. Significant p-values are bolded.

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; M, mean; MMSE, Mini-mental State Examination; SD, standard deviation; SRF, self-rated function; SRH, self-rated health; T, timepoint

Table D3: Logistic regression of missingness at timepoint k, using baseline covariates and k-1 measures of age, subjective health and physical function in the analytic sample (n=549)

Measure	*Level*	*Odds Ratio*	*95% Wald Confidence Limits*	
Previous bADL		1.213	0.862	1.707
Previous iADL		0.824	0.602	1.126
Previous SRH		1.075	0.758	1.523
Previous SRF		0.945	0.645	1.384
Previous Age		**0.878**	**0.803**	**0.961**
Previous MMSE		1.078	0.976	1.191
Education (vs. ≥ Masters)	< High School	2.084	0.414	10.506
	High School	0.338	0.025	4.524
	Bachelors	1.216	0.645	2.294
Occupation (vs. Teacher)	Domestic Worker	2.891	0.622	13.446
	Nurses Aid/Other	1.124	0.160	7.884
Place of Birth (vs. Born in US)	Not Born in US	2.263	0.917	5.587
Timepoint (vs. Timepoint 12)	2	**0.028**	**0.003**	**0.310**
	3	0.205	0.030	1.393
	4	0.556	0.091	3.387
	5	0.191	0.027	1.350
	6	0.421	0.068	2.626
	7	0.376	0.056	2.518
	8	0.944	0.159	5.607
	9	0.357	0.040	3.192
	10	0.439	0.049	3.925
	11	0.219	0.010	4.617

Significant values are bolded. Previous bADL, iADL, MMSE, SRF and SRH are treated as continuous measures in the logistic regression.

Abbreviations: bADLs, basic activities of daily living; iADLs, instrumental activities of daily living; MMSE, Mini-mental State Examination; SRF, self-rated function; SRH, self-rated health

Table D4: Logistic regression of missingness using backwards selection at timepoint k, using baseline covariates and k-1 measures of age, subjective health and physical function in the analytic sample (n=549)

Measure	*Level*	*Point Estimate*	*95% Wald Confidence Limits*	
Previous Age		**0.875**	**0.801**	**0.956**
Occupation	Domestic Worker	**4.658**	**2.149**	**10.098**
(vs. Teacher)	Nurses Aid/Other	1.697	0.224	12.874
	2	**0.032**	**0.002**	**0.621**
	3	0.330	0.034	3.237
	4	0.912	0.103	8.100
	5	0.265	0.025	2.819
Timepoint	6	0.603	0.065	5.612
(vs. Timepoint 12)	7	0.499	0.049	5.087
	8	1.367	0.153	12.196
	9	0.365	0.022	5.995
	10	0.476	0.029	7.790
	11	<0.001	<0.001	>999.999

Significant values are bolded.

Appendix E: Correlations Between Measures of Physical Function Across Timepoints 1 to 12

Appendix E presents correlations between bADLs and iADLs. Tables E1 and E2 display the results of the Spearman's rho correlations for bADLs and iADLs respectively for each assessment timepoint. The level of independence in bADLs was significantly associated between timepoints that were within six assessment timepoints from each other. Level of independence in iADLs was significantly correlated between all assessment timepoints. Table E3 displays the results of the Spearman's rho correlations between bADLs and iADLs at each timepoint. Generally, level of independence in bADLs was significantly correlated with level of independence in iADLs at any assessment timepoint. All associations between bADLs and iADLs were positive.

Table E1: Spearman Rho correlations for basic activities of daily living from timepoint 1 to 12 in the analytic sample (n=549)

		bADL1	*bADL2*	*bADL3*	*bADL4*	*bADL5*	*bADL6*	*bADL7*	*bADL8*	*bADL9*	*bADL10*	*bADL11*	*bADL12*
bADL1	Correlation	1.0000											
	P-Value	**<.0001**											
bADL2	Correlation	0.6602	1.0000										
	P-Value	**<.0001**	**<.0001**										
bADL3	Correlation	0.5225	0.6651	1.0000									
	P-Value	**<.0001**	**<.0001**	**<.0001**									
bADL4	Correlation	0.4570	0.5927	0.6728	1.0000								
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**								
bADL5	Correlation	0.4186	0.4913	0.5519	0.7592	1.0000							
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**							
bADL6	Correlation	0.2970	0.4870	0.4717	0.6752	0.7709	1.0000						
	P-Value	**0.0005**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**						
bADL7	Correlation	0.2016	0.3449	0.3389	0.5063	0.6092	0.7288	1.0000					
	P-Value	**0.0137**	**0.0003**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**					
bADL8	Correlation	0.1810	0.2204	0.2589	0.5060	0.5834	0.6507	0.8051	1.0000				
	P-Value	**0.0494**	**0.0282**	**0.0042**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**				
bADL9	Correlation	0.2124	0.2159	0.1965	0.5509	0.5951	0.6137	0.7233	0.8203	1			
	P-Value	0.0507	**0.0466**	**0.0391**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**			
bADL10	Correlation	0.2490	0.2009	0.1636	0.4979	0.5218	0.5457	0.7000	0.7188	0.8461	1.0000		
	P-Value	0.0504	0.0831	0.1209	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**		
bADL11	Correlation	0.2225	0.1767	0.2116	0.3513	0.3926	0.4340	0.6019	0.6355	0.6992	0.7970	1.0000	
	P-Value	0.1487	0.3099	0.0604	**0.0109**	**0.0048**	**0.0006**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	
bADL12	Correlation	0.1309	0.1793	0.0989	0.0048	0.2478	0.1395	0.4261	0.4347	0.4651	0.6121	0.7692	1.0000
	P-Value	0.3124	0.3081	0.3578	0.9590	0.0611	0.2033	**0.0017**	**0.0002**	**<.0001**	**<.0001**	**<.0001**	**<.0001**

Significant values are bolded.

Abbreviations: bADL(k), basic activities of daily living at timepoint k

Table E2: Spearman Rho correlations for instrumental activities of daily living from timepoint 1 to 12 in the analytic sample (n=549)

		iADL1	*iADL2*	*iADL3*	*iADL4*	*iADL5*	*iADL6*	*iADL7*	*iADL8*	*iADL9*	*iADL10*	*iADL11*	*iADL12*
iADL1	Correlation	1.0000											
	P-Value	**<.0001**											
iADL2	Correlation	0.6521	1.0000										
	P-Value	**<.0001**	**<.0001**										
iADL3	Correlation	0.5733	0.6543	1.0000									
	P-Value	**<.0001**	**<.0001**	**<.0001**									
iADL4	Correlation	0.5448	0.5877	0.6933	1.0000								
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**								
iADL5	Correlation	0.5126	0.5883	0.5918	0.7073	1.0000							
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**							
iADL6	Correlation	0.4242	0.5021	0.5619	0.6204	0.7041	1.0000						
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**						
iADL7	Correlation	0.4431	0.4561	0.4283	0.6184	0.6644	0.7515	1.0000					
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**					
iADL8	Correlation	0.3188	0.3778	0.4274	0.5544	0.6389	0.6862	0.7850	1.0000				
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**				
iADL9	Correlation	0.3860	0.3645	0.3344	0.4733	0.5092	0.6746	0.7129	0.7430	1.0000			
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**			
iADL10	Correlation	0.3800	0.3226	0.3711	0.5496	0.5080	0.6532	0.6889	0.6570	0.7422	1.0000		
	P-Value	**<.0001**	**0.0003**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**		
iADL11	Correlation	0.3022	0.3916	0.2944	0.4018	0.3572	0.5194	0.5307	0.5259	0.5956	0.7346	1.0000	
	P-Value	**0.0018**	**<.0001**	**0.0038**	**<.0001**	**0.0006**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	
iADL12	Correlation	0.2414	0.4421	0.2559	0.2731	0.2546	0.4078	0.4969	0.3449	0.4670	0.7133	0.7383	1.0000
	P-Value	**0.0230**	**<.0001**	**0.0146**	**0.0157**	**0.0222**	**<.0001**	**<.0001**	**0.0021**	**<.0001**	**<.0001**	**<.0001**	**<.0001**

Significant values are bolded.

Abbreviations: iADL(k), instrumental activities of daily living at timepoint k

Table E3: Spearman Rho correlations between basic and instrumental activities of daily living from timepoint 1 to 12 in the analytic sample (n=549)

		bADL1	*bADL2*	*bADL3*	*bADL4*	*bADL5*	*bADL6*	*bADL7*	*bADL8*	*bADL9*	*bADL10*	*bADL11*	*bADL12*
iADL1	Correlation	0.5162	0.5093	0.4102	0.4442	0.4361	0.3958	0.3085	0.3289	0.3505	0.3675	0.3621	0.2213
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0005**	0.0507
iADL2	Correlation	0.456	0.5882	0.5055	0.4892	0.4501	0.4117	0.2695	0.3347	0.2617	0.2327	0.3188	0.2208
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0001**	**<.0001**	**0.0023**	**0.0122**	**0.0018**	0.0631
iADL3	Correlation	0.4113	0.5298	0.562	0.5777	0.5092	0.4504	0.2963	0.2935	0.2367	0.2187	0.2007	-0.0222
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0049**	**0.0168**	0.0574	0.8429
iADL4	Correlation	0.3876	0.5217	0.5656	0.6752	0.5857	0.5739	0.4695	0.4788	0.3935	0.3656	0.3315	0.0819
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0022**	0.4819
iADL5	Correlation	0.3366	0.4015	0.4247	0.6344	0.6611	0.6289	0.5173	0.5742	0.5297	0.4766	0.3614	0.0913
	P-Value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0008**	0.4595
iADL6	Correlation	0.2579	0.3637	0.3675	0.5764	0.6319	0.7227	0.585	0.5786	0.5749	0.5544	0.4298	0.1291
	P-Value	**0.0003**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	0.2638
iADL7	Correlation	0.1914	0.3121	0.3202	0.4952	0.5617	0.6159	0.6523	0.6534	0.61	0.6216	0.5652	0.3466
	P-Value	**0.0168**	**0.0005**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0011**
iADL8	Correlation	0.052	0.2234	0.1559	0.434	0.4871	0.5631	0.5713	0.6607	0.5596	0.5522	0.4532	0.1321
	P-Value	0.5462	**0.0139**	0.0842	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	0.2571
iADL9	Correlation	0.1528	0.2028	0.2114	0.44	0.4957	0.5333	0.4961	0.6374	0.6821	0.5744	0.5017	0.2004
	P-Value	0.0966	**0.0299**	**0.0144**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**0.0830**
iADL10	Correlation	0.1777	0.1040	0.1124	0.4047	0.5071	0.4444	0.5657	0.5775	0.6270	0.6502	0.6181	0.4939
	P-Value	0.1135	0.2709	0.2841	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**
iADL11	Correlation	0.1249	-0.0059	0.1883	0.2591	0.4138	0.2974	0.3776	0.5135	0.5243	0.5518	0.7068	0.5776
	P-Value	0.1801	0.7458	**0.0344**	**0.0344**	**0.0009**	**0.0165**	**0.0012**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**
iADL12	Correlation	-0.0358	0.0413	0.0921	0.1023	0.25	0.0905	0.2769	0.4269	0.3808	0.4341	0.5692	0.6481
	P-Value	0.3797	0.3666	0.3242	0.2586	**0.0471**	0.4102	**0.0238**	**<.0001**	**0.0004**	**0.0002**	**<.0001**	**<.0001**

Significant values are in green (<0.0001 <0.01 ≤0.05) and bolded, where darker shades of green signify higher levels of significance.

Abbreviations: bADL(k), basic activities of daily living at timepoint k; iADL(k), instrumental activities of daily living at timepoint k