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Measuring Resilient Aging in Different Populations of Older Adults

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Measuring Resilient Aging in Different Populations of Older Adults

by

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Dedication

To my wife Alejandra for her unconditional support, her love and her patience and for enduring this long process without any complaints. To my son Gabriel for understanding that I had to spend long hours away from him to finish this dissertation.

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Measuring Resilient Aging in Different Populations of Older Adults

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Resilience, the ability to adapt and ‘bounce back’ despite adversity, has gained a lot of attention in the aging literature in the past decade. The risk of adverse events increases linearly with age and therefore focusing on factors that help older adults recover can result in improvements in care and quality of life for older adults. There is still no consensus on how to operationalize resilience in aging research. There is even less information on how divergent resilience is in populations under different epidemiological regimes. I therefore conduct a cross-national comparison on resilience to identify factors that promote or prevent resilience in a developed country and a developing country with important socioeconomic and demographic differences. I use data from the Mexican Health and Aging Study and the Health and Retirement Study in the United States to analyze how health, function, mental status and social status change over time after an adverse event. Both studies have similar designs and are nationally representative of adults over 50 years of age. I compare resilience in each of the four domains and examine the differences between Mexico and the United States. I conclude by proposing some ways in which these findings can be translated into improvements in patient care.

TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviations

BPS	Biopsychosocial
WHO	World Health Organization
CGA	Comprehensive Geriatric Assessment
ADLs	Activities of Daily Living
IADLs	Instrumental Activities of Daily Living
AADLs	Advanced Activities of Daily Living
FIM	Functional Independence Measure
PC-PART	Personal Care – Participation Assessment and Resource Tool
PASE	Physical Activity Scale for the Elder
SPPB	Short Physical Performance Battery
MMSE	Mini Mental State Exam
ADASCOG	Alzheimer's Diseases Assessment Scale – Cognition Subscale
MOCA	Montreal Cognitive Assessment
GDS	Geriatric Depression Scale
CES-D	Center for Epidemiological Studies – Depression Scale
PHQ-9	Patient Health Questionnaire 9 Scale
SES	Socioeconomic Status
US	United States
CDC	Center for Disease Control and Prevention
MHAS	Mexican Health and Aging Study

HRS	Health and Retirement Study
INEGI	Instituto Nacional de Estadística, Geografía e Informática
AHEAD	Assets and Health Dynamics Among the Oldest Old
CODA	Children of Depression Age Cohort
TICS	Telephone Interview for Cognitive Status
CCCE	Cross-Cultural Cognitive Evaluation
NHATS	National Health and Aging Trends Study
CAPI	Computer Assisted Personal Interviewing
ENSA	Encuesta Nacional de Salud México
IMSS	Instituto Mexicano del Seguro Social
ISSSTE	Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado
PEMEX	Petroleos Mexicanos
NIAAA	National Institute of Alcohol Abuse and Alcoholism
UTMB	University of Texas Medical Branch
GSBS	Graduate School of Biomedical Science

Chapter 1 Introduction

The first chapter will review the implications of the biomedical model on current aging research. It will also summarize the biopsychosocial model and present some of its advantages for aging research. Finally, this chapter will tie the biopsychosocial model to the purpose of this study on resilience in different groups of older adults.

THE BIOMEDICAL MODEL

More than thirty years ago George L. Engel, a prominent psychiatrist and medical theorist, challenged the traditional biomedical model that had guided medicine for centuries (Engel, 1977). The biomedical model exists today and relies on molecular biology as its basic scientific discipline and focuses on biochemical changes as fundamental causes of disease. In his manuscript published in 1977, Engel explains how the biomedical model developed in response to the limited knowledge on the functioning of the human body and was influenced by religious practices and beliefs at the time (Engel, 1977). Engel also argues that the biomedical approach to disease has been successful beyond expectation. However, Engel presented a very compelling argument warning us that the success of the biomedical model has been achieved at a high cost (Engel, 1977).

THE BIOPSYCHOSOCIAL (BPS) MODEL PROPOSAL

In Engel's opinion, a fragmented approach to disease - where biological factors are highly regarded over psychological and social factors (biomedical model) - has limited the ability of medicine to understand and advance in many areas (Engel, 1977). Engel uses the term "biopsychosocial" to define a more comprehensive and accurate model that medicine should use (Engel, 1977). This model not only includes the biological, psychological and social factors underlying the disease process but also examines the interaction between the different factors to establish therapeutic models that truly benefit patients (Engel, 1977). Application of this innovative model and the comprehensive approach proposed by Engel has not been as widespread as expected. Medicine today is under scrutiny and criticized because it still predominantly relies on the biomedical model and fails to address many of the needs and concerns manifested by patients seeking care. More recently, the unprecedented advances in genetics have added to the notion that molecular changes are the key focus of disease. Important questions have been raised because the scientific community still needs to come a long way before genetic therapy can be widely implemented. Additionally, the rising costs of healthcare that do not result in corresponding improvements in quality of life or care, question whether mainly focusing on molecular changes brings the most benefits to patients (Brindis & Spertus, 2006; Efficace et al., 2006; Kaplan, 2003; McCollum & Pincus, 2009).

ADVANTAGES OF THE BIOPSYCHOSOCIAL MODEL

A close evaluation of the BPS model reveals its advantages very quickly. This model includes the individual's perception on his/her health, in addition to the biochemical and physiological changes most physicians eagerly examine and promote as fundamental causes of disease (McCollum & Pincus, 2009; Vaillant & Mukamal, 2001). The model also takes into consideration how healthcare providers perceive and interpret what patients report about their health concerns. In contrast to the biomedical model, the BPS model focuses on characteristics of the patient's environment and how they affect health. The BPS model also recognizes social, cultural and economic aspects of health and analyzes their role in the disease process (McCollum & Pincus, 2009; Vaillant & Mukamal, 2001). Additionally, the BPS model accepts psychological and social factors as causes of biological changes that affect health (Borrell-Carrio et al., 2004). These differences not only make the BPS model superior, but also present a model that is more inclusive, especially for specific population groups such as older adults (Borrell-Carrio et al., 2004; Engel, 1977; Engel, 1980).

The biopsychosocial model in aging

Contrary to what many people believe, older adults are very heterogeneous (American Geriatrics Society, 2009). This heterogeneity is expected since aging is dependent on the accumulation of many internal and external factors over the life-course. Genetic characteristics, prenatal nutrition and diseases, childhood experiences, the environment where individuals grow up, adult work history and exposure to different substances, in addition to social support and chronic conditions in old age, determine how a person arrives to old age (Bartali et al., 2006; Bates et al., 2002; Mendes de Leon et al., 2001; Menec, 2003; Wong et al., 2005; Wong et al., 2007). Each experience is unique making older adults very different from each other unlike the common belief that older adults are a homogenous group. These distinctive characteristics limit the applicability of the biomedical model to older adult populations. Additionally, the molecular aspects of aging are not completely understood. Thus, psychological and social characteristics are required to better understand aging pathways and help us guide older adults in their aging process (Borrell-Carrio et al., 2004; Engel, 1980; Molton & Jensen, 2010).

Why models to understand older adults are important

Older adults are not only heterogeneous, they are also the fastest growing population group in the world. The number of adults 65 years and older is expected to triple in the next 40 years (Kinsella & Wan, 2009). In the United States alone, this population is expected to reach 72 million, a growth of 100% from the population size at the beginning of the century (Butler, 2008; Department of Health & Human Services, 2010). Unfortunately, traditional models, such as the biomedical model, have nourished the notion that aging and disease overlap (Borrell-Carrio et al., 2004; WHO, 1999). Better models that help us understand the aging process, the unique health characteristics of older adults and that better characterize the aging experience are therefore necessary if society wants to adequately care for this growing population group.

LIMITATIONS IN CURRENT AGING RESOURCES

Despite the inevitable growth of the older adult population, healthcare resources devoted to this population are not growing at a comparable rate (Butler, 2008). Not only is there a growing deficit to meet the healthcare needs of older adults today, the shortage of healthcare providers trained to care for older adults is not expected to improve anytime soon (Butler, 2008; Institute of Medicine, 2008). A clear cut distinction of what is normal aging and what is disease is somewhat hard to establish. Additionally, there are cultural, social and psychological considerations that make this distinction even more difficult. Society therefore needs more resources to better understand the aging process and identify the psychological and social needs of older adult populations in order to better serve them in the near future (Butler, 2008).

LIMITATIONS IN AGING RESEARCH

Resources to conduct research related to aging are limited, but even more alarming is that current aging research mainly focuses on negative outcomes such as complications from diseases, disability and mortality. Recovery from adverse events is many times overlooked and older adults’ perceptions and opinions of their aging experience are the exception rather than the rule in research (Bowling, 2007; Callahan & McHorney, 2003; Depp & Jeste, 2006; Phelan et al., 2004). Furthermore, most aging research focuses on current events and conditions and fails to incorporate the life-course experiences of these adults to give context and meaning to their events and conditions (Blane et al., 2004; Elder & Johnson, 2003; George, 2003). Also, cultural factors contributing to differences among older adult populations are poorly understood (Angel, 2009; Laditka et al., 2009).

Purpose of the dissertation

With this information in mind, this dissertation intends to modify the current aging research paradigm by incorporating recovery into an aging model. This model moves away from the traditional outcomes of disability and mortality and incorporates positive aspects of aging, such as recovery. It also helps us understand the aging process and identify appropriate interventions to enhance independence and improve quality of life among older adults. The model's conceptual framework accounts for the heterogeneity of older adults and includes cultural and life-course factors, essential to comprehensively understand the aging process in different population groups.

I will use a comprehensive approach to older adults. Using population-based data I will analyze different domains that affect older adults' health and determine how these domains change over time. By using a comprehensive approach I will be able to compare how the different domains affect recovery from adverse events and determine patterns that will promote resilience among older adults.

Chapter 2 Conceptual Framework

This chapter will present the conceptual framework that lead to the study of resilience in different populations of older adults. The comprehensive geriatric assessment, a clinical tool that has proven to be effective and beneficial for older adults at high risk of adverse events will be initially described. The rationale behind this assessment and the different domains it includes will also be described. The comprehensive view derived from the comprehensive geriatric assessment will then be tied to the concept of successful aging. The advantages and downfalls of the successful aging concept will be presented next in addition to some alternatives that researchers have used. Finally, the concept of resilience will be presented and the rationale behind why this concept is used for this study is discussed.

2.1 The Comprehensive Geriatric Assessment

As noted in the introduction, medicine over the past century has mostly relied on the biomedical model to deal with diseases and develop ways to prevent or manage them (Engel, 1977). More recently, advances in genetics have added to the notion that molecular changes are the key focus of disease. Fortunately, some clinical disciplines have opted out of this model and have incorporated a broader approach to patient care (Holtzman & Marteau, 2000; Rees, 2002; Strohman, 2002; Temple et al., 2001; Willett, 2002). Geriatrics, for example, is a clinical specialty that focuses on the overall health of older adults, taking into account maintenance of functional capacity and promotion of independent living at home (Finucane, 2004; Kong, 2000; Stuck et al., 1993; Warren, 1946b). To achieve this goal Geriatricians use a comprehensive approach to evaluate patients (Finucane, 2004; Stuck et al., 1993). For older adults with multiple conditions or at high risk of adverse events Geriatricians use a structured clinical tool called the

Comprehensive Geriatric Assessment. This tool was initially proposed by Marjory Warren 60 years ago in England (Kong, 2000; Warren, 1946b).

Doctor Warren, a prominent surgeon and public health advocate, introduced the notion that older adult care should be comprehensive and multidisciplinary given their unique health characteristics (Kong, 2000; Warren, 1946a). Doctor Warren recognized the importance of intensive rehabilitation in helping sick older adults return home after they were admitted to health institutions (Warren, 1946a; Warren, 1946b). Based largely on her work, the Comprehensive Geriatric Assessment (CGA) was developed and usually includes four domains: physical health, functional status, social function and mental health (Stuck et al., 1993; Stuck & Iliffe, 2011). Geriatricians evaluate these domains together to classify individuals at high risk. This evaluation results in a structured plan focused on helping older adults at risk maintain or improve their health status.

The four domains

The four domains of the CGA are measured independently and describe different aspects of health. However, they are highly correlated with each other and affect quality of life (Andrews et al., 2002; Mair & Thivierge-Rikard, 2010; Wilson & Cleary, 1995). Each domain measures a unique aspect of health and each domain has different implications for older adults. Nevertheless, when combined, the four domains provide an accurate picture of the health status of an individual. The domains can be used to design management plans for older adults at risk, in order to maintain or improve their health status so they can live independently for as long as possible. Next, each domain will be described in detail.

A) What is Physical Health?

Physical health refers to how different physiologic processes affect health status. Physical health includes different diseases, but it also includes health behaviors and how these behaviors affect health overall. The traditional biomedical model mainly focuses on physical health. Physical health has a subjective and an objective component. The subjective component includes how the person perceives his/her physical health. It includes a general impression of health, but it also includes feelings and perceptions (symptoms) related to physical health. It also includes the attitude a person has towards his/her health and the health behaviors he/she adopts. On the other hand, the objective component of health deals with measurements of different physiologic processes. Blood pressure, heart rate, respiratory rate, body temperature and blood sugar measure different aspects of human physiology and are important indicators of physical health. Both the subjective and objective components of physical health are equally important. The subjective component is sometimes neglected; conversely, the objective component is highly valued in the traditional biomedical model. The subjective component determines how individuals relate to disease and affects how well they follow their treatment guidelines (Horne & Weinman, 1999; Vik et al., 2004). If the person's perception is not taken into consideration, physical health cannot be measured accurately.

Physical health in older adults

Absence of disease has been reported as one of the most important determinants of quality of life in old age (Borowiak & Kostka, 2004; Bowling et al., 2002; McDowell & Newell, 1996). Older adults place a lot of value on having no diseases or at least having no complications from the diseases they do have (Bowling & Dieppe, 2005; Depp & Jeste, 2006; Lamond et al., 2008; Palmore, 1979). Unlike other population groups, older adults have a unique and highly heterogeneous health profile that results from life-long habits, exposures and experiences. Therefore, evaluation of physical health in older adults requires a comprehensive approach and knowledge of the normal and abnormal changes resulting from the aging process (Baumgartner, 2000; Ben Shlomo & Kuh, 2002).

THE AGING AND DISEASE MYTH

It is therefore important to refute a long standing myth that disease and old age are the same. In fact, between 20 and 30% of older adults are free of any chronic conditions (Burke et al., 2001; Reed et al., 1998; Rowe & Kahn, 1999b). Aging increases the risk of developing certain conditions such as cardiovascular disease, arthritis, pneumonia and dementia (Ben Shlomo & Kuh, 2002; Halter et al., 2009). However, aging is not the sole cause of these conditions. A combination of genetic predisposition, physiologic changes due to aging, acute or chronic stressors, in addition to lifestyles choices and environmental exposures, are necessary for disease development (Doherty, 2003; Halter et al., 2009; Lipsitz, 2004; Rowe & Kahn, 1987). Children, for example, are at high risk for upper respiratory infections, while teenagers are at high risk for accidental injuries and middle aged men are at risk of heart attacks. However, being a child or a teenager or a middle-aged man is not considered the main cause of any of those conditions. Therefore, older age cannot be considered a main cause of diseases that are highly prevalent in this age group. Older age increases the risk of certain conditions but it is not the sole cause of those conditions.

PHYSICAL HEALTH MEASUREMENT BY SETTING

Physical health has been measured differently depending on the setting. In the clinical setting, physical health is traditionally measured with a physical exam that can then result in more objective measures of different biomarkers. Apart from the physical exam physicians and other healthcare providers perform routinely, there are blood tests and imaging studies that can help assess physical health. Conversely, most population-based studies rely on self-reports as a proxy for physical health. Trained interviewers obtain information about physical health from the subjects and sometimes from a family member or caregiver. Despite studies reporting good agreement between self-reported clinical conditions with actual clinical diagnoses (Bush et al., 1989; Okura et al., 2004; Simpson et al., 2004), there are differences in how physical health is measured in both settings that must be taken into account.

B) What is Functional status?

Functional status is the ability an individual has to perform normal activities necessary to meet basic needs, to fulfill usual roles and to maintain physical health and wellbeing (Leidy, 1994; Wang, 2004). Functional status also has a subjective and an objective component. The subjective component refers to the perception that a person has of his/her ability to perform different activities. The objective component refers to measuring how well a person performs certain activities. As with physical health, both components of functional status are very important. However, functional status has not been a major part of the biomedical model. In fact, functional status only became a relevant aspect of older adult care after the CGA was instituted and rehabilitation became a key goal of older adult care.

How is functional status measured?

Studies have shown that self-reported and performance-based functional measures provide differing yet complementary information (Guralnik et al., 1994; Reuben et al., 1992). Functional status can be divided in three levels: basic activities of daily living (ADLs), instrumental activities of daily living (IADLs) and performance–based function (Chandler, 2000; Halter et al., 2009). ADLs refer to self-care tasks like bathing, dressing and toileting (Darzins, 2004; Katz et al., 1963; Mahoney & Barthel, 1965). IADLs refer to the ability of an individual to live independently and include tasks like shopping, driving or using public transportation, and managing finances (Chandler, 2000; Fillenbaum, 1985; Lawton & Brody, 1969). Performance-based function measures include strength of upper and lower body and leisure time activities (Chandler, 2000; Guralnik & Ferrucci, 2003; Podsiadlo & Richardson, 1991; Washburn et al., 1993). Table 2.1 lists some instruments used to measure ADLs, IADLs and performance-based function. Additionally, some authors consider that activities related to an individual's ability to fulfill social, community or family roles and to participate in social activities are a separate category and have labeled them advanced activities of daily living (AADLs) (Halter et al., 2009).

Functional status in older adults

Functional independence is highly valued by older adults (Bowling & Dieppe, 2005; Knight & Ricciardelli, 2003). There is some degree of functional decline related to age. Part of this decline is associated with changes in body composition like sarcopenia, the age related loss of muscle mass and muscle quality. Other factors such as chronic diseases, the physical environment and some physiologic changes have also been related to functional decline (Stuck et al., 1999). Regardless of the risk factors, functional decline is a process with intrinsic and extrinsic components that progressively lead to disability if no interventions are started (Verbrugge et al., 1994). A list of validated tool used to assess functional status id provided in Table 2.1.

Disablement process and difference between functional decline and disability

The Disablement Model proposed by Verbrugge and Jette (Verbrugge & Jette, 1994), clearly defines disability as an end result of multiple factors. Disability and functional decline cannot be used interchangeably. The first one refers to a distinct stage in the disablement process that results when functional limitations interfere with daily function (Verbrugge & Jette, 1994). The second one refers to the dynamic process that begins with pathology and ends in disability. An adaptation of the model is presented in Figure 2.1. This dissertation will only focus on limitations with ADLs, IADLs and performance measures as self-reported by individuals. These limitations could be interpreted as functional limitations or representations of disability depending on the context in which they are analyzed.

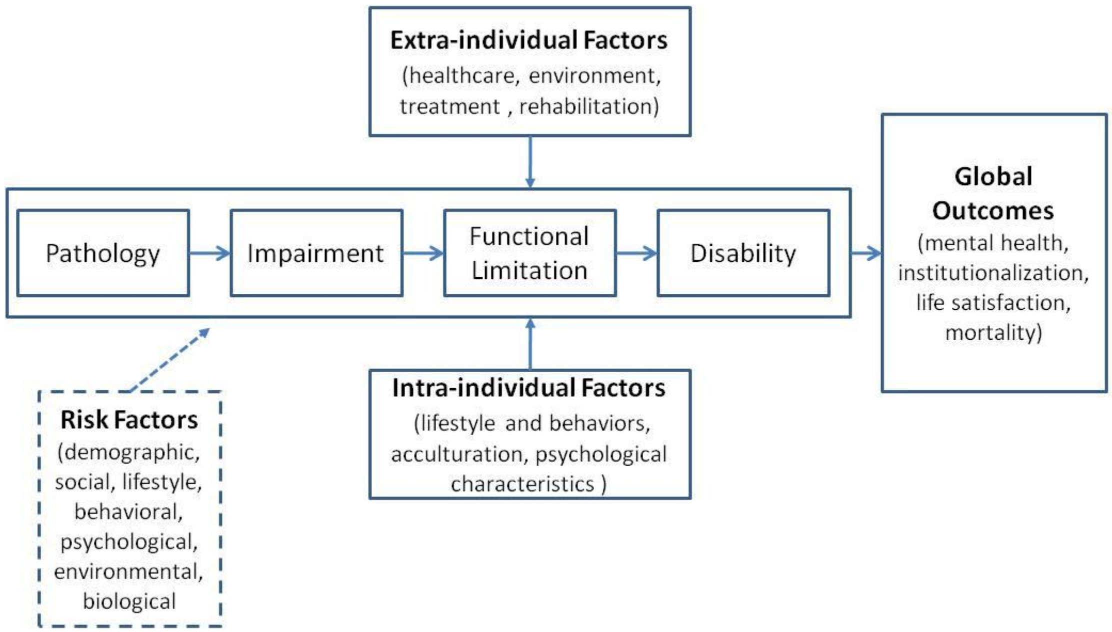
Table 2.1: List of validated instruments used to measure different levels of functional status

ADLs	IADLs	Performance-based Function
Katz Index(Katz et al., 1963).	Lawton Scale(Lawton & Brody, 1969).	Timed Up & Go(Podsiadlo & Richardson, 1991).
Barthel Index(Mahoney & Barthel, 1965).		Physical Activity Scale for the Elderly (PASE)(Washburn et al., 1993).
Functional Independence Measure (FIM) Scale(Uniform Data Systems, 1999).		Minnesota Leisure Time Activity questionnaire(Taylor et al., 1978).
Personal Care Participation Assessment and Resource Tool (PC-PART)(Darzins, 2004).		Short Physical Performance Battery (SPPB)(Guralnik et al., 1994).

MEASURING FUNCTIONAL STATUS

Functional decline is determined by multiple components as depicted in Figure 2.1. Functional status depends on many biological systems and mechanical processes making it difficult to measure. To make matters more complex, there are several ways and multiple instruments that can be used to assess functional status as stated above. There are different instruments available to measure functional status in the clinical setting and in population-based studies. However, in the past decade, several population-based studies have incorporated instruments used in the clinical setting and have validated their use and shown they are reliable (Halter et al., 2009).

Figure 2.1: Disablement model (Adapted from Verbrugge and Jette , 1994)



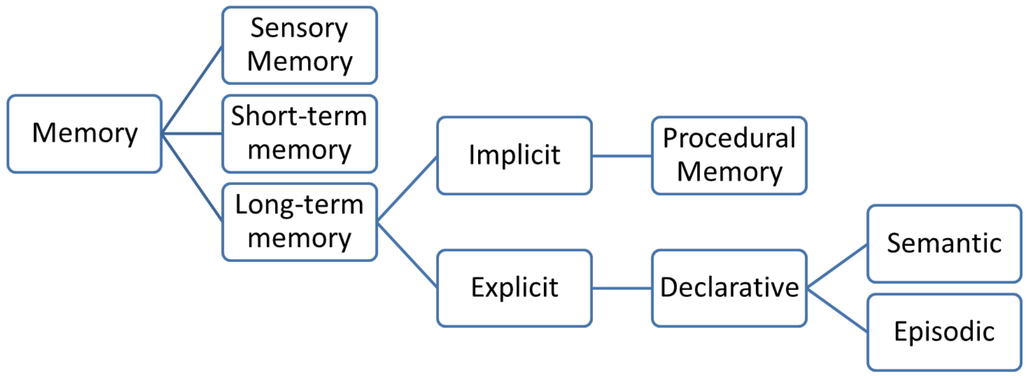
C) WHAT IS MENTAL HEALTH?

According to the World Health Organization (WHO) mental health is a state of well-being in which individuals are aware of their own abilities, can cope with normal life stressors, can work productively and contribute to their community (WHO, 2001). Adequate cognitive and emotional health is necessary for mental health. Cognition deals with how the brain processes information, but it is not the only function of the brain. When people think of cognitive function they usually think of memory. Cognitive processes like orientation, planning and judgment are additional important and independent components of memory. Research has shown that memory is composed of several sub-domains that reflect the complexity of how the brain processes information (Estes, 1999). Figure 2.2 summarizes the different types of memory and provides a short explanation for each type of memory. Diseases such as dementias primarily affect cognition. Alzheimer's disease for example, is characterized by alterations mainly in episodic memory, semantic memory and working memory (Halter et al., 2009). These alterations are a result of inappropriate function of the neurons of the temporal lobe and the prefrontal cortex primarily (Halter et al., 2009). Emotion, on the other hand, deals with how individuals relate to their surroundings (Carstensen & Charles, 1998; Keyes & Lopez, 2002). When people think of emotion they usually think of mood or affect. Feelings of how individuals relate to their environment and how the environment affects individuals are usually analyzed when determining emotional status (Carstensen & Charles, 1998; Keyes & Lopez, 2002). Diseases like depression primarily affect mood or affect. Depression results from an imbalance in neurotransmitters, substances produced by different brain structures (Halter et al., 2009). The main areas of the brain affected in depression are the forebrain and the limbic system (Halter et al., 2009).

How is mental health measured?

Functional imaging studies have been used to identify areas of the brain that are not working properly in different clinical conditions (Hedden & Gabrieli, 2004; Kaye et al., 1997; Silverman et al., 2001). These diagnostic studies however, are mostly used for research purposes or as confirmatory studies for clinical and neuropsychological diagnoses (Halter et al., 2009).

Figure 2.2: Types of human memory (Adapted from model by Atkinson & Shiffrin, 1968)



Type of Memory	Description
Sensory memory	Filters all information coming from the five senses for very brief periods of time
Short-term memory	Also known as working memory, acts as a temporary location where small amounts of information can be remembered and processed for a short period of time
Long-term memory	Intended for storage of information over long periods of time
Implicit long-term memory	Unconscious and deals with skills and task developed through the life-course
Explicit long-term memory	Conscious and deals with facts and events
Semantic memory	Focuses on general facts and knowledge, independent of the context in which they are acquired or experienced
Episodic memory	Focuses on experiences and events in a serial form, related to autobiographical events

In addition to these diagnostic studies, the literature is full of validated tools used to measure cognitive function and emotional status. Some tools are favored by clinicians because they can be easily applied in the clinical setting and because of the ease of translating results into clinical interventions (Halter et al., 2009). Other tools are favored by researchers because they are useful screening tools to identify risk for different conditions in large populations (Halter et al., 2009). The list of tools validated to measure cognitive function has grown dramatically in the past decade. The

Minimental State Exam (MMSE) (Folstein MF et al., 1975), the Alzheimer's Diseases Assessment Scale – Cognition Subscale (ADASCOG) (Rosen et al., 1984), the Mini-cog (Borson et al., 2000), and the Montreal Cognitive Assessment (MOCA) (Nasreddine et al., 2005), are widely used tools to identify cognitive impairment in older adults. The Geriatric Depression Scale (GDS) (Yesavage, 1988), the Center for Epidemiologic Studies – Depression Scale (CES-D) (Radloff LS, 1977), and the Patient Health Questionnaire 9 Scale (PHQ-9) (Spitzer et al., 1999), are widely used to identify affective disorders in older adults.

MENTAL HEALTH IN OLDER ADULTS

Mental health is as highly regarded by older adults as functional independence (Halter et al., 2009; Pinquart, 2001). With the rapid advances in medicine and technology and improvements in clinical diagnosis, we are now aware of many mental illnesses and their devastating effects on quality of life and survival of older adults. The high prevalence of conditions like Alzheimer's disease and depression among older adults make mental health a sensitive and highly relevant issue and place it in the realm of public health (Alzheimer's Association, 2010; Bowers et al., 1990). Both cognitive impairment and affective disorders affect quality of life and increase mortality risk and risk of adverse events in older adults (Bowling et al., 2002; Nguyen et al., 2003; Plassman et al., 2008; Schulz et al., 2000). However, there is a lack of knowledge on normal cognitive and mood changes related to aging. Many health care providers assume mental health alterations are due to aging and therefore require no interventions (Bowers et al., 1990; Petersen et al., 2001). As a result, older adults are not commonly screened for cognitive impairment and mood disorders (Bowers et al., 1990). Additionally, healthcare professionals are not properly trained to treat cognitive and mood disorders, jeopardizing the well-being and prognosis of affected older adults (Bowers et al., 1990; Bowers et al., 1992; O'Connor et al., 2001).

D) *WHAT IS SOCIAL FUNCTION?*

Social function is a difficult domain to define because it relates to many different factors. There is a large body of literature that analyses social function in older adults and its effect on health (Berkman, 1983; Berkman, 1984; Berkman, 1986; Berkman, 2000; Cannuscio et al., 2003; Halter et al., 2009; Islam et al., 2006; Kawachi et al., 1997; Kawachi & Berkman, 2001). Based on this literature, social function can be divided in two components: 1) the life-long social function and 2) the current social function. The life-long component basically deals with social capital. Social capital is defined as the sum of existing and potential resources individuals can use to establish relationships (Bourdieu, 1986). Current social function deals with the social support and social networks available to and used by an individual at a given point in time (Berkman, 1983; Berkman, 1986; Penninx et al., 1999). Social support is based on the social relations provided by individuals, while social networks are based on the number and type of individuals who can provide social relations (Due et al., 1999; Golden et al., 2009). For example, work history of an individual helps determine if pension or retirement funds are available for use in old age; this establishes a life-long component of social function. On the other hand, composition of the household and who a person lives with provide information on social support. Furthermore, information on volunteering or community participation provides information on social networks. In summary, social support refers to the resources an individual has to face adversities, while social networks refer to the persons an individual can go to for support if needed.

HOW IS SOCIAL FUNCTION MEASURED?

Social Capital, social support and social networks are necessary to understand social function (Berkman, 2000). There is a lot of controversy on whether social capital should be measured at the community or the individual level (Brewer, 2003). Life-long experiences and exposures an individual had, like where an individual was born, his/her work history, the type of family he/she was born into, dictate the existing and potential resources that an individual has based on the relationships he/she was able to establish. Thus, measuring work history, family composition and migration history helps determine an individual's social capital. Similarly, current living arrangements, volunteering, social activities and available social networks, help determine how a person relates to the social environment and the resources he/she uses to meet his/her needs.

SOCIAL FUNCTION IN OLDER ADULTS

Social function is highly relevant for older adults, yet how it affects the aging experience is not completely understood (Berkman, 1983; Due et al., 1999). In recent years, a growing body of literature has reported on the devastating effects of poor social function on older adult health (Berkman, 1984; Berkman, 1986; Kawachi et al., 1997; Kawachi & Berkman, 2001; Penninx et al., 1999; Tomaka et al., 2006). Research on loneliness, for example, has shown that loneliness increases the risk of mortality, decreases quality of life and affects physical health and function (Berkman, 1983; House et al., 1988; Penninx et al., 1999). Similarly, work history that reveals exposure to adverse work conditions, as well as prior exposure to a harsh family environment, are related to poor quality of life in older age (Lundberg, 1993; Schwartz et al., 1995). Social function is also a good predictor of adherence to medical and rehabilitation treatment and more importantly, it serves as a preventive measure because it determines the strength of the safety network an older adult has in case of need (Grundy & Bowling, 1999; Penninx et al., 1999). Additionally, social function serves as a predictor for independent living and provides a good prognosis for older adult health (Berkman, 2000).

Benefits of the comprehensive geriatric assessment

The CGA is a useful tool used in clinical practice. It has an important focus on functional status because better functional status has been related to decreased mortality, better self-reported health, lower institutionalization rates and better outcomes after hospitalizations (Cohen et al., 2002; Cott et al., 1999; Depp & Jeste, 2006; Fried et al., 1998; Hogan et al., 1999). However, the CGA recognizes that functional status is not the only domain necessary for older adults to live independently and have a good quality of life. Studies have reported that using the CGA is associated with decreased rates of institutionalization, better adherence to medical treatment, increased satisfaction with medical treatment, and decreased death rates compared to the use of more traditional models of care derived from the biomedical model (Fenton et al., 2006; Graf et al., 2011; Stuck et al., 1993; Stuck & Iliffe, 2011). Additionally, its use is also associated with reduced costs of care for older adults compared to more traditional care models (Scanlan, 2005; Stuck et al., 1993). Beyond this tool, the comprehensive view behind the CGA provides a useful framework that can potentially shift the current aging paradigm and move it closer to the biopsychosocial model described earlier.

The four domains and older adult health

The four domains described above (physical health, functional status, social function and mental health) present a comprehensive way to evaluate older adult health. These domains are useful predictors of health outcomes (Scanlan, 2005; Stuck & Iliffe, 2011). They are important individually but also in combination and provide a valuable tool for healthcare providers. For researchers, these domains provide a complete baseline status for older adults. This baselines status can then be used to determine how these adults will cope when exposed to adversities. This status can also be used to analyze the relationship between different factors and recovery over time.

2.2 RESILIENCE

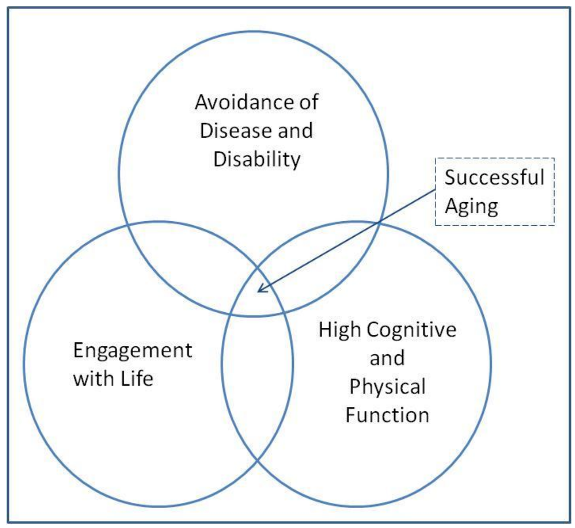
The successful aging concept

In the literature several terms are used interchangeably to define or describe individuals who are at an advantage despite advancing age, the presence of different diseases, or exposure to adverse conditions (Peel et al., 2007). R.J. Havighurst was the first to use the term "successful aging" and defined it as adding quality to the number of years a person lives (Havighurst, 1961). Since then, this term and others like "healthy aging" have been used to refer to individuals who stand out from other older adults, either because they live longer (longevity), or because they are more vigorous, have an active role in their community and have control of their life. These individuals usually have exceptional mental and physical health and some were able to overcome adverse events and report a good quality of life despite those events (Bowling et al., 2002; Bowling, 2007; Harris, 2008). Several psychological, social, biomedical and behavioral factors have been utilized to define successful aging. Many of the same factors have also been used as predictors of successful aging (Depp & Jeste, 2006). However, physical factors tend to be the primary focus.

Models of Successful Aging

A large portion of the literature studying successful aging comes from The MacArthur Study of Successful Aging. This study began in the late 1980's as a longitudinal study intended to define successful aging and identify predictors that could increase the probability for successful aging (Rowe & Kahn, 1987). Selected subjects were given a detailed assessment and were then followed from 1988 through 1996 with periodic interviews, to monitor their status as they aged (Seeman et al., 1994). This study provided important knowledge related to the concept of successful aging and predictors of successful aging. A popular and widely used model of successful aging derived from the MacArthur Studies was published by Rowe and Kahn and is shown in Figure 2.3 (Rowe & Kahn, 1999a). This model is mostly a biomedical model, however it includes a social perspective. This model proposes that absence of disease and disability, social engagement and high cognitive and physical function are the pillars of successful aging (Rowe & Kahn, 1987; Rowe & Kahn, 1999a).

Figure 2.3: Successful aging model (Adapted from the Successful Aging Model by Rowe and Kahn)



Other authors have proposed psychosocial models that emphasize the importance of life satisfaction, social participation, social functioning and psychological resources as key components of successful aging (Baltes & Baltes, 1990; Bowling & Dieppe, 2005; Ryff, 1982). These psychological models focus more on adaptability in older ages and how, despite losses, older adults can adapt to them to age successfully (Baltes & Baltes, 1990). Apart from the biomedical and psychological models of successful aging, the role of older adults' views, perspectives and opinions as key components of successful aging has been analyzed in some studies (Bowling & Dieppe, 2005; Callahan & McHorney, 2003; Strawbridge et al., 2002). Some discrepancies have been documented between what older adults perceive successful aging to be and how researchers define it (Bowling & Dieppe, 2005; Callahan & McHorney, 2003; Strawbridge et al., 2002). Many researchers advocate for a combined approach were the biomedical and psychological models are informed by the needs, interests and opinions of older adults (Bowling & Dieppe, 2005; Callahan & McHorney, 2003). Yet no consensus has been reached thus far.

Benefits related to successful aging

Those using different biomedical approaches have reported that successful aging is related to lower mortality rates, better self-reported health and quality of life (Depp & Jeste, 2006; Rowe & Kahn, 1999a). Authors using psychological approaches have reported that successful aging is related to increased life satisfaction, better quality of life and better adaptation to change (Baltes & Carstensen, 1996; Baltes & Baltes, 1990; Bowling et al., 2002; Ryff, 1982; Strawbridge et al., 2002). A combination of both approaches reveals promising outcomes that would be beneficial to all older adults (Bowling, 2007; Callahan & McHorney, 2003; Phelan et al., 2004). This is the reason why, despite the limitations in the concept of successful aging, it still remains an attractive concept. Many researchers continue to investigate it and establish definitions that are acceptable to many disciplines and can be used to improve older adult health.

Conceptual limitations of successful aging

Researchers have identified four main limitations when trying to apply the successful aging concept. First, existing conceptual frameworks of successful aging are inadequate because they either fail to include many dimensions important to older adult well-being and health or because the dimensions included are too broad and difficult to translate into empirical measures (Bowling, 2007; Bowling & Dieppe, 2005; Callahan & McHorney, 2003; Depp & Jeste, 2006). Additionally, little justification is provided on measures of well-being used in different studies (Bowling, 2007). Second, most successful aging research is conducted based on measures of disease rather than measures of well-being (Berkman et al., 1993; Montross et al., 2006; Ryff, 1982; Vaillant & Mukamal, 2001). In other words, well-being is basically defined as the absence of disease, rather than an independent state with known benefits on health and disease outcomes. Third, most models fail to recognize growth and developmental processes in older adults (Baltes & Baltes, 1989; Baltes & Baltes, 1990). Older age is usually presented as a static stage. The challenges and unique capital of old age in addition to the possibilities of growth and development are disregarded in most models. Finally, the successful aging concept is very sensitive to cultural differences and change over time. How the concept of successful aging is interpreted by different groups of older adults and the cultural differences in how successful aging is experienced are not addressed in most models (Baltes & Baltes, 1989; Baltes & Baltes, 1990). In addition to these conceptual limitations, some argue that operational limitations also exist.

What successful aging is lacking

People who live longer and are healthier in older life and those who satisfactorily overcome adverse events have common characteristics (i.e. healthier lifestyles, better coping mechanisms, positive attitude) that facilitate overcoming those events (Bowling, 2007; Rowe & Kahn, 1987; Rowe & Kahn, 1998). Many of these characteristics are included in the different successful aging models that are available. To date however, most existing models lack a multidimensional approach and reflect a discipline specific perspective rather than a multidisciplinary comprehensive perspective.

Problems with the term successful aging

Some researchers argue that “successful” is not an appropriate term because it dichotomizes adults into either successful or unsuccessful (Baltes & Carstensen, 1996; Bowling & Dieppe, 2005; Strawbridge et al., 2002) limiting the variability of the successful aging experience and overlooking the heterogeneity among older adults. Another flaw in the successful aging term is that it fails to include recovery as a key part of aging successfully. It is clear that with old age the risk of disease and disability increases. However, many older adults recover from diseases and disability while others do not. It is those characteristics that facilitate the recovery process that are thought to be of most value for a successful aging experience.

Limitations of successful aging studies

Many criticize that studies analyzing successful aging have excluded older adults with disability who might still age successfully despite not fitting existing successful aging models. (Holstein & Minkler, 2003; Scheidt et al., 1999). To complicate matters further, a considerable amount of research on successful aging has derived from population based studies not designed to assess successful aging (Andrews et al., 2002; Angel, 2009; Day & Day, 1993; Lamb & Myers, 1999; Menec, 2003; Montross et al., 2006; Palmore, 1979; Uotinen et al., 2003; Vaillant & Mukamal, 2001). These studies have used tools to measure different aspects of aging that are then incorporated into successful aging models. External validity of this approach has not been thoroughly analyzed questioning the generalizability of many findings.

Selected studies on successful aging

The MacArthur studies for example, selected the top 30% of the population in terms of cognitive status (Berkman et al., 1993). This approach introduces a bias because those individuals defined as successful agers are mostly individuals who were successful during their entire lives because they had higher socioeconomic status (SES) (Lupien & Wan, 2004). Moreover, very few studies have directly asked older adults if they believe they are aging successfully or what they think successful aging is (Baltes & Carstensen, 1996; Bassett et al., 2007; Bowling & Dieppe, 2005; Phelan et al., 2004).

Finally, most studies on successful aging to date have neglected to differentiate subpopulations of older adults. Hence, it is difficult to compare the likelihood of success among older adults with high SES to those in underserved populations with limited access to resources. This latter group is likely to have a different path to successful aging (Austin, 1991).

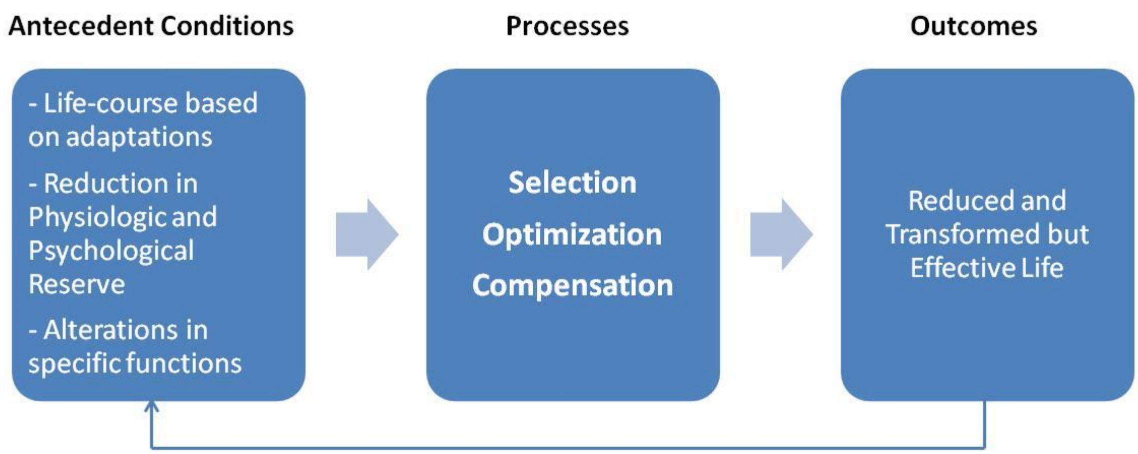
Problems with alternate terms

Use of alternative terms such as healthy aging, active aging and positive aging has been attempted ineffectively. The term healthy has several limitations because if aging successfully is regarded only as more years of "healthy" life, older adults with any medical condition are automatically excluded (Bowling & Dieppe, 2005; Hildon et al., 2008). The term active aging has been endorsed by the World Health Organization (WHO, 2002). Despite their attempts to use a more comprehensive and less biomedical model, the term active aging still relies heavily on function as the most relevant factor of the aging experience. Similar to the limitations presented by the term successful aging, many have argued that active aging excludes older adults with disability who can have a successful aging experience despite their functional level. Furthermore, the WHO model includes the terms health, independence and productivity. This adds to the conceptual difficulties and limits the likelihood that many older adults fit the criteria (Bowling, 2009; WHO, 2002). Positive aging has also been used. Many have criticized this term because it implies that all older adults have a positive view of the aging experience. Additionally, the term automatically excludes older adults with common psychological conditions like depression. Use of a broader and more inclusive term has therefore been proposed.

The model of selective optimization and compensation

In 1990 Paul and Margret Baltes proposed an alternate model of successful aging. This model mostly uses a psychological perspective and is the first to include variability and plasticity as key components necessary to adequately study the psychology of aging (Baltes & Baltes, 1990). Based on the premise that there is large variation in the aging experience among older adults and that regardless of age all older adults have the capacity of learning new things and adapting to change, Baltes and Baltes propose the model of selective optimization with compensation (Baltes & Baltes, 1989; Baltes & Baltes, 1990). This model is one of the few that analyzes successful aging as a life-long process and includes adaptation as an important and widely used mechanism older adults use to age well. The model is summarized in Figure 2.4.

Figure 2.4: Model of selective optimization and compensation (Adapted from Baltes & Baltes 1990)



There are several conditions that adults bring with them when faced with adverse events. Life-course characteristics and declines secondary to age or disease represent the antecedent conditions of the model presented above. When individuals are faced with an adverse event, they go through a process that researchers have divided in three steps as presented in Figure 2.4. Once individuals undergo this process then different outcomes are observed.

Losses and deficits "force" older adults to focus on high priority areas and adapt to new situations. In other words, older adults make choices and adjust their expectations and goals to maintain satisfaction and control (selection) based on their losses and deficits. Older adults also "engage in behaviors to enrich and augment their general reserves and to maximize their chosen life-courses"(Baltes & Baltes, 1990) in order to deal with these situations (optimization). Finally, individuals make changes, develop new strategies and use aids and technologic devices to sort the limitations and adapt to the situations they are facing (compensation). Ultimately the selection, optimization and compensation processes result in older adults transforming their lives and living effectively.

Framework of the selective optimization and compensation model

The selective optimization with compensation model is based on seven principles related to the aging process: 1) normal, pathological and optimal aging are distinct processes, 2) aging is a heterogeneous process, 3) plasticity and reserve capacity are present in all individuals, 4) the aging process causes losses that affect reserve capacity and adaptation, 5) individual and social knowledge (including technology) can buffer the aging losses 6) the balance between gains and losses is affected in old age, 7) individuals remain resilient in old age (Baltes & Baltes, 1990). Despite this model being very comprehensive and more flexible than other models, several authors have pointed two major limitations. First, the heavy emphasis on psychological aspects of aging mask the major role of physical and physiological changes in aging. Second, the model puts a lot of emphasis on how much individuals can contribute to their own successful aging when in fact this might be limited (Fry & Debates, 2010; Hertzog & Jopp, 2010; Lupien & Wan, 2004). Additionally, this model, like most other successful aging models, was developed based on a mostly white population. Many cultural and social distinctions are not included in the model, thus making it hard to apply to a variety of population groups. Nevertheless, this model addresses the concept of adaptation and provides a clear and positive picture of psychological changes that occur with aging.

The Concept of resilience

In the 1960s and 1970s, psychologists and psychiatrists observed that among children exposed to risk or adversity there was a group that developed normally and led normal adult lives, despite these adversities. Researchers termed this ability to overcome adversity, resilience. Most of the literature on resilience to date comes from studies on children and adolescents (Windle, 2011). From this literature, several important points have been derived. First, to talk about resilience two judgments are usually made: a) successful adaptation has occurred and b) there was exposure to a significant threat (Masten et al., 1999; Masten, 2007). Second, resilience is a multidimensional concept (Fry & Debates, 2010; Masten, 2007; Schoon, 2006). Third, resilience is embedded in a cultural, developmental and historical context (Fry & Debates, 2010; Schoon, 2006). Fourth, there are internal and external factors that determine resilience (Fry & Debates, 2010; Schoon, 2006). These points seem to overcome many of the limitations previously identified of successful aging. Furthermore, recovery from adverse events is a key component of resilience making it well suited for the study of aging.

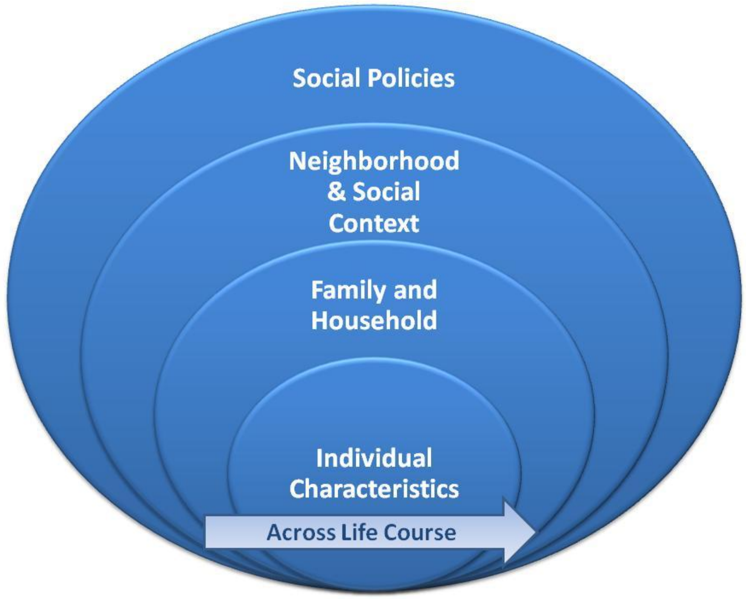
Importance of resilience

Gerontological research has changed in the past two decades and more attention is focused on health policy and practice and the impact that different conditions have not only on older adult health, but also on well-being and quality of life (Fry & Debates, 2010; Windle et al., 2011). Resilience is hence an important topic to analyze in older age. The aging experience is quite different from childhood and adolescence and therefore several attempts have been made to define and operationalize resilience in older age (Windle et al., 2011; Windle, 2011). Based on a recent literature review there is consensus in the literature about the ability older adults to recover from adverse events (Windle, 2011). It also reports that there is consensus on the role of protective factors (assets, resources or strengths) on recovery (Windle, 2011). Protective factors are essential for achieving resilience. In addition to these protective factors, there is also consensus on the role of competence as an essential component of resilience. Competence is the motivation behind recovery that allows individuals to use their resources and adapt to adverse situations. (Windle, 2011).

Protective factors in resilience

Protective factors are essential in accomplishing resilience. They determine the degree to which an individual can positively respond to adverse exposures and change to reduce the effects caused by these exposures. Protective factors interact, allowing individuals to adapt by using internal and external resources (Windle, 2011). Protective factors have been commonly identified at four levels that are summarized in Figure 2.5: 1) individual, 2) life and 3) social (Garmezy, 1985; Werner, 1995; Windle, 2011). Individual protective factors include psychological characteristics of the individual including personality traits and biological characteristics. They also include physiological responses to stress and physiological reserve. Life related factors include unity within the family, family structure and emotional support. Social protective factors include support systems, social networks and economic factors. Social policies present another level where resources can be obtained to facilitate resilience. Social policies determine the availability of employment, healthcare, housing and education for all individuals. However, individuals usually have little control over which resources will be available to them.

Figure 2.5: Levels where protective factors may take place (Adapted from Windle, 2011)



What is resilience?

From the evidence available, an assessment of resilience should at minimum include a description of the risk or adverse event the person was exposed to, the protective factors this person has to compensate for this adversity, and finally a description of the outcome where evidence of a better than expected outcome is observed (Windle, 2011). Based on this Windle proposes the following definition of resilience: “The process of effectively negotiating, adapting to, or managing significant sources of stress or trauma. Assets and resources within the individual, their life and environment facilitate this capacity for adaptation and ‘bouncing back’ in the face of adversity” (Windle, 2011). Additionally, she concludes that the experience of resilience varies through the life-course and that protective factors are specific in the sense that they may work for some adverse exposures but not others (Windle, 2011). From the above information it is evident that resilience is broader than “successful aging”; resilience also removes the physical bias that current successful aging models have and highlights the psychosocial aspects of aging.

2.3 LIFE-COURSE APPROACH

How the comprehensive geriatric assessment, successful aging and resilience fit together

Older adults reach old age bringing with them a life of experiences, exposures and health conditions that have shaped who they are. Older adults have grown and developed through different life stages. They have been exposed to physical, biological and psychological factors, some of them good and some of them bad that have left a positive or negative mark on them. A large portion of the aging literature focuses on a specific life period and analyzes how different factors modify this period. Despite this being an important issue, little attention has been given to the difference between old age (a life period), old persons (as individuals), old people (as a group) and aging (as a lifelong process) (Settersten, 2005). Thus, a comprehensive evaluation of older adults (using the conceptual basis behind tools like the CGA), that 1) focuses on factors that promote healthy, active, productive and gratifying aging experiences (using the successful aging concept) and 2) includes recovery as a key element allowing individuals to cope with adverse events and return to baseline functioning, is a worthwhile endeavor.

What is the life-course framework?

In order to appropriately understand aging, the life-course of individuals must be considered. As previously stated, older adults do not simply become old overnight. There is a process that occurred over their life-course that made them who they are. This life-course can provide clues not only to understand why they are the way they are, but also to plan what needs to be done in the future. Since the 1990's a lot of attention has been devoted to analyze and understand the life-course and how it affects the aging experience. It is now widely accepted that experiences in childhood and adolescence outline trajectories into old age (Keating & Hertzman, 1999; Settersten, 2003). In the medical field, for example, key components of the medical history are the personal health history and the family health history. Clinicians recognize that diseases experienced earlier in life and diseases experienced by family members have a predictive value on a person's health later in life (Hall et al., 2002; Scheuner et al., 2004; Strohman, 2002). Similarly, research from sociology, psychology, and developmental sciences has shown that the social context, the psychological condition, and the interaction between biological and social factors have an enduring effect on individuals and must be analyzed to adequately understand individual development and consequently aging (Settersten, 2003). Thus, the life-course framework is a "dynamic and process-based approach to understanding trajectories and transitions for individuals and cohorts as they grow up and older."(Settersten, 2005).

Principles of the life-course framework

A good summary of the life-course framework is that it "emphasizes the need to identify the processes and mechanisms that underlie age-related effects."(Settersten, 2003). In order to identify these processes and mechanisms, five principles have been established that guide the life-course framework and are listed in Table 2.2 (Elder & Johnson, 2003). The first principle emphasizes that childhood experiences are necessary to understand adaptation in later life (Elder & Johnson, 2003). Since aging is a lifelong process that starts with conception and ends with death, all experiences are connected and relevant in the aging process (Crosnoe & Elder, 2002; Elder & Johnson, 2003). The second principle emphasizes the notion that individuals are active participants in the life-course and construct it through the choices and actions they take (Elder & Johnson, 2003). It also provides a caveat: choices and actions are limited by historical and social circumstances. The third principle states that the life-course is determined by the time in history when the individual lives (Elder & Johnson, 2003). Historical events such as wars, natural disasters, epidemics, scientific advances and economic conditions shape the life-course and impact aging. The fourth principle establishes that not only the type of events or transitions individuals experience but when in their lives they occur determine the effects of such events and the enduring consequences for older life health (Elder & Johnson, 2003). The fifth and final principle, proposes that individuals are connected to others and establish networks based on relationships that affect the life-course and therefore shape aging (Elder & Johnson, 2003).

Table 2.2: Principles of the Life-Course Framework (Adapted from Elder and Johnson, 2003)

Five Principles of the Life-Course Framework
Principle of Human Development and Aging as Lifelong Processes
Principle of Human Actions in Situations With Different Limitations and Options
Principle of Historical Time and Place
Principle of Timing in Lives
Principle of Linked Lives

Using the life-course framework

Based on the five principles, several propositions that guide aging research have been identified (Settersten, 2003). Many of these propositions are related to the overarching topic of this dissertation. Despite the benefits of the life-course approach and recent advances in life-course methodology, it is still difficult to link early experiences to outcomes in old age (Settersten, 2003). Some authors propose that the life-course is "comprised of multiple, interlocking trajectories that vary according to the synchronization of those trajectories."(Settersten, 2003). They also propose that "…life-course experiences generate trajectories of vulnerability and resilience that culminate in different levels of health and well-being."(Settersten, 2003). The objective of life-course studies, therefore, must be to understand variations in the context that have an effect on individuals' lives, their development and aging overall. Thus, breaking down the life-course into patterns of change and stability, termed trajectories by many researchers, provides an easy way to approach the dynamic interaction between social factors and health (Elder et al., 1996; George, 2003). Trajectories can be characterized on the basis of: 1) timing or age, 2) duration, 3) sequencing of transitions and 4) density of transitions (George, 2003). At what age a trajectory started and ended, how long the trajectory lasted, the order in which different transitions started or ended within a given trajectory and the number of transitions within a given trajectory can be used depending on the source on the data and the research question (George, 2003).

Life-course and resilience

The life-course framework provides a comprehensive approach to aging by recognizing that older adults become old after a process that is influenced by both external and internal factors that shape each individual differently (George, 2003). Therefore, analyzing the response to adverse events from a life-course perspective provides a better assessment of why the individual responded in a specific way and serves as a predictor of how he/she might respond to future events. Resilience consequently depends on both the status of the individual when faced to an adverse event (current status) but also to the history he/she brings from previous events and conditions. Understanding how factors from the present and the past interact to outline the aging experience of different individuals, can provide useful information to help older adults prepare for adverse events and face these events while limiting their harmful effects.

Life-course in different countries

The life-course approach is also very important when populations of older adults from different countries, even from different ethnic backgrounds, are compared

(Settersten, 2003). As previously stated, one of the flaws of the successful aging literature is that the models used have been created from Non-Hispanic White American or European populations. Populations from developing countries are quite different from these populations and therefore the validity of these models is not known. Major differences that might limit the validity of such models are differences in the life-course that shape older adults, who respond completely different to adverse events and have completely different resources to help them overcome those events and "bounce back" after them.

Life-course and aging in Latin America and the US

In the case of Latin America for example, aging has occurred at a faster rate compared to developed countries (Wong & Palloni, 2009). Additionally, this aging process has occurred in the midst of low economic development and inadequate infrastructure to support a growing number of older adults (Kinsella & Wan, 2009; Wong & Palloni, 2009). The life-course of older adults in Latin America is therefore marked by exposure to many infectious diseases, poor access to healthcare and limited basic needs (Samper-Ternent et al., 2012b; Wong & Palloni, 2009). Additionally, older adults in Latin America are currently living in a mixed epidemiological regime (Samper-Ternent et al., 2012b). Conversely, older adults in developed countries like the United States benefited from a life-course with higher standards of living and lower exposure to infectious diseases. How the combination of a disadvantaged childhood with a current mixed epidemiological regime will impact health, disability, and mortality of older adults in Latin America compared to those in the United States, requires further examination. Resilience is therefore likely to be different for older adults with diverse life-course experiences.

2.4 Cross-national Comparisons

Why are cross-national comparisons important?

Since the 1990's there has been increasing awareness on the importance of cross-national comparisons (National Academy of Sciences, 2001). It is widely accepted that studies that use these comparisons advance our understanding of many sociomedical issues (Lynn, 2003; Lynn et al., 2005; National Academy of Sciences, 2001). However, there are important conceptual and methodological limitations to keep in mind when conducting cross-national comparisons (Lynn, 2003; Lynn et al., 2005). We live in a globalized world where economic trends are affected by what happens in markets around the world, where migration is a pressing issue for many countries and where limited resources promote taking advantage of existing initiatives that work rather than inventing and testing new solutions every time a problem arises (Kapteyn, 2010; National Academy of Sciences, 2001). Additionally, it is important to determine which social processes are universal and which are specific to each country and influenced by specific cultural and social norms.

Advantages of cross-national comparisons

In addition to the conceptual benefits of cross-national comparisons, they are also appealing because researchers can compare parameter estimates for different regions (Lynn, 2003; Wolf & Hoffmyer-Zlotnik, 2003). Life expectancy, mortality rates, and healthcare access are all parameters that can be compared between countries and can provide useful information (Wolf & Hoffmyer-Zlotnik, 2003). Also, countries can be ranked according to, for example, the quality of care provided to their population (Wolf & Hoffmyer-Zlotnik, 2003). Indicators like infant mortality, use of preventive measures and distribution of economic resources, can be compared among countries to establish a rank. Additionally, cross-national comparisons allow for the aggregation of estimates from many countries in order to provide estimates related to regions or countries with shared characteristics (Lynn et al., 2005; Wolf & Hoffmyer-Zlotnik, 2003). Comparisons of developing and developed countries or European and American countries can provide useful information on regional trends and shared regional characteristics that can enhance our knowledge on social processes occurring in those regions. Finally and most importantly, cross-national comparisons allow researchers to analyze and compare how different determinants affect specific outcomes in different countries (Kapteyn, 2010).

Limitations of cross-national comparisons

Despite these advantages, cross-national comparisons also have some limitations. First, between and within country variation must be accounted for (Kuechler, 1987; Lynn et al., 2005). Between country variation is more apparent than within country variation. For example, health and education coverage differs by country, some countries have universal coverage while others do not. Political and economic conditions also vary by country. Healthcare coverage, education, political and economic conditions all affect health and must be controlled for when comparing two countries (Banks et al., 2006; Banks et al., 2010). On the other hand, variation within each country is harder to capture but also impacts cross-national comparisons. Two countries may have a similar percent of the population with healthcare coverage or a similar mean number of years of education. However, the same percent healthcare coverage or mean education can be observed in countries that are quite different. Cultural differences between different regions within each country, a centralized versus a decentralized government, economic factors affecting different regions within each country, can all affect health in each country (Larsen et al., 2009; Wolf & Hoffmyer-Zlotnik, 2003). Health profiles for each country are different and comparing health conditions among these countries must be done carefully (Larsen et al., 2009; Wolf & Hoffmyer-Zlotnik, 2003). Comparable healthcare and education categories that account for the variability in each country must be established before a reasonable comparison can be made.

Another limitation with cross-national studies lies on how equivalent different dimensions are between countries. How populations in different countries understand and manage different conditions imposes limitations on how different dimensions can be compared (Kuechler, 1987; Lynn et al., 2005). This is even more difficult given the limited availability of analytic tools and methodologies to perform adequate data analysis (Kuechler, 1987; Lynn et al., 2005). Finally, measuring the effect of cultural bias is an important issue and there is a lot of debate over whether this type of bias can be appropriately accounted for (Kuechler, 1987; Lynn et al., 2005; Wolf & Hoffmyer-Zlotnik, 2003).

Cross-national comparisons and aging

With these advantages and limitations in mind, cross-national comparisons are useful in aging research because they draw attention to the differences in the aging process between nations (National Academy of Sciences, 2001). They also explore whether national trends related to aging are distinct and culture specific or more widespread than commonly thought (National Academy of Sciences, 2001). Cross-national comparisons offer an opportunity to evaluate the impact of public policy. This is highly relevant for aging since several years of follow-up are usually required to evaluate the effect of policies on health outcomes. Finally, cross-national comparisons also enhance our understanding of variations in the dynamics of population aging by comparing how populations in different countries age (National Academy of Sciences, 2001).

2.5 Older Adults in Mexico and the United States

Why comparing these groups makes sense

There are geographic, economic and demographic reasons why comparing older adults in Mexico and the United States (US) is important. Given that the US and Mexico are neighboring countries, individuals and resources are constantly moving across the border. This movement of individuals and resources between both countries generates economic, social and health dynamics that are unique. Mexico has provided a labor force for many years to the US. This international migration has economic and demographic implications for both countries. Additionally, a considerable amount of remittances are sent back to Mexico by immigrants, which also has important implications (de la Fuente, 2010; Sana, 2008). Individuals move between both countries for different reasons. Why people move between both countries, and under what circumstances they move, are questions with implications for public policy and health. These geographic, economic, social and demographic characteristics over the life-course impact older adults. Understanding the factors that modify how individuals are affected by these factors will provide information necessary to improve older adult health in both countries.

Aging in Mexico

Aging in Mexico and other Latin American countries is quite different compared to aging in the United States. Researchers have summarized the aging differences between Latin America and more developed regions in five major points: first, aging in Latin America has occurred faster compared to other regions (Wong et al., 2007; Wong & Palloni, 2009); second, this faster aging occurs in countries with poor standards of living (Wong et al., 2007; Wong & Palloni, 2009); third, aging is occurring in the midst of weak economies, changing intergenerational relations and limited institutional support and health care services for older adults (Wong et al., 2007; Wong & Palloni, 2009); fourth, the current cohorts of older adults are the product of medical advances that among other things significantly decreased childhood mortality (Wong et al., 2007; Wong & Palloni, 2009); and fifth, older adults in Latin American countries are exposed to a significant number of infectious diseases while chronic conditions continue to rise to levels similar to those experienced in more developed regions (Wong et al., 2007; Wong & Palloni, 2009). This epidemiological transition where chronic conditions are rapidly rising while infectious conditions are highly prevalent creates a unique aging environment (Samper-Ternent et al., 2012b). This dissertation explored these unique characteristics and how they frame aging and affect resilience.

Older Adults in Mexico

Like most countries in Latin America, the aging process of older adults in Mexico is distinct from that of more developed countries. The large migration from Mexico to the US is an important determining factor for the aging process in Mexico. Other factors that contribute to the unique aging experience in Mexico are the differences between urban and rural areas of the country (Wong et al., 2007; Wong & Palloni, 2009). Older adults in rural areas have limited access to healthcare and education (Wong et al., 2007; Wong & Palloni, 2009). Also, basic needs such as filtered water and electricity are limited in rural areas exposing older adults to more infectious agents (Flisser et al., 2002). Additionally, the limited number of hospitals and healthcare professionals in rural areas - together with the limited infrastructure - translates into higher risk of death from infections. Conversely, older adults in urban areas have better access to healthcare and education (Frenk, 2006; Wong & Palloni, 2009). However, urbanization also brings with it 1) exposure to “westernized” diets with processed foods and 2) limited time for physical activity, both of which increase the rates of obesity (Shamah-Levy et al., 2008). Additionally, exposure to unhealthy lifestyles is more apparent in urban areas, thus increasing the risk for chronic conditions (Smith & Goldman, 2007). Cultural factors such as reliance on families for social support and placing a high value on religious practices also make the aging experience in Mexico unique (Benjamins & Buck, 2008; De et al., 2004).

Aging in the US

The aging experience of adults in the US is quite different compared to the aging experience in Mexico. Rural and Urban differences are present; however, racial/ethnic disparities are more significant (Crimmins et al., 2004). Comparisons between White and Non-White older adults show important differences in life expectancy at birth, in mortality rates and in disability rates (Dunlop et al., 2007; Kissela et al., 2004). These differences closely replicate the socioeconomic gradient reported using data from the Whitehall Study (Marmot et al., 1991). This socioeconomic gradient determines aging pathways and presents challenges to improving older adult health. Additionally, older adults in the US are surrounded by cultural factors that promote individuality and limit the availability of family support while providing better infrastructure and access to resources.

Older Adults in the US

Unlike older adults in Mexico, older adults in the US are eligible for federal health coverage when they turn 65 through Medicare. There is no universal health coverage for older adults in Mexico. This factor alone makes a big difference on the aging experience in both countries. While there are variations in the types of coverage for older adults (depending on their qualifications), overall there is basic coverage available to virtually all older adults in the US. Additionally, from the demographic point of view, older adults in the US benefited from higher standards of living at the time when demographic aging in the US became significant. These living standards provide an "advantage" over older Mexican adults who are still experiencing the epidemiological transition described above. Higher standards of living, healthcare coverage and racial/ethnic disparities present a different historical context for resilience compared to that of older adults in Mexico.

2.6 Research Impact

Accomplishing the specific aims proposed in this dissertation will have a significant impact on aging research. First, a theoretical model of resilient aging will advance the literature on successful aging by adding recovery as a core component. Additionally, the model will identify the medical, functional, cognitive and social aspects that most affect recovery. Differences between two countries, Mexico and the US, will be included in the analysis to determine how factors in each country affect recovery. This comprehensive model ensures that characteristics unique to each population group are captured and analyzed in the context of recovery to better understand resilient aging.

Second, construction of a resilience measure will allow us to validate the concept of resilience in the clinical setting. Resilience is a multidimensional concept. A resilience measure provides a simple way of capturing the different dimensions of the concept. We must carefully understand all the dimensions and capture the essence of each dimension and its relation to other dimensions. This process guarantees that a careful approach to understanding resilience has been followed. Finally, researchers from different disciplines can validate a resilience measure with different interests.

Third, closing the circle, this dissertation will help translate findings from population-based studies into a tool that clinicians can use to measure resilience and counsel patients on ways to maintain or enhance characteristics that may facilitate recovery from adverse events. The translational nature of this dissertation will serve to develop policy and clinical interventions that can positively impact the aging process based on the identified determinants of resilient aging.

2.7 Research Hypothesis

This dissertation will use a comprehensive and life-course approach to study resilient aging in two countries, the US and Mexico. The cross-national comparison between the US and Mexico will provide a great resource to analyze cultural differences, how individual factors affect recovery in two countries with vastly different socioeconomic conditions, and how resilience varies in these countries.

For Aim 1 - Develop a theoretical model of resilient aging applicable to diverse older adult populations. The following hypothesis about resilient aging will be addressed: 1) The predictors of resilient aging will be different in Mexico and the US; 2) Gender will play a different role in resilient aging for Mexico and the US; 3) Life-course will play an important role in differences observed in resilient aging between Mexico and the US; 4) Recovery from different events will vary by country.

Compared to older Non-Hispanic whites in the US, older Mexican adults have lower socioeconomic status, characterized by lower literacy rates, higher poverty rates and lower economic resources, exposure to poorer childhood conditions, limited access to healthcare, and poorer overall health (Palloni et al., 2002; Wong et al., 2007; Wong & Palloni, 2009). Additionally, international migration plays an important role in the aging profile of older Mexican adults while domestic migration is more relevant for current cohorts of older Non-Hispanic Whites in the US. (Wong & Palloni, 2009). Thus, it is safe to assume that predictors of resilience will vary between the US and Mexico.

Similarly, participation rates in labor among older adults in Mexico is much higher compared to participation in labor rates of older adults in the US (Wong et al., 2006). In addition, older adults who participate in the labor force in Mexico usually do so in jobs with high physical demand throughout their labor force career. Conversely, older adults in the US usually participate in less physically demanding jobs (Kinsella & Wan, 2009).

Finally, gender also plays an important part in the differences observed between the US and Mexico. First, the social roles of women in the US and Mexico are quite different (Kanaiaupuni, 2000; Pagan & Sanchez, 2000). As stated above, migration patterns are different in the US and Mexico. Among the age cohorts of older adults that we study, international migration from Mexico into the US is mostly done by men (Durand et al., 2001; Kanaiaupuni, 2000). Educational attainment in Mexico is also higher for men compared to women. Additionally, employment rates for men in Mexico are significantly higher compared to women (Palloni & McEniry, 2007; Smith & Goldman, 2007). Differentials in education and employment are also observed between men and women in the US, but the differences between men and women are smaller in the US (World Bank, 2012). These and other factors are likely to result in aging patterns that are quite different for men and women.

For Aim 2 (Construct a resilience measure using four domains that provide a comprehensive evaluation of older adults) I will address the following hypothesis: 1) Validity and reliability of my resilience measure will be similar in both population groups; 2) The resilience measure will significantly predict important adverse outcomes similarly in both population groups; 3) The correlation between the different domains and the relationship between the different domains and recovery will be similar for both population groups.

For Aim 3 (Determine which domains at baseline are associated to recovery for both populations) I will address the following hypotheses: 1) Health and function will be stronger predictors of recovery in the US; 2) Social function will be a stronger predictor of recovery in Mexico; 3) Mental status will play a similar role in recovery for both countries, however, cognitive status will be more important in the US while affective status will be more important in Mexico; 4) The recovery measure will be a better fit for older adults in the US compared to the cohort in Mexico.

Availability of health insurance for most older adults in the US, in addition to better technology and resources, will result in different recovery rates from the physical and functional standpoint (Centers for Disease Control and Prevention (CDC), 2001; Kinsella & Wan, 2009). Additionally, less exposure to infections, better education and a stronger infrastructure that supported the needs of older adults in the US will also impact overall health and function in this group compared to the group in Mexico (Flisser et al., 2002; George, 2003). Conversely, cultural factors that place a lot of value on family and social cohesion will positively influence the recovery rates of older Mexican adults (Mendez-Luck et al., 2009; Wong et al., 2007; Wong & Palloni, 2009).

The relationship between mental status and recovery will be more difficult to analyze. From the cognitive standpoint, higher SES, specifically higher education rates and better overall health, will benefit older adults in the US. However, better social support will probably protect older adults in Mexico from affective conditions such as depression. Finally, since most of the available literature on resilience comes from populations in developed countries like the US, it is reasonable to expect that the measurement derived from this theoretical background will better characterize older adults in the US compared to their Mexican counterparts. However, the careful design of the measurement will account for this and provide a good tool that can be used in both populations with similar results.

Chapter 3 Data Sources

This chapter will describe the Mexican Health and Aging Study and the Health and Retirement Study that were selected for the analyses of this dissertation. Details from both studies will be provided to show the high comparability between them. Important differences will also be highlighted. Then, an ideal study to analyze resilience will be described briefly. Finally, the inclusion criteria used to select the samples from both studies will then be described.

3.1 Studies

Objective of the Mexican Health and Aging Study and the Health and Retirement Study

For this dissertation I selected panel survey data from the Mexican Health and Aging Study (MHAS) and the Health and Retirement Study (HRS) in the United States (U.S.). I use two waves of data from the MHAS and HRS studies, each conducted two years apart, in order to examine resilience. The objectives for both studies are presented below. Additionally, general details for both studies are presented in Table 3.2.

Table 3.2: Comparison of general characteristics of the MHAS and HRS studies (Adapted from Wong et al., 2010)(Wong et al., 2010).

	HRS	MHAS
General Description	Large-scale longitudinal study of adults 50 years and older. Started in 1992, conducted every two years, and is ongoing.	Prospective panel study, of adults 50 years and older in 2001, with a follow-up in 2003. Third wave collected in 2012.
Representativeness	Nationally representative of the United States community dwelling population. Includes an oversample of African Americans, Hispanics and residents of the state of Florida.	Nationally representative of non-institutionalized individuals in urban and rural areas in Mexico. Includes an oversample of high migration states.
Survey Protocol	Direct interview with eligible respondents and proxy interviews when poor health or absence. A next-of-kin interview is conducted with a proxy informant for deceased respondents.	Direct interview with eligible respondents, and proxy interviews when poor health or absence. A next-of-kin interview was conducted with an informant for deceased respondents.
Weights	Weights were post-stratified to the Current Population Survey (CPS) of the month of March based on the birth cohort as well as the gender and race/ethnicity.	Weights were stratified, based on the birth cohort, household composition, and place of residence by urban/rural areas.
Survey Content	Health and cognitive evaluation Demographic background Employment status and job history Retirement plans and perspectives Family structure and transfers Housing conditions Anthropometric measures	Health and brief cognitive evaluation Detailed demographic background (childhood health and living conditions, and migration) Family structure and transfers Housing conditions Anthropometric measures
Samples Used in the Analyses	Waves 5 and 6 (2000 and 2002) Adults 65 years and older in 2000, and 67 years and older in 2002 Sample size = 7898 in 2000 and 6567 for longitudinal analyses	2001 and 2003 waves Adults 65 years and older in 2001, and 67 years and older in 2003 Sample size = 4423 in 2001 and 3606 for longitudinal analyses

Mexican Health and Aging Study

The MHAS is a two-wave prospective panel study of community-dwelling individuals born in Mexico prior to 1951 and their spouses regardless of their age. The study was funded by the National Institute on Aging and conducted by researchers at University of Pennsylvania, University of Maryland, University of Wisconsin, and the Instituto Nacional de Estadística, Geografia e Informática (INEGI) in Mexico. The aims of the MHAS study were to examine the burden of disease and disability on the aging processes of a large representative panel of older Mexicans. This study also wanted to evaluate the effect of individual health behaviors, early life conditions, migration and economic status, community characteristics, and family transfers on multiple health outcomes. The MHAS study provides information about perceived health conditions, cognitive status, and use of health services among adults 50 years and older in the year 2000 who resided in urban or rural areas of Mexico. This study also identifies the employment conditions, income status, well-being, availability of pension, and family networks of this population cohort. More detailed information can be found elsewhere (Mexican Health and Aging Study, 2009; Wong et al., 2007; Wong et al., 2010).

Health and Retirement Study

The HRS is a large-scale longitudinal study of Americans over the age of 50 with funding from the National Institute on Aging. This ongoing study is nationally representative for community-dwelling elders in the United States and is conducted bi-annually. It was designed to collect information to help explain the factors preceding retirement and the consequences of retirement in the US. It was also designed to examine the longitudinal relationship between health, income, and wealth and the life-cycle patterns of wealth accumulation and use. The HRS also provides information to analyze work disability. Finally, the HRS collects information that can help identify how differences in socioeconomic status affect health outcomes among older adults in the

U.S.; additional information on the HRS is available elsewhere (Juster & Suzman, 1995; Ofstedal et al., 2005; Wallace & Herzog, 1995).

Sampling Scheme for the MHAS and the HRS

MHAS

The sampling procedures and survey design of the MHAS were modeled after the HRS (Mexican Health and Aging Study, 2009; Wong et al., 2010). MHAS is nationally representative of approximately 13 million Mexicans from rural and urban areas. Oversampling of states with history of high out-migration to the United States was done using a rate of 1.7 to 1 (Mexican Health and Aging Study, 2009; Wong et al., 2010). The baseline survey was conducted during the summer of 2001 and is composed approximately of 15,000 eligible persons. The baseline sample was randomly selected from the National Employment Survey in Mexico collected in 2000 and included 11,000 households with at least one respondent aged 50 years or older from rural and urban areas (Mexican Health and Aging Study, 2009; Wong et al., 2010). This study used a cluster sampling methodology with multiple stages, to randomly select households with at least one eligible adult aged over 50 years (Mexican Health and Aging Study, 2009; Wong et al., 2010; Wong & Degraff, 2009). An in-person interview was conducted with each individual whenever possible and proxy interviews were obtained when the subjects had poor health or were not present. A response rate of 90.1% was achieved on this wave with a sample of 13,463 adults (Mexican Health and Aging Study, 2009; Wong et al., 2010; Wong & Degraff, 2009).

A follow-up visit was conducted in 2003, 93% of original respondents were re-contacted. Both, respondents and their partners interviewed in 2001, were targeted for the second interview, regardless of whether or not the household had relocated between baseline and follow-up. Direct and proxy interviews were performed. If the respondent died between the two time points a next-of-kin interview was performed if an informant was available. More detailed information of the study has been published elsewhere (Mexican Health and Aging Study, 2009; Wong et al., 2006; Wong et al., 2010; Wong & Degraff, 2009).

HRS

The HRS is a multi-stage national area probability sample of households in the United States. Oversampling of Blacks, Hispanics and persons living in the state of Florida was used to obtain a more balanced sample (Juster & Suzman, 1995). Proxy interviews were given to subjects that were too sick or had significant cognitive impairment.

The study began as two distinct longitudinal studies. The first HRS began in 1992 surveying individuals born between 1931 and 1941 (51-61 years of age). In 1993, the Asset and Health Dynamics among the Oldest Old (AHEAD) surveyed a cohort of adults born prior to 1923 (Older than 70 years). Both studies included spouses of respondents. In 1998 the two studies merged and two additional cohorts were added to fill the gaps. Persons born between 1924 and 1930 were added and are known as the Children of Depression Age (CODA) cohort. Additionally, the younger portion of sample was replenished with persons born between 1942-1947 (the War Baby cohort). The result is a national representative panel study of adults over age 50. The combined panel study is ongoing with phone interviews conducted every two years. More detailed information has been published elsewhere (Juster & Suzman, 1995; Wong et al., 2010).

For this dissertation data were used from wave 5 conducted in the year 2000 (baseline) and wave 6 conducted in 2002 (follow-up) of the HRS, using version K of the dataset prepared by the Center for the Study of Aging at the RAND Corporation (Saint Clair et al., 2011). This is a user-friendly dataset compiling all waves of the HRS data and using bracketing methods to minimize non-response in variables such as income and wealth (Saint Clair et al., 2011). The sample size of the 2000 wave of the HRS was 19,579 representing a response rate of 86.9% for that wave (Saint Clair et al., 2011).

Advantages of using the MHAS and the HRS

There are several advantages of using the MHAS and HRS studies to compare resilience. First, the sampling procedures and survey design of the MHAS were modeled after the HRS making both studies highly comparable. Second, both are studies with high response rates and longitudinal follow-up allowing us to observe change over time, in this case recovery over time. Third, researchers have successfully used both studies to study aging in both countries. Additionally, researchers have compared trends of disability using both studies and reported significant differences in the disability profiles of older adults in both countries (Wong et al., 2010). Fourth, Mexico and the U.S. are neighboring countries with ongoing issues related to migration. There are several unanswered questions on how migration affects the health of older adults using comparable studies, some of these questions can be addressed using the MHAS and the HRS. Fifth, each study analyzes a population in a different stage of the epidemiological transition that results in important differences in the challenges each country faces to meet the needs of older adults (Frenk et al., 1991; Samper-Ternent et al., 2012b; Wong et al., 2010). Comparing resilience in both countries will establish a baseline for future studies to develop strategies to improve resilience in different groups of older adults.

Limitations of the MHAS and the HRS in the study of resilience

Despite the advantages presented above, there are some limitations in using the MHAS and the HRS to study resilience. First, issues such as recovery, psychological aspects of aging, and social support are not thoroughly evaluated. Both the MHAS and HRS studies lack a comprehensive psychological evaluation of older adults and lack validated scales to analyze social function. Perception of control, personal competencies, self-esteem and adaptability are not evaluated and yet have been reported to play an important role in recovery (Windle et al., 2008; Windle et al., 2011).

Second, even though the MHAS and HRS are highly comparable, they do not use an identical approach to many aspects of aging that are important for recovery. For example, the tools used to measure cognitive status are quite different. The Telephone Interview of Cognitive Status (TICS) was adapted from an earlier version published in 1988 (Brandt et al., 1988). The TICS evaluates self-rated memory, verbal memory, working memory, orientation, language and abstract reasoning (Ofstedal et al., 2005). Conversely, MHAS uses the screening portion of the Cross Cultural Cognitive Evaluation (CCCE), an instrument designed for cross-cultural epidemiological dementia studies (Glosser et al., 1993). The CCCE has an initial screening part designed to be applied in the field and evaluates visuospatial ability, verbal memory, visual memory and psychomotor speed.

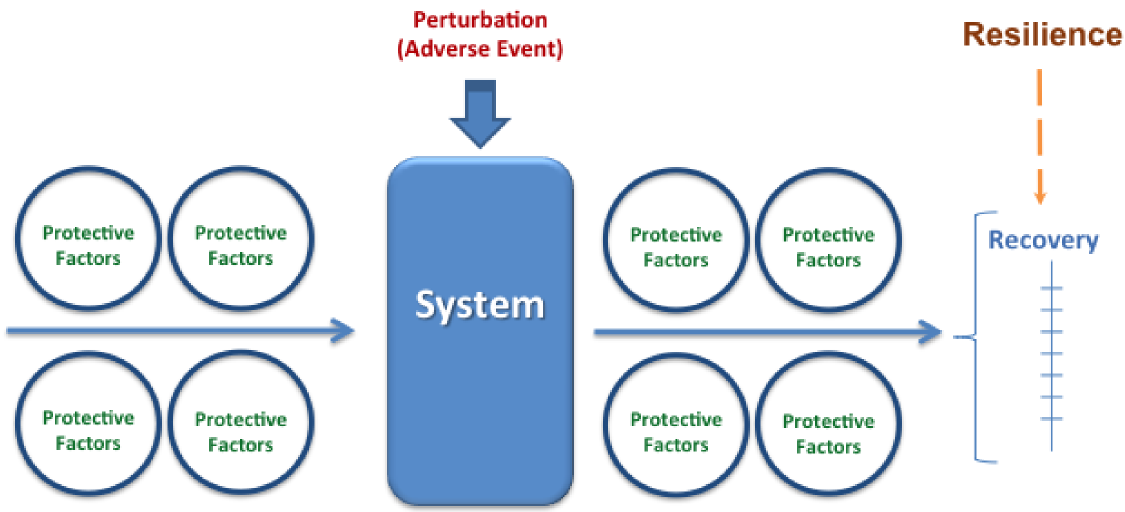
Third, the health evaluation in both studies is based on self-report for most conditions. To adequately assess some aspects of recovery, a clinical evaluation by a physician and a psychologist would be useful. Nevertheless, there are reports in the literature that support a high agreement between self-reported diseases, actual clinical diagnoses and functional status (Bush et al., 1989; Guralnik et al., 1994; Idler & Kasl, 1995; Okura Y et al., 2004). Additionally, this type of evaluation would increase the costs of population-based studies significantly. For the study of resilience however, specific details on onset of symptoms related to the different conditions, type of treatment used for the conditions and perception of how symptoms affect performance of everyday activities, and severity of events, would be useful and are best obtained through standardized in person evaluations (Bush et al., 1989; Idler & Kasl, 1995; Okura Y et al., 2004; Simpson et al., 2004).

Fourth, MHAS conducted in-person interviews on all participants in both waves. Conversely, HRS conducted in-person interviews on the first interview of each participant only. All follow-up interviews for HRS are conducted over the phone. This difference can introduce potential response bias to the data. Despite the excellent and comparable response rates for both studies, answering questions over the phone and in-person is not the same. However, in the initial phases of the HRS study some analyses were conducted that showed no major differences when conducting follow-up interviews over the phone and in person (Willis, 2006).

THE IDEAL STUDY

Based on the conceptual framework presented in Chapter 1, the ideal dataset to study resilient aging will include additional variables to expand on the information currently available. In order to study resilience, I need to identify protective factors in different health domains and observe how they change over time after an individual suffers an adverse event (Figure 3.1). Additional information in the four domains (health, function, mental and social) to get a better picture of the individual's baseline status and how this status changes over time would be very useful. This additional information would then allow us to better understand resilience and identify interventions that can enhance resilience.

Figure 3.1: Model to define resilience



All systems have protective factors. When systems are perturbed, these factors adjust and help the system return to balance. In the case of older adults, health factors, functional status, cognitive abilities and social support protect them. When they suffer an adverse event these protective factors help them recover. This ability to recovery is termed *resilience*.

ADDITIONAL INFORMATION FOR EACH DOMAIN

In the physical domain, exposure to risk factors for different diseases at different stages of the life-course is desirable in the ideal study. For example, exposure to infectious diseases that affect the heart in childhood and lead to congestive heart failure in adulthood would be available in the study. Additional information to identify important geriatric syndromes such as urinary incontinence, polypharmacy, and vision and hearing loss would be included in the ideal study. Biomarkers related to medical conditions that affect health overall and decrease resilience would also be incorporated. Some examples include thyroid hormone levels, vitamin B12 and folic acid levels, creatinine levels, albumin and hemoglobin levels. Low levels of these biomarkers have been associated with diseases that have a significant impact on older adults (Carusso & Silliman, 2009; Crimmins et al., 2008; Halter et al., 2009).

In the functional domain, information to better understand the effect of ADLs, IADLs and mobility limitations on daily function would be added. Even though identifying functional limitations is important, how much adults perceive these limitations interfere with their usual activities is also important and might be a better indicator of where interventions to enhance resilience are required (Guralnik & Ferrucci, 2003; Suthers & Seeman, 2004). Additionally anthropometric measures that determine functional status such as grip strength, walking speed and waist circumference would be obtained. Alterations in any of these anthropometric measures can be indicators of functional decline and can lead to adverse events (Al Snih et al., 2004; Burke et al., 2001; den Ouden et al., 2011; Hughes et al., 2004; Newman et al., 2006; Rothman et al., 2008). Recent work derived from the National Health and Aging Trends Study (NHATS) proposes that disability must be studied using a broad scope where self-reported and performance based measures are included (Freedman, 2009; Jette et al., 2007). Researchers also propose that in order to fully understand functional status, the participation level of individuals and the role of the environment must be analyzed (Fried et al., 2004; Jette et al., 2007; Jette, 2009; Keysor et al., 2010).

In the social domain, validated scales to measure perceived social capital, social support and social networks would be included. These three concepts provide a comprehensive status of the resources available to older adults in the community (Berkman, 1983; Berkman, 1984; Bowling et al., 2002; Kawachi et al., 1997). Additionally, social capital, social support and social networks, provide a life-course idea of such resources, thus allowing researchers to identify stages in the life-course where gains in these resources are observed the most or are affected the most. Understanding how older adults have used resources to overcome difficulties during their lives is useful to determine how they will fair if exposed to adverse events. These findings can then allow researchers to determine life stages where individuals can build social capital and strengthen their social support and social networks. Additionally, this information can help establish patterns of social capital, social support and social networks that are more effective to achieve resilience and others that are less effective.

Finally, in the mental domain, a more comprehensive evaluation of cognitive function would be added to evaluate different cognitive domains. There is a lot of controversy surrounding what the most sensitive and specific tools to measure cognitive function and cognitive decline are in population based studies (Glosser et al., 1993; Shih et al., 2011). The HRS uses a comprehensive set of cognitive measures in all waves starting in 1996 (Ofstedal et al., 2005). However, it has recently added new tools to its longitudinal evaluation based on a longitudinal neuropsychological evaluation conducted on a subsample of individuals between 2001 and 2008 (Langa et al., 2005; Plassman et al., 2007). According to researchers, the addition of tasks such as working memory, verbal fluency, and executive function increase the ability of the HRS cognitive battery to identify individuals with cognitive impairment with and without dementia (Crimmins et al., 2011). It is also clear from the literature that information from a close family member or caregiver provides additional important data to better understand cognitive function among older adults (Crimmins et al., 2011; Fisher et al., 2011; Plassman et al., 2007). Additionally, higher control over one's life, (Diehl & Hay, 2010; Rodin, 1989; Windle et al., 2008), mastery in different life domains (Cott et al., 1999; Hildon et al., 2008; Montross et al., 2006), and positive attitudes and a positive outlook on life (Fisher et al., 2004; Laditka et al., 2009; Ryff, 1982), have all been shown to enhance resilience and therefore are important in understanding resilience in older ages.

The second area that needs improvement in the ideal study is the use of a validated measurement of resilience. The ideal dataset will include a structured evaluation of what older adults perceive resilience to be. In the successful aging literature, researchers have shown that how individuals define successful aging and how they perceive they can achieve successful aging is many times different from what researchers define and perceive successful aging (Bowling & Dieppe, 2005; Phelan et al., 2004). The same holds true for resilience. How older adults define and perceive resilience for each of the four domains would add important information to the study of resilience.

The ideal dataset will also measure commonly accepted psychological components for resilience such as self-esteem, competence and control over interpersonal relations (Windle et al., 2008). A better evaluation of psychological status in older adults will provide information to better understand the psychological aspects of resilience. Recently, researchers have analyzed and validated scales to measure resilience and new scales are being developed and validated (Windle et al., 2011). However, no scale to my knowledge has been validated in minority populations or populations of Hispanic origin. Studies by Windle and colleagues have identified some scales that provide important information that allows researchers to understand the psychology of resilience in older adults (Windle et al., 2011). However, additional research is necessary to validate these scales in different populations.

Finally, the ideal study must provide detailed information to better classify and describe adverse events and analyze how older adults recover from them. The ideal study would include detailed information on onset of each event, specific characteristics of the event such as severity and timing, a self-reported assessment of the event to determine how each event affected each individual. I will describe below how I selected widowhood, severe falls and heart attacks as the three adverse events that I will use to analyze resilience in this study. Table 3.1 lists some additional variables that should be added to the ideal resilience study by domain.

Table 3.1: Additional variables needed in the ideal study for resilience based on my conceptual framework and literature review

To better analyze the Physical Domain:
Medications (number, name and dose; side effects)
Measurement of blood pressure in two different positions
Blood tests such as thyroid function tests and complete blood count
Oral health assessment
Nutritional assessment
Self-report of additional conditions such as congestive heart failure (CHF), Parkinson's disease, fractures, anemia and lung disease
Urinary Incontinence Assessment
Document symptoms and correlate with reported conditions to determine severity
Screening for vision and hearing problems
To better analyze the Functional Domain:
Functional assessments including walking speed, grip strength, balance,
Use of leisure time
Details regarding physical activity (Type, intensity, frequency)
To better analyze the Cognitive Status:
Comprehensive evaluation of memory, executive function, visual-spatial ability, orientation, attention, concentration, learning, language
Depressive symptom evaluation
Neuropsychiatric symptom inventory
Delirium screening
Family member opinion on cognitive status
Positive Affect
Perception of control
Outlook on life: self-esteem, control, mastery
To better analyze Social function:
Social support resources
Social network construction
Identify interests and activities
Financial security
Caregiver burden evaluation

3.2 Analysis of the cohorts from MHAS and HRS

THE MHAS COHORT

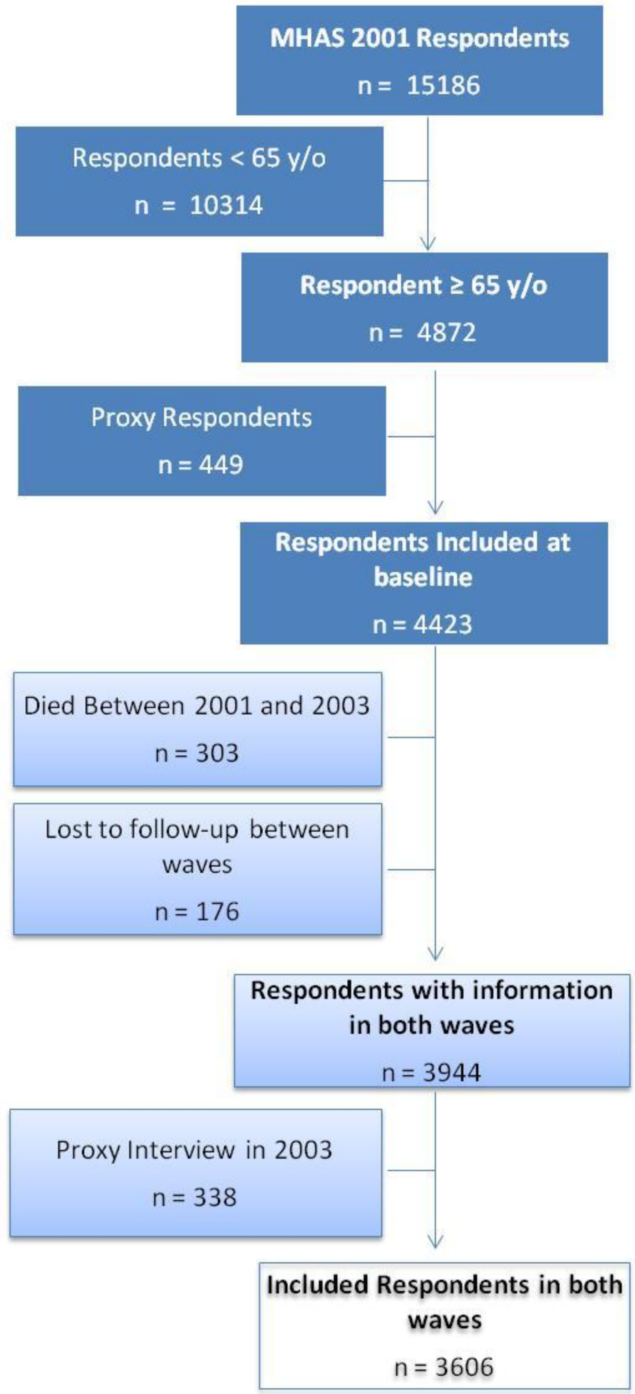
As previously stated, the MHAS study has collected two waves of data so far, one in 2001, from here on referred as baseline and one in 2003, from here on referred as follow-up. A total of 15,186 adults had complete interviews at baseline. Of these 15,186

I excluded 10,314 adults under 65 years of age because my focus is on older adults and because one of the events used to assess resilience – serious falls – was only evaluated in adults over 65. Because complete information in the four domains is necessary for my analyses, a total of 449 proxy respondents at baseline were also excluded from the analyses. This resulted in 4,423 adults over 65 with complete information at baseline.

At follow-up, it was confirmed that of the 4,423 older adults included at baseline, 303 adults died between waves, this group was also excluded. Moreover, because of the longitudinal nature of resilience I removed a total of 176 subjects lost to follow-up, resulting in a sample of 3944. Lastly, 338 adults became proxy respondents between baseline and follow-up and were also excluded from the analyses. The final sample used for analyses consists of 3,606 older adults with complete information from both waves. An outline of the selection of the sample is depicted in Figure 2.2 of this chapter.

Compared to the 1,266 excluded older adults, the 3,606 included individuals are significantly younger, have better cognitive function, have less depressive symptoms, are wealthier, a smaller percentage has healthcare access, have healthier life-styles for the most part and a smaller percentage of adults report poor health (SRH) ($p<0.05$). No significant differences are observed between included and excluded individuals in mean number of years of education, number of children alive, gender distribution or location.

Figure 2.2: Flow chart explaining inclusion criteria used to reach the final sample used for analysis of data from the MHAS Study



THE HRS COHORT

In comparison to the MHAS study, the HRS study has more waves of data. To make both cohorts comparable, I selected the two waves that were the closest in time to the MHAS waves. Waves 5 and 6 of the HRS were conducted in the years 2000 and 2002 and were selected for this study. As seen in Figure 2.3, selection of the sample form HRS was more complex. According to data from previous waves of the HRS, a total of 22,975 individuals were eligible for interview at wave 5. This wave will be from here on referred as baseline. From this sample, 2,479 adults refused to participate in the interview, 1,439 died before the interview and no one was able to provide a proxy interview, and 198 could not be contacted. Additionally, 720 eligible adults were added to the sample mostly because they were new spouses of study respondents. This resulted in a sample of 19,575 eligible respondents at baseline.

From this sample, 3,451 adults identified as belonging to a race/ethnic group different from Non-Hispanic whites and were excluded from the sample to establish a benchmark comparison group for the Mexican cohort. Of the remaining 16,124, 7,076 adults under 65 years of age where excluded. Of the 9048 Non-Hispanic White adults over 65, an additional 1,150 were excluded because they were interviewed by proxy. This resulted in a sample of 7,898 respondents at baseline.

From these respondents at baseline, 624 were confirmed dead between baseline and follow-up and 310 were lost to follow-up between both waves resulting in 6,964 adults with information in both waves. From this group, an additional 397 adults became proxy respondents between baseline and follow-up and were also excluded from the cohort. The final sample used for analysis consists of 6,567 older adults with complete information in both waves.

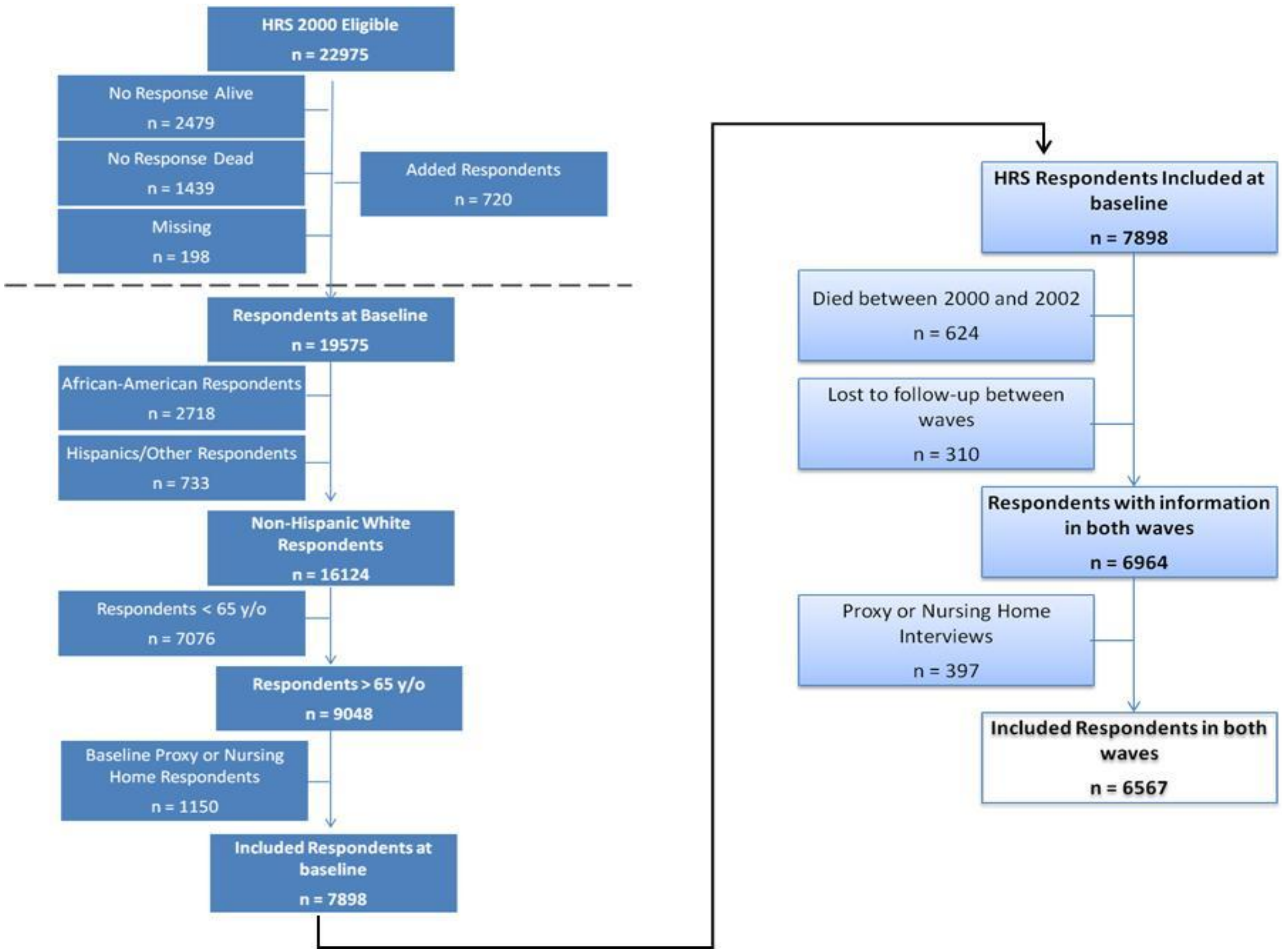
Compared to the 4,167 excluded respondents the 6,567 included respondents were significantly younger, more educated, had higher cognitive function and had fewer depressive symptoms (p<.0001). There were significantly fewer women in the included cohort, there was a larger percentage of respondents living in rural areas, included respondents were wealthier than their excluded counterparts and a smaller percentage reported being sick as a child (p<0.05). Even though there is no significant difference in smoking rates between both cohorts (p=0.44), included respondents have higher rates of at risk drinking, but also have higher rates of exercise compared to excluded respondents (p<.0001). Finally, included respondents have significantly lower rates of poor SRH compared to excluded respondents (p<.0001).

3.3 Conceptual considerations for this Cross-National Comparison

Despite the similarities in the design between the HRS and the MHAS studies, there are some conceptual implications that must be identified and clarified before presenting the methodology used to analyze the data.

First, combining both studies to create a unique dataset to conduct direct comparison is complicated and raises some statistical, conceptual and methodological problems. As previously discussed, the main topic of my work, resilience in aging, is relatively new and how I am defining, operationalizing and analyzing it has not been done before to my knowledge. Therefore, to avoid complicating matters further, and following what other researchers have done when comparing data from different datasets, I will not combine both datasets (Banks et al., 2006; Banks et al., 2010; Patel et al., 2006; Samper-Ternent et al., 2012a). I will conduct a parallel comparison between both studies and highlight observed differences and discuss their implications.

Figure 3.3: Flow chart explaining inclusion criteria used to reach the final sample used for analysis of data from the HRS Study



Second, one major difference to consider between the HRS and MHAS studies is how the baseline interview was selected for each study. For MHAS, the selection was straightforward because there are only two waves of data thus far, so the first wave is baseline and the second wave is follow-up. For HRS however, the actual baseline of the study can be defined in many ways. For example, each original study that now makes the HRS (The original HRS and the AHEAD) has a different baseline (1992 for HRS and 1993 for AHEAD). Additionally, 1998 is the first interview after both original studies were combined. This presents three potential waves of data that could serve as baseline. For comparison purposes however, I decided to use the wave that was closest in time to the MHAS baseline. A total of 36.4% of respondents interviewed for the HRS study in 2000 (wave 5) were from the original HRS and AHEAD studies, the rest were from the new HRS and War Baby cohorts (Saint Clair et al., 2011). Hence most individuals included in my study had already been interviewed at least once before, introducing some recall bias to my study (Dawson & Trapp, 2001). Other authors have discussed this limitation in studies comparing HRS data with European studies and have concluded that even though there is a measurable effect, it is not likely to alter the overall conclusions that can be drawn from comparing the data (Banks et al., 2006; Banks et al., 2010).

Third, there are many factors including historical, political, demographic and cultural factors that might explain some of the differences observed between older adults in both countries. Since I am limited by the available data I cannot determine how these factors affect resilience. However, since these factors are not measured in either study, the comparison may not be affected to the extent that these factors exert a similar effect on both studies.

Fourth, the selection criteria explained above also has implications for my study. I have excluded proxy respondents, deceased respondents and respondents lost to follow-up. This has several implications to the generalizability of the data and highlights some additional differences between the studies. One major difference is that because of cultural, economic and demographic characteristics, institutionalization is a common outcome for older adults in the U.S. but not in Mexico. Hence, the HRS provides data for persons who become institutionalized. However, in Mexico there is no information for institutionalized persons, since most long-term care is provided by family members. I have therefore excluded institutionalized adults from my analysis to keep the datasets more comparable. My analysis is therefore only applicable to non-institutionalized older adults in both countries. Additionally, exclusion of proxy respondents has implications on the analysis of resilience. Proxy respondents usually have poorer health and poorer outcomes. Therefore, it is likely that I am overestimating resilience. However, scholars using HRS and MHAS have shown that proxy respondents only represent about 7% of adults over 50 for both studies (Wong et al., 2010). Finally, exclusion of individuals who die between waves can also bias my estimates of resilience. Death is the opposite of resilience, meaning that the individual could not overcome the adverse event and died. However, since MAHS only has 2 waves, I needed complete information on all respondents to be able to analyze recovery. Again, death rates for both studies are low at 6.9% of respondents at baseline over 65 for MHAS and 7.9% for HRS.

3.4 Summary

I have selected two nationally representative samples of older adults in Mexico and the U.S. to compare resilience. These samples were obtained from studies with similar design schemes and use comparable instruments to investigate the aging experience of adults in each country. Researchers have successfully used these studies in the past to analyze related research questions (Banks et al., 2006; Patel et al., 2006; Samper-Ternent et al., 2012a; Wong et al., 2010). Despite these advantages I have listed three limitations that must be considered for the remainder of the study: 1) Baseline interviews for both studies are different and could affect some of the conclusions drawn from the data; 2) I am limited by the available data to the number of factors that can be controlled for when making conclusions about resilience in both groups of adults; and 3) My inclusion criteria make the results of this study applicable to non-institutionalized, non-proxy respondents only and death cannot be included in the analyses. Finally, I have selected to conduct parallel comparisons between both studies instead of combining both datasets, this has methodological and conceptual advantages and disadvantages that must be considered throughout the dissertation. The next chapter will describe the methodology used in my study.

Chapter 4 Methods

This chapter will describe the methodology followed to examine resilience in the two cohorts described in the previous chapter. A detailed description of how the dependent variable, the independent variable and the covariables were selected and coded will be provided. Also, an explanation on how type and timing of event were treated in the analysis of resilience will be given. Finally the statistical analyses used to examine resilience are explained.

4.1 Study Overview

The current study is a cross-national comparison of resilience among older adults in Mexico and the US. This cross-national comparison uses cross-sectional and longitudinal data to examine recovery from adverse events in two nationally representative samples of older adults: The Mexican Health and Aging Study (MHAS) and the Health and Retirement Study (HRS). In addition to identifying protective factors that promote resilience and risk factors that prevent it, this study will also explore resilience among older adults who have not experienced an adverse event. My resilience model will provide additional information that can hopefully be used in the clinical setting to help adults build resilience so that when they experience an adverse event they can recover and maintain their independence and quality of life.

In Chapter 1, I presented the conceptual framework that supports why studying resilience is important and why we built the resilience model used for my analyses. In Chapter 2, I described both study cohorts and identified differences and similarities between them. I also indicate why these datasets were selected and highlighted the importance of studying resilience in these population groups. In this chapter I will describe the methodology used to select the data, construct the variables and analyze the concept of resilience. I will also present my validation process and explain the sequence I followed to obtain the results presented in the next chapter.

4.2 Brief Description of samples

Figures 3.2 and 3.3 summarize the algorithm used to select my sample. In total, there are 4,872 adults over 65 that were interviewed in person or by proxy at baseline in the MHAS study. There are 9,048 Non-Hispanic White adults over 65 that were interviewed at baseline in the HRS study. Of the 4,872 adults included at baseline in MHAS, 3,606 (74.01%) have complete information at baseline and follow-up and are therefore included in all longitudinal analyses. Similarly, of the 9,048 adults included at baseline in HRS, 6,567 (72.58%) have complete information in both waves and are therefore included in all longitudinal analyses.

As previously stated, MHAS was designed to be comparable to other studies, including the HRS. As a result, most of the survey questions are similar (Kohler & Soldo, 2004). I therefore used comparable indicators to build the four domains necessary for a comprehensive view (following the Comprehensive Geriatric Assessment (CGA) model) and identified change over time in these domains as a proxy for resilience. However, some differences across the two studies must be highlighted.

4.3 Dependent Variable

Domains and components

In the conceptual framework I explained that the CGA is a clinical tool used to comprehensively evaluate older adults and designed to decrease disability and improve quality of life. This tool has four domains: physical health, functional status, mental status and social function. I evaluated all available variables in both studies and selected those that were comparable between both studies and that contributed to a global measurement of each domain. MHAS data was obtained directly from the study research team. On the other hand, the dataset prepared by the RAND center was used for the HRS study (2011). This dataset compiles all waves of the HRS data and uses bracketing methods to minimize non-response in variables such as income and wealth (see RAND, 2011 for more details) (2011). For this study I will only use data from the 2000 (Baseline) and the 2002 (Follow-up) waves for comparability purposes with the MHAS study waves (2001 and 2003).

Health Status Domain

To construct the physical health domain I selected: seven self-reported medical conditions, report of change in health over the two years prior to the interview, weight loss, hospitalization and pain. The six medical conditions are: hypertension, diabetes, cancer, lung disease, stroke and arthritis. To assess these conditions both studies asked respondents: “Has a doctor or medical personnel ever told you that you have …” These conditions were then coded as dichotomous variables where 1 corresponds to having the condition and 0 otherwise. Respondents were also asked to rate their health compared to two years prior to the interview with the question: “Comparing your health now with your health two years ago, would you say your health now is…” A 5-item response scale was offered that ranges from much better to much worse. A dichotomous variable labeled “worsening health” was created were “much worse” and “somewhat worse” were coded as 1 and “more or less the same”, “somewhat better” and “much better” were coded as 0. Weight loss is also a dichotomous variable were 1 includes individuals who report losing 5kg or more in the past two years (or its equivalent of 10 pounds in the HRS study). Individuals who reported the same weight or weight gain were coded as 0 for this variable.

The question about hospitalization used a different reference point for the MHAS and HRS studies. MHAS asked respondents about the number of nights spent in a hospital in the past year. Conversely, HRS asked respondents about the number of nights in the past two years. The variable labeled hospitalization is a dichotomous variable were 1 represents spending one or more nights in a hospital and 0 otherwise. Finally, pain was coded as 1 if the response to the question "Do you often suffer from pain?" for MHAS and "Are you often troubled by pain" for HRS was yes and 0 otherwise.

Since HRS uses computer-assisted personal interviewing (CAPI), disputes on self-reported diseases like hypertension and diabetes are corrected in every wave. Therefore cases where hypertension was present at baseline and not at follow-up are corrected and a special flag is provided for researchers in the HRS dataset. Conversely, MHAS did not use CAPI so there are cases where disagreement exists between baseline and follow-up. This disagreement was only significant for cardiovascular conditions. I corrected these cases by replacing the baseline code with the follow-up code. This means that if there is disagreement, the variable becomes 0 and the prevalence of the condition decreases. However, I compared the prevalence in conditions before making this change and after making this change with results from the National Health Interview in Mexico (ENSA) that was conducted in 2000. The prevalence after my modification is very similar to the one reported by ENSA 2000 (Velasquez-Monroy et al., 2003).

Functional Status Domain

To construct the Functional Status Domain I selected: activities of daily living (ADLs), instrumental activities of daily living (IADLs) and mobility disability. Questions from both studies were recoded replicating the methods used by RAND for recoding of HRS data (Saint Clair et al., 2011). This approach has been previously used to examine differences in disability between Mexico and the US (Hayward et al., 2010; Wong et al., 2010). Five activities were used to create the ADLs variable: walking, bathing, dressing, eating, transferring and using the toilet. The question used to assess ADLs disability was "Because of a health problem, do you have difficulty with …?" in both studies. An interval variable from 0-6 was constructed where the number of affected ADLs was added for each individual. This variable was then transformed to a scale from 0 – 100 where 100 represents alterations in all ADL.

Four activities were used to create the IADLs variable: taking medications, preparing meals, managing finances and shopping. Respondents were also asked "Because of a health problem, do you have any difficulty with…?" in both surveys. An interval variable between 0-4 was constructed where the number of affected IADL was added for each individual. The variable was then transformed to a scale from 0 -100 were 100 represents alterations in all IADLs.

Finally, the mobility disability variable was constructed based on two activities: difficulty walking one block and difficulty climbing one flight of stairs. Individuals reporting difficulty with either of these activities were coded as 1 for the mobility variable and 0 otherwise.

Mental Status Domain

This domain was very hard to construct because I am limited both by the number of variables available that capture mental status and the comparability of the variables used in both studies (Page 46). As explained earlier, the scales used to assess cognitive function in both studies are different. Moreover, the only additional component of mental status that is assessed in both studies is depressive symptomatology. I therefore only included two variables in the mental status domain. The first variable is labeled cognitive score. There are only two cognitive tasks that were measured the same way in both studies: verbal learning and verbal recall. In both studies, older adults were asked to repeat and learn a list of words and were then asked to recall them after a couple of minutes. However, the number of words that adults were given in both studies is different. In the MHAS study, adults were required to repeat, learn and recall 8 words. In contrast, HRS adults were given 10 words.

Verbal learning and recall are independent yet correlated measures that are usually measured and reported together (Libon et al., 2011). Verbal learning and verbal recall have been used before as markers of overall cognitive status. Additionally, poor verbal learning and recall scores have been shown to predict cognitive impairment (Delis et al., 2000; Lezak, 1983; Libon et al., 2011). I therefore created a cognitive score variable by adding the number of words each individual was able to repeat and then the number of words each individual was able to recall. I then divided the sum of words repeated or recalled by the total number of words - 8 for MHAS and 10 for HRS - to create a mean score between 0 – 100. Finally, to standardize the scoring for all domains, I reverse coded the scale by subtracting each mean score from 1. After these transformations the resulting variable has a range from 0 – 100 where 0 corresponds to individuals who repeat and recall all words and 100 corresponds to those unable to repeat or recall any words.

The other variable in the mental domain is depressive symptomatology. Both the MHAS and HRS study use a short version of the CES-D scale. HRS introduced this modified version of the CES-D scale that includes only eight of the 20 original items: a) six negative items (depression, everything is an effort, sleep is restless, felt alone, felt sad, and could not get going) and b) two positive items (felt happy and enjoyed life). When the MHAS interview was designed, the item "could not get going" could not be translated into a single question in Spanish and was separated into two questions. To make both studies comparable I decided to use only the seven items that were equivalent. To construct the variable, I initially added the number of affirmative responses to the negative items and subtracted any affirmative response to the positive items. The resulting score was then divided by 7 to create an interval variable form 0 - 100 were 0 represented no depressive symptoms and 100 represented having all depressive symptoms.

Social Function Domain

The social domain was also difficult to create. Similar to the mental domain, the number of variables available to capture social function in both studies is limited. Additionally, as presented in Chapter 1, there are many factors that need to be included for a comprehensive evaluation of social function (Berkman, 1984; Berkman, 1986; Due et al., 1999). Unfortunately, neither the MHAS nor the HRS includes validated scales to evaluate social support, social networks or social capital. I therefore selected variables that were related to social support, social networks and social capital, but these variables are limited in their ability to carefully capture social function in older adults.

The first variable selected in the social domain is volunteer work. Extensive literature has shown that older adults who do volunteer work have better physical health, better functional status, better mental status and better social function compared to those who do not volunteer (Herzog et al., 2002; Lum & Lightfoot, 2005; Morrow-Howell et al., 2003; Morrow-Howell, 2010; Thoits & Hewitt, 2001). For the MHAS study, adults were asked if they had spent any time doing charitable work for religious, educational or other charitable organizations in the past 2 years. The time frame for HRS was the 12 month period before the interview. Again, to keep a consistent coding for all the variables (where 1 is presence of "bad" things (i.e disease and disability) and 0 is absence of "bad" things), individuals responding yes to the volunteering question were coded as 0 and those who did not report volunteering were coded as 1.

The second variable selected for the social domain was importance of religion. The literature shows that older adults who engage in religious practices have better health outcomes compared to those who do not (Benjamins & Buck, 2008; Waite & Lehrer, 2003). Additionally, religion has been reported to play a significant role in adaptation (Consedine et al., 2004). In the MHAS and HRS studies, respondents were asked to rate the importance of religion in their lives on a 3 level scale ranging from not too important to very important. The variable was coded one if religion was not too important and 0 otherwise. I acknowledge that importance of religion is by no means the same as religious participation, however, this was the information available in both studies and I decided to use it.

The third variable in the social domain is the availability of friends in the respondent's neighborhood. This question provides information related to social networks. In Chapter 1, I explained that social networks are one of the two components that make up current social function. If respondents need someone to talk to, want someone to spend leisure time with or need help in case of an accident, the availability of friends in close proximity helps establish the size of the network available for them. To continue with the same coding pattern, this variable has a value of 1 if respondents do not report having friends in the neighborhood and 0 otherwise.

The last variable of the social domain is the availability of people to count on. This variable is also related to social networks. The question used to assess this variable was worded differently in both studies. The MHAS study asked respondents: "Do you have neighbors or friends you can count on for daily activities, such as bringing food if you are sick, or bringing you something from the store?" In contrast, HRS asked: "Suppose in the future, you need help with basic personal care activities like eating or dressing. Do you have relatives or friends who would be willing and able to help you over a long period of time?" The case presented to HRS respondents is more severe and requires a larger commitment from relatives or friends. In general, I feel that less people would think relatives or friends would be available to provide care for long periods of time. I therefore expect that affirmative response rates to this question can be higher for MHAS compared to HRS for this reason. Like the previous variables, a positive response was coded as 0 and a negative response was coded as 1.

In summary the health domain is composed of 10 dichotomous variables, the functional domain of two interval variables and one dichotomous variable, the mental domain of two interval variables and the social domain is made up of four dichotomous variables. How the components and domains were weighted to analyze resilience is described in the following section.

Domain weights

Determining how the different components and domains would be weighted for the analysis was a complicated task. There were different methodologies available with literature supporting each methodology. However, considering the nature of the question and the clinical approach to this project, equal weights were used for the four domains. Based on the literature and clinical experience, the four domains were needed to reach a global measurement of recovery. Also, given the limitations of the data, an approach that would eliminate components to establish a hierarchy would affect the comprehensive nature of my approach. Therefore the methodology used by others to create composite indicators was used (OECD group & JCR group, 2008). This methodology has also been used to study an important geriatric syndrome (Rockwood & Mitnitski, 2007; Searle et al., 2008).

In 2008 the Organization for Economic Co-Operation and Development and the Joint Research Centre of the European Commission developed a book that explains the methodology behind creating composite indicators (OECD group & JCR group, 2008). The authors of this book suggest the steps listed in Table 4.1 towards constructing a composite indicator.

Table 4.1: Steps for Constructing a Composite Indicator (Adapted from the Handbook on Constructing Composite Indicators)(OECD group & JCR group, 2008)

Steps
Create Theoretical Framework
Select Data Sources
Imputation of Missing Data
Multivariate Analysis
Data Normalization
Weighting and Aggregation of Domains and Components
Sensitivity Analyses
Identify the Factors that Drive how the Indicator Behaves in the Different Datasets
Correlate the Composite Indicators with Existing Indicators and Establish Links with Them
Correctly Present Results to Ensure Interpretability

Even though these steps were not followed as presented, the steps were used as a guide for creating and analyzing the composite indicator. One of the sections of this book deals with weighting and aggregation and one of the methodologies explained is equal weighting. The authors indicate that equal weighting does not imply no weighting, it means that a decision is made to give equal weights to domains or components because of their theoretical effect on the phenomenon that is going to be studied (OECD group & JCR group, 2008). Of interest in this research is observing recovery in two samples of older adults after they experienced at least one of three adverse events. From the conceptual framework and from clinical experience, it was clear that physical health, function, mental status and social function are equally important in establishing a complete picture of an individual's overall status.

With this is mind equal weights were assigned to the four domains. Table 4.2 provides a summary of the weights assigned to each domain and the resulting weights for each component. From this table it can be concluded that individual components in the health domain carry a smaller comparative weight to individual components in the mental or social domain. Regardless, each domain has the same weight, in this case a weight equal to 1.

Table 4.2: Summary of weights assigned to each domain and hence to each component

	Individual indicator weight		*Total weight*	
Domain	**Indicator**	**Percentage form**	**Domain weight**	**Decimal form**
Physical Health			1	
0 vs. 1	Health change	0.10		0.10
0 vs. 1	Hypertension	0.10		0.10
0 vs. 1	Diabetes	0.10		0.10
0 vs. 1	Cancer	0.10		0.10
0 vs. 1	COPD	0.10		0.10
0 vs. 1	Stroke	0.10		0.10
0 vs. 1	Arthritis	0.10		0.10
0 vs. 1	Weight Loss	0.10		0.10
0 vs. 1	Hospitalization	0.10		0.10
0 vs. 1	Pain	0.10		0.10
Functional Status			1	
0-6	ADL Disability	0.33		0.33
0-4	IADL Disability	0.33		0.33
0 vs. 1	Mobility Disability	0.33		0.33
Mental Status			1	
0-1	Cognitive function	0.50		0.50
0-1	Depressive Symptoms	0.50		0.50
Social function			1	
0 vs. 1	No Volunteer work	0.25		0.25
0 vs. 1	Religion not important	0.25		0.25
0 vs. 1	No Friends in neighborhood	0.25		0.25
0 vs. 1	No one to count on	0.25		0.25

Equations used for each domain score

With the weights explained in Table 2, four equations were created, one for each domain, to estimate a score for each domain in both waves of both studies. Following are the equations for each domain:

$$H_1 = (h_1 \times 0.10) + (h_2 \times 0.10) + (h_3 \times 0.10) + (h_4 \times 0.10) + (h_5 \times 0.10) + (h_6 \times 0.10) + (h_7 \times 0.10) + (h_8 \times 0.10) + (h_9 \times 0.10) + (h_{10} \times 0.10) + \varepsilon$$

Where, H_1 = Health Domain Score at Baseline, h1 – h10 = each component, 0.10 is the assigned weight, and ϵ represents the error term.

$$F_1 = (f_1 \times 0.33) + (f_2 \times 0.33) + (f_3 \times 0.33) + \varepsilon$$

Where, F_1 = Functional Domain Score at Baseline, f_1 – f_3 = each component, 0.33 is the assigned weight, and ϵ represents the error term.

$$M_1 = (m_1 \times 0.5) + (m_2 \times 0.5) + \varepsilon$$

Where, M_1 = Mental Domain Score at Baseline, m_1 – m_2 = each component, 0.5 is the assigned weight, and ϵ represents the error term.

$$S_1 = (s_1 \times 0.25) + (s_2 \times 0.25) + (s_3 \times 0.25) + (s_4 \times 0.25) + \varepsilon$$

Where, S_1 = Social Domain Score at Baseline, s_1 – s_4 = each component, 0.25 is the assigned weight, and ϵ represents the error term.

Domain analysis and validation

The equal weight methodology was used to create the weights for each domain and created the equations to calculate a score for each individual at baseline and another one at follow-up. Each score has a range from 0 to 1, where 0 represents having no alterations in any component (healthy) and 1 represents having alterations in all components (unhealthy) for each given domain. To make sure that there was some internal consistency within each domain, Cronbach's alpha was calculated for the components in each domain. The alphas did not reach the reliability score of 0.70 that has been suggested by some authors, in any of the domains (Spector, 1991). Nevertheless, each domain is consistent to the clinical approach that is regularly used by physicians and other healthcare providers. In both studies, functional status had the highest Cronbach's alpha and social function had the lowest Cronbach's alpha.

The distribution of the data for each domain, was then examined. As shown in the next chapter, none of the domains is normally distributed, which means that non-parametric tests are used to analyze cross-sectional data for each domain (See Pages 104-105). Spearman correlation coefficients were then used to determine the level of correlation between the four domains at baseline and the four domains at baseline and at follow-up. A correlation matrix including this information is presented in the results chapter (Pages 107-108). Finally, to complete the validation process the effect of each domain on the risk of poor SRH at follow-up or death was calculated. Logistic regression models estimated the odds of poor SRH or death at follow-up by each domain score at baseline.

Change in total domain score

Once the domains were described and validated cross-sectionally and used to predict important outcomes such as poor SRH and death at follow-up, the resilience score was created. Four scores were created, one for each domain, by subtracting the domain score at baseline form the follow-up score. Each score ranges between -1 and 1, where -1 represents complete improvement in total score for a specific domain between waves (recovery), 0 represents no change between baseline and follow-up and

1 represents worsening in domain score between baseline and follow-up. As stated in the definition of resilience, -1 and 0 represent resilience while 1 represents worsening for each domain. The difference between follow-up and baseline scores for each domain separately was then used to observe recovery among individuals suffering at least one of three selected events (See detailed description below). Distribution of these four new variables was also plotted. Graphs show that the resilience score for all domains is normally distributed (data not included). Therefore, for longitudinal analysis using the difference score, parametric analyses are used. The events used to identify individuals where resilience could be measured are described in the next section.

4.4 Events

Event selection

Individuals must suffer an event in order to recover. With this in mind I had to select events with significant sample sizes in both studies in order to analyze how the four domains change after individuals are exposed to these events. Additionally, I needed to identify events where available interventions have been shown to effectively return individuals to their baseline status. Finally, I needed events where individuals could show significant improvement (or worsening) in a relatively short period of time (2 years between waves in both studies). Events such as cancer or stroke could have been selected because they meet the first criterion. However, neither cancer nor stroke met the other two criteria. For some cancers there are promising experimental therapies, but they are not readily available for all individuals. Additionally, recovery from cancer can take several years. The same applies to stroke. I therefore selected three events that met the three criteria: widowhood, heart attack and serious falls. The number of older adults who suffer these events is large enough, there are interventions that have been proven to help individuals recover from these events, and recovery occurs in a relatively short period of time (Balady et al., 2007; Forthofer et al., 2001; Hagedoorn et al., 2006; Peel et al., 2007; Tinetti & Kumar, 2010). An additional benefit from selecting these events is that they are not purely health related but also psychological in nature, this makes the analysis of resilience even more interesting.

Event variable construction

Construction of the three event variables was different for both studies. For the MHAS study the first wave (2001) is the actual baseline for the study. Individuals had not been contacted before, so there was no prior information. Conversely, there are four waves of data prior to the 2000 HRS interview. Therefore, identification of events for HRS was simpler because I used the previous wave as a reference point to establish timing of the events. For MHAS however, the actual year when the event occurred had to be used to establish timing of the events. To clarify, there are some new respondents added to the HRS cohort in 2000 and 2002 as presented in the previous chapter. For new individuals, determination of events follows the same procedure and uses comparable measures to that of individuals in the MHAS baseline cohort. However, this sample is very small. To determine if an event occurred between baseline and follow-up, information from the previous wave was used as reference for both studies. How each variable was created for the two studies and how timing issues were addressed are described in the following sections.

WIDOWHOOD

For the MHAS study individuals were asked at baseline about their marital status. For those reporting to be divorced, separated or widowed, a follow-up question was asked to determine the year when this event occurred. Since for both studies interviews are conducted every two years, 1999 was used as the reference year to identify individuals who reported being widowed for the sample. Therefore, all individuals who responded that they were widowed and then reported that this event occurred in 1999 or later were coded as 1 for the baseline widowhood variable. However, if individuals were married or in a union, they were coded as 0. Those who became widowed before 1999 in addition to those who were divorced or separated, or single were coded as 9 for the baseline widowhood variable because they do not fit the criteria for 0 or 1 but provide useful information for the sample. For the widowhood variable between baseline and follow-up, those who reported being married at follow-up regardless of where they started were coded as 0. Individuals who reported being married at baseline and widowed at follow-up were coded as 1. Finally, individuals who were single, widowed or divorced in both waves, and those with contradicting information between waves, such as being widowed at baseline and then single at follow-up, were coded as 9. Individuals coded as 9 were included in the subsequent analysis and the variables was used as having three levels.

For the HRS study, individuals who reported being married in 1998 (wave 4 of the study) and then reported to be widowed in 2000 were coded as 1 for the widowhood variable at baseline. Those who reported being married in both waves, and those who were married between 1998 and 2000 were coded as 0. Individuals who were widowed before 1998, those who were divorced or separated, or single in 1998 and 2000, and those who reported contradicting information in 1998 and 2000 (e.g. being widowed in 1998 and then single in 2000) were coded as 9 for the baseline widowhood variable. The same procedure was used for the follow-up widowhood variable. Individuals coded as 9 were included in the subsequent analysis and the variable was used as having three levels.

Three different variables are therefore available with information on widowhood for both studies: a widowhood variable at baseline, a widowhood variable for follow-up, and a widowhood variable for either baseline or follow-up.

Heart Attack

A similar procedure as the one just explained was used to create the heart attack variable. In the MHAS study individuals were asked at baseline if they had ever been told by a doctor that they had a heart attack. If the response was yes, individuals were asked to specify the year or age when the heart attack occurred. For this study, individuals who had a heart attack in 1999 or later were coded as 1, otherwise 0 was assigned. At follow-up, the same questions were used and the same process was used to create the variable.

For the HRS study the question regarding whether or not a doctor has told the respondent he/she had a specific condition is different from the MHAS question because respondents are asked about heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems in the same question. Unlike MHAS, in the HRS the previous wave was used as a reference so individuals who responded no to the question in 1998 and yes in 2000 were coded as 1 for the heart attack variable. Conversely those who responded *no* in 2000 were coded as 0. The same procedure was used to create the heart attack variable between baseline and follow-up.

Thus, there are three additional variables available with information on heart attack for both studies: a heart attack variable at baseline, a heart attack variable for follow-up, and a third variable for either baseline or follow-up.

Serious Falls

Respondents in both studies were asked if they had a fall in the two years before the interview in both waves. Individuals were then asked if the fall was serious enough to require medical attention. The serious falls variable was created by coding individuals who fell and required medical attention as 1. Individuals who did not fall were coded as 0. Finally, individuals who fell but did not require medical attention were coded as 9. Similar to the other two event variables, a variable for baseline, another one for follow-up and a last one with information on falls either at baseline or follow-up was created for both studies.

Event combinations

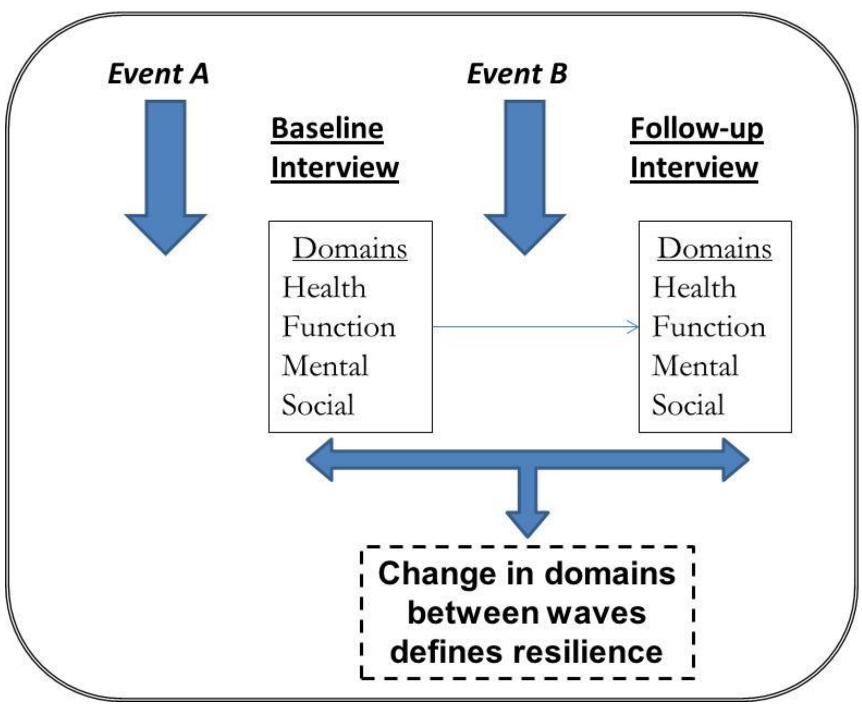
Analyses were conducted to identify the different event combinations that were observed in both samples. Determining if events mostly occurred as single or multiple events was important for subsequent analyses. Therefore each sample of adults was stratified by the type of event they had and the different possible combinations. These findings are summarized in the results chapter (See Page 113); for the most part, individuals have a single event in both studies.

Event timing

The timing of the event is important in the analysis of resilience. Some investigators have demonstrated that the same event can have very different effects depending on when it occurs in the life-course (George, 2003). Given my two-year observation period, event timing in this study may not carry large effects as those proposed by these investigators. Nevertheless, timing of the event in relation to when the dependent variable is measured can have a significant effect on the study results. Figure 4.1 depicts when events in this study are measured in relation to when the four domains are measured and when recovery is observed. Events that occur earlier (labeled *event a*) occur before baseline measurement of the four domains. Therefore, for individuals suffering *event a*, the baseline domain measurement is performed on individuals who recently had an event. For these individuals, there are two domain measurements posterior to the event. In contrast, *event b* occurs after baseline measurement of the four domains. In this case, there is a pre and post measurement of the four domains. Measuring recovery based on these scenarios can be quite different.

Measuring recovery when *event a* is taken into account makes it possible to observe how the domains change in a fixed time period for all individuals (2 years). With *event a*, it is possible to measure an earlier and a later version of the same recovery process. On the other hand, measuring recovery when event b is taken into account provides better information on the factors that affect recovery. This is possible since the method allows for analysis of individuals that start without an event, they then suffer and event and are observed after the event has occurred. The problem with this approach is that it cannot determine in the two-year period when the event actually occurred between the waves. Hence, the post-event measurement could be 1 month after the event occurred or 20 months after the event occurred.

Figure 4.1: Timing of events in relation to when the four domains are measured and when resilience is observed



Based on the finding that most adults suffered a single event and in order to address the timing issue, four variables were created using dummy coding to capture event timing for the regression analyses. The first variable was coded as 1 if individuals had at least one event regardless of the timing of that event and coded as 0 if they had no event. The second variable was coded as 1 if an individual experienced at least one event before baseline only and 0 otherwise. The third variable was coded as 1 if an individual experienced at least one event only between baseline and follow-up and 0 otherwise. The fourth and last variable was coded as 1 if individuals experienced events both before baseline and between baseline and follow-up and 0 otherwise. These variables were used to distinguish individuals who had an event from those who did not in the initial analyses, and were then used as control variables in the regression analyses to determine if timing of event significantly affected recovery.

4.5 Independent Variables

Age was measured as a four level categorical variable for descriptive analyses and as a continuous variable for longitudinal analyses. Other demographic variables included gender and education (broken down into tertiles for each country and also as a continuous variable). For MHAS, low education included individuals with less than three years of education; medium education included those with 3 to 6 years of education; and high education included those with more than 6 years of education. In contrast, low education in the HRS included individuals with less than 12 years of education; medium education included those with 12 years of education; and high education included those with 13 or more years of education.

The definition of location is different for each country. HRS collapses the ten category 1993 Beale Rural-Urban Continuum Codes into three locations: 1) Urban (population 1 million or more), 2) Suburban (population between 250,000 to 1 million), and 3) Ex-urban (population less than 250,000) (Saint Clair et al., 2011). By combining urban and suburban I created the “urban” category and ex-urban represents the “rural” category. The MHAS divided locality size in four categories. However, for this study I use community residence with 100,000 people or more as the cut-off point for “urban” and collapse the other three categories to create “rural”.

Other variables include total number of children ever had and total number of children alive at interview to determine size of family available to individuals. The first variable is used as a continuous variable. The second variable is used both as a continuous and dichotomous variable. Two or more children is used as the cut-off point based on the distribution of the variable for both studies. Living arrangements is also used as a covariable. Four categories were created based on the household roster information for both studies. Individuals living alone make up the first category; individuals living with their spouse only, make up the second category; individuals living with their spouse and another family member, make up the third category. Finally, individuals living with a family member other than their spouse, make up the last category.

Wealth was collected at the level of the couple for both HRS and MHAS. It was measured using each household’s net worth of homes, businesses, rental properties, capital, vehicles, and other debts or assets. There is a high non-response rate for these questions, therefore both studies use imputations. The imputation technique used in MHAS was modeled after the HRS technique where unfolding brackets are used to recover the non-response (Saint Clair et al., 2011; Wong & Espinoza, 2004).

The study also controlled for whether respondents had health insurance coverage. A dichotomous variable was created for both studies. In the HRS, respondents were asked if they are covered by a government health insurance, an employer-based program, or some other health insurance plan (either through themselves or a spouse). A response of yes to any of these plans was coded 1 for the health insurance variable. In the MHAS, respondents were asked whether they had the right to medical care through the Mexican Institute of Social Security (IMSS), the Institute of Social Security and

Services Workers (ISSSTE), the Social Security of Mexican Oil Workers (PEMEX), the Armed Forces Social Security (Defense or Navy), or any other private medical or public health insurance. Health care coverage with at least one of these institutions was coded as 1 for the health insurance variable.

Self-reported health was also included in the analyses. For both studies individuals were asked to respond to the statement “Would you say your health is….” With one of five responses: poor, fair, good, very good or excellent. This variable was used as a categorical variable for descriptive purposes and as a dichotomous variable (poor vs. fair, good, very good and excellent) for regression analyses. Body mass index, calculated as the self-reported weight in kg divided by the self-reported height in meters squared, was also used but only for descriptive statistics because of the large number of individuals with missing data.

Health status as a child was also used as a covariable. Wording of the question and the age used as a reference were quite different in both studies. For the MHAS study, respondents were asked if before age 10 they had serious health problems that affected their activities for more than a month. An affirmative response was coded as 1, 0 otherwise. For the HRS, the question used 16 years of age as the reference age and the response used a 5-item scale from poor to excellent. A dichotomous variable was created where poor or fair was coded as 1 and good, very good or excellent were coded as 0.

To determine working status at interview, MHAS respondents were asked “Last week you: worked, did not work but had a job, looked for work, were a student, dedicated self to household chores, did not work”. If respondents answered that they worked or had a job they were coded as 1 for the current work variable and 0 otherwise. HRS respondents were asked if they were currently working for pay, if they responded yes they were coded as 1, otherwise they were coded as 0.

Three health behaviors were also included as covariables: ever smoking, at risk drinking and exercising. Ever smoking is a dichotomous variable in both studies where 1 is yes and 0 is no. At risk drinking was constructed based on guidelines published by the National Institute of Alcohol Abuse and Alcoholism (NIAAA) for older adults. According to these guidelines, older adults who drink *3 or more drinks on a single occasion* are considered to have *at risk drinking* and were coded as 1. Adults who had *2 drinks or less on any occasion* were coded as 0. Adults who reported *never drinking* were coded as 9. For the exercise variable, MHAS asked respondents if they had exercised or done hard physical work in the past two years. Instead, HRS asked respondents about exercise or hard physical work in the past 12 months. A positive response was coded as 1 for both studies.

Table 4.3: Summary of Covariables used for regression models

Covariable	How it was coded
Age	Continuous variable
Education	Number of years of education as continuous variable
Gender	Men vs. women
Location	Urban vs. rural
Number of children alive	Dichotomized as 1 children and no children vs. more than 1 children
Wealth	Tertiles based on population distribution
Healthcare access	Yes vs. no
Sick as child	Yes vs. no
Ever smoke	Yes vs. no
At risk drinking	Three categories: more than 3 drinks on any given occasion (yes); drinks less than 3 drinks on any given occasion (no); never drinks
Exercise	Yes vs. no
Self-reported health	Poor vs. fair+good+very good+excellent
Event before baseline	Yes vs. no
Event between waves	Yes vs. no
Heart Attack	Yes vs. no
Widowhood	Yes vs. no
Serious fall	Three levels: had a fall that required medical attention (yes); did not have a fall (no); had a fall that did not require attention (other)
Baseline score	Continuous variable

4.6 Statistical Analyses

Descriptive statistics are presented as percentages or means and standard deviations. For weighted statistics PROC SURVEYFREQ and PROC SURVEYMEANS in SAS were used. For continuous variables the Wilcoxon rank sum test is used to identify significant differences between included and excluded individuals and between individuals with an event and those without an event in both studies. Chi-square tests are used to identify differences in categorical variables. For multivariable analyses including some cross-sectional analyses and all longitudinal analyses, general linear models were used (PROC GLM in SAS) for these analyses.

Initially binomial analysis was conducted at baseline to identify the cross-sectional relationship between recovery for each country and the covariables listed above. The dependent variables were the total scores for each domain ranging from 0 to 1. The estimates of the binomial analyses show a relationship where negative numbers predict a better score for a given domain at baseline while positive numbers predict worse score. In all models, the p-value indicates significant associations ($p<0.05$) between the independent variables and the dependent variable for each country.

Sample weights were only used in the first descriptive analysis to identify adjusted differences and similarities of the two cohorts. However, weights are not used in the subsequent analysis because the main focus of these analyses is not to determine if the prevalence of certain conditions is the same between Mexico and the US, or if the prevalence of resilience is the same for both cohorts. The main focus of the analyses in this study is to analyze associations between different variables and resilience. Additionally, use of weights in studies analyzing associations can complicate the interpretation of the results.

A general linear model was then used to evaluate resilience as the change in score for each domain between baseline and follow-up. Covariates at time 1 included in the model were: age, education, gender, location, number of children alive, wealth, healthcare access, sick as child, ever smoking, at risk drinking, exercising, self-reported health. Also included were timing of event (event before baseline, event between waves) Event both before baseline and between waves is the reference category. Type of event (heart attack, widowhood or falls) was also included as a covariable where *no* was used as the reference category for the three variables. Finally, total domain score at baseline was included as a covariable because change in score over time depends on where individuals start. Other investigators have shown that if the conceptual framework strongly supports that the baseline measurement is highly predictive of the change score then it should be included in the regression equation (Allison, 1990).

For each study, four different regression equations were used, one for each domain. The regression equations had the following form:

$$Y_i = a_i + \beta_{1i}x_{1i} + \beta_{2i}x_{2i} + \beta_{3i}x_{3i} + \ldots + \beta_{18i}x_{18i} + \varepsilon_i$$

Where, Y_i = the difference between follow-up and baseline score for each specific domain, i = one of the four domains (physical health, physical function, mental status and social status), α = the Y-intercept of the line, β = the beta coefficient for each of the 18 covariables, x = each of the 18 covariables, and ε = the residual.

The beta coefficients resulting from the regression equation presented earlier can be interpreted as predictors of change for the score in each domain. The range of the score change is between -1 and 1. Therefore, positive estimates predict worsening in the score and hence indicate poor resilience and negative estimates predict improvement in score and hence indicate resilience.

Chapter 5 Results

This chapter summarizes the findings of this study. Results from descriptive and regression analyses are presented. Initially a comparison of both cohorts is presented. Then, a comparison of resilience between the MHAS and HRS cohorts is presented. After that, the validation process of our resilience measurement is presented including the regression analysis of poor self-reported health and death stratified by the four domains is shown. Next, regression analyses of change in domain score by all the covariables are summarized. Finally, the translational implications of the study's findings are presented.

5.1 WHERE WE ARE SO FAR

In Chapter 1, evidence was presented to support moving away from the biomedical model and into the biopsychosocial model to better understand the aging process and be able to help older adults be more resilient and recover from adverse events and have good quality of life. Also presented was a model to analyze resilience where recovery from adverse events in two different populations was compared: older adults in the US and Mexico. In Chapter 2, the datasets that were described and selected for this study and an ideal dataset proposed that would allow for the study of resilience. Then in Chapter 3, the methodology behind the current study was explained. Also explained was how the study operationalized the concept of resilience and how the cross-national comparison was conducted. The results of those analyses are presented below.

5.2 DESCRIPTIVE RESULTS

Differences between the two cohorts

Table 5.1 presents the characteristics of adults over 65 from the Mexican Health and Aging Study (MHAS) and the Health and Retirement Study (HRS) that were included in this study. This table presents characteristics of 4,423 Mexican adults and 7,898 US adults over 65 who had in person interviews at baseline for both studies (2001 for MHAS respondents and 2000 for HRS respondents). Weighted and unweighted percentages and means are presented for the different covariables for both populations. This table shows that older adults in Mexico are younger compared to the HRS respondents. The percentage of adults 65-69 in Mexico is 8% higher and the percentage of adults over 80 years of age is 8% lower compared to the HRS population. The percentage of women compared to men is higher in Mexico and the US. Surprisingly, differences in marital status are not as large between the US and Mexico. The percentage of individuals reporting being single or widowed is slightly higher in Mexico while the percentage of married individuals in the US is slightly higher when using the unweighted statistics. However, based on the weighted statistics, the percentage of widowed individuals is slightly higher in the US compared to Mexico. Despite these marginal differences in marital status, based on the distribution of living arrangements in both countries, the percentage of adults who report living alone or only with their spouse is noticeably higher in the US compared to Mexico. Conversely, the percentage of older adults who report living with their spouse and another family member or with another family member different from their spouse is noticeably higher in Mexico compared to the US. This is the only table where

Based on the location where individuals live, the percentage of older adults living in rural areas in Mexico is higher especially when comparing the weighted statistics, where the percentage of adults living in rural areas in Mexico is more than 25% higher compared to the HRS respondents. A similar pattern is observed related to wealth where the percentage of older adults in the lowest tertile of wealth is higher in Mexico, especially when weighted percentages are compared. Similarly, important differences are observed in educational attainment. The mean number of years of education for adults over 65 in the MHAS study is 4 times lower than the mean number of years of education for the HRS respondents. Despite the differences in the schooling systems in the US and Mexico, this huge difference can be translated as: the average older adult in Mexico has not completed primary education while the average older adult in the US has completed high school. In summary, socioeconomic status (SES) of adults 65 and older of the MHAS study is strikingly lower compared to their HRS counterparts based on the data presented in Table 5.1.

Table 5.1: Unweighted and weighted descriptive statistics of selected sociodemographic and health characteristics of adults over 65 interviewed at baseline in the MHAS and HRS studies

Variable	MHAS (2001) n=4,423[a]			HRS (2000) n=7,898[b]		
	n[c]	Unweighted %	Weighted %	n[c]	Unweighted %	Weighted %
Age						
65-69	1,685	38.10	37.09	2,389	30.25	28.52
70-74	1,218	27.54	25.66	1,919	24.30	25.72
75-79	842	19.04	18.73	1,713	21.69	22.36
80+	678	15.33	18.51	1,877	23.77	23.40
Gender						
Women	2,317	52.39	50.21	4,628	58.60	59.48
Men	2,106	47.61	49.79	3,270	41.40	40.52
Marital Status						
Single	168	3.80	4.28	180	2.28	2.85
Married/ Union	2,516	56.88	56.18	4,858	61.56	57.71
Divorced	292	6.60	8.31	494	6.26	7.40
Widowed	1,447	32.72	31.24	2,360	29.90	32.04
Location (1)						
Rural	1,604	36.26	57.25	2,243	28.40	29.70
Urban	2,819	63.74	42.75	5,654	71.60	70.30
Living Arrangements						
Alone	609	13.77	13.30	2,332	29.53	32.49
With Spouse	968	21.89	22.38	4,150	52.56	49.67

Spouse + Other	1,540	34.82	33.89	698	8.84	7.91
With Other	1,306	29.53	30.43	716	9.07	9.94
Wealth (2)						
Low	1,686	38.12	41.34	2,554	32.34	31.95
Medium	1,417	32.04	30.41	2,667	33.77	34.09
High	1,320	29.84	28.26	2,677	33.89	33.96
SRH						
Poor	1,015	22.96	23.71	591	7.49	7.45
Fair	2,092	47.33	45.27	1,532	19.40	19.11
Good	1,120	25.34	24.92	2,543	32.21	32.41
Very good	139	3.14	4.20	2,358	29.87	29.90
Excellent	54	1.22	1.90	871	11.03	11.13
BMI in kg/m2 (mean)						
Underweight	91	3.00	4.54	195	2.49	2.46
Normal	1,202	39.62	39.34	3,148	40.39	40.66
Overweight	1,192	39.29	38.45	3,078	39.41	39.40
Obese	549	18.09	17.68	1,385	17.71	17.48
Sick as Child (yes) (3)	486	11.15	9.60	470	5.95	5.94
Ever smoke (yes)	2,053	46.43	45.34	4,505	57.35	57.13
At Risk Drinking (4)						
Yes	212	4.80	4.14	308	3.90	3.84
No(5)	844	19.10	18.52	3,327	42.12	43.03
Never Drinks	3,362	76.10	77.35	4,263	53.98	53.13
Exercise (yes) (6)	1,131	25.72	25.18	3,253	41.20	41.38
Currently Working (yes)	1,287	29.28	29.82	1,381	17.51	17.63

Variable	n[c]	Mean (SD)	Weighted Mean (SEM)	n[c]	Mean (SD)	Weighted Mean (SEM)
Education (years)	4,419	3.22(3.83)	3.06(0.14)	7,885	12.16(3.11)	12.25(0.04)
Total Children (7)	4,412	6.91(4.04)	6.66(0.12)	7,877	2.88(1.98)	2.83(0.02)
Alive Children (8)	4,117	6.10(3.14)	5.90(0.10)	7,825	3.15(2.13)	3.08(0.02)

[a] Adults over 65 y/o Included at baseline; [b] Non-Hispanic White Adults over 65 included at baseline; [c] sample size varies due to missing data;

Notes: (1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000. (2) In Mexican pesos for MHAS; in dollars for HRS. (3) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent. (4) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA). (5) Drinks less than 3 drinks on any occasion. (6) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months. (7) For women the question asks about the total number of children they gave birth to, for men is the total number of children parented. (8) Number of children alive at baseline interview.

Differences are also observed in variables that directly assess health status. For example, the percentage of adults in Mexico that report being sick as a child is twice as large in the unweighted percentages and 4% higher in the weighted percentage compared to HRS adults. As stated in the methods chapter, the wording for the question assessing childhood health is not the same in both studies and this can explain part of the observed difference. Also, self-reported health (SRH) is remarkably lower among Mexican adults with more than 60% of them reporting either poor or fair SRH compared to less than 30% in the US. Furthermore, the percentage of older adults reporting excellent health in Mexico is less than 2% while this percentage is more than 11% in the US. Differences are also observed in body mass index (BMI) even though they are not as marked as those observed in SRH. The percentage of underweight older adults in Mexico is higher compared to the US. Obesity rates are similar in both countries were using WHO cut-off points 17% of older adults are obese (WHO, 2006).

Regarding health behaviors, a mixed picture is observed. Older adults in Mexico have lower smoking rates. However, older Mexican adults also report higher rates of at risk drinking and lower rates of exercising compared to HRS adults. Furthermore, social conditions of older adults in Mexico are quite different to that of older adults in the US. The percentage of adults over 65 who report to work for pay at the time of interview is more than 10% higher in Mexico compared to the US. Additionally, and characteristic of a developing country, older adults in Mexico have on average twice as many children compared to older adults in the US. This higher number of children results in a higher number of children available to support older adults in Mexico compared to the US. The implications of these differences are discussed in the next chapter.

In summary, Table 5.1 shows that the socio-demographic distribution in Mexico and the US is different. Older Mexican adults have lower SES and report poorer health compared to their US counterparts. Also, Mexican older adults have better health behaviors according to some but not all indicators and they also have larger families and more are working compared to the HRS respondents.

Differences between those included and excluded in the study

So far I have compared 4,423 Mexican adults 65 years and older that had direct interviews at baseline with 7,898 older adults in the US with the same characteristics. A comparison between included and excluded individuals for each of the studies is presented in Tables 5.2 & 5.3. As explained in the methods section, the excluded group in both studies is composed of proxy respondents at baseline and follow-up, individuals lost to follow-up between waves, and individuals who die between waves. For HRS, the excluded group additionally includes nursing home residents in both waves.

Table 5.2: Comparison of baseline characteristics between included and excluded respondents over 65 in the MHAS study with the sample with direct interviews in both waves (n=4,872[a])

Variable	Excluded[b] (n=1,266)		Included (n= 3,606)		p-value
	n[c]	Mean (SD)	n[c]	Mean (SD)	
Age (mean)	1,266	74.95 (8.00)	3,606	72.3 (6.08)	<.0001
Education (years)	1,258	3.07 (3.84)	3,603	3.22 (3.80)	0.05
Number of Children Alive (mean)	1,187	6.1 (3.25)	3,361	6.1 (3.11)	0.88
	n[c]	**%**	**n[c]**	**%**	**p-value**
Gender					0.0500
Women	634	50.08	1,920	53.24	
Men	632	49.92	1,686	46.76	
Marital Status					<.0001
Single	37	3.25	143	3.97	
Married/Union	521	45.78	2,080	57.68	
Divorced	69	6.06	244	6.77	
Widowed	511	44.90	1,139	31.59	
Location (1)					0.0500
Rural	497	39.26	1,306	36.22	
Urban	769	60.74	2,300	63.78	
Living Arrangements					0.0020
Alone	166	13.11	486	13.48	
With Spouse	243	19.19	800	22.19	
Spouse + Other	405	31.99	1,271	35.25	

With Other	452	35.70	1,049	29.09	
Wealth (2)					0.0300
Low	527	41.63	1,355	37.58	
Medium	372	29.38	1,171	32.47	
High	367	28.99	1,080	29.95	
Healthcare Access (yes) (3)	553	56.22	1,717	47.84	0.0100
SRH					0.0010
Poor	233	28.52	782	21.70	
Fair	374	45.78	1,718	47.68	
Good	180	22.03	940	26.09	
Very good	22	2.69	117	3.25	
Excellent	8	0.98	46	1.28	
BMI in kg/m2 (mean)					<.0001
Underweight	43	5.11	69	2.76	
Normal	370	44.00	968	38.72	
Overweight	297	35.32	996	39.84	
Obese	131	15.58	467	18.68	
Sick as Child (yes) (4)	83	10.26	403	11.35	0.3700
Eversmoke (yes)	585	46.35	1,670	46.32	0.9900
At Risk Drinking (5)					0.0010
Yes	68	5.38	171	4.75	
No (6)	189	14.84	712	19.77	
Doesn't Drink	1,008	79.68	2,718	75.48	
Exercise (yes) (7)	169	20.76	962	26.84	0.0003
Currently Working (Yes)	290	23.03	1,083	30.23	<.0001

[a] Adults over 65 y/o Included at baseline including proxies and non-proxies; [b] Excluded= proxies, lost to follow-up and dead between waves over 65 years of age; [c] sample size varies due to missing data;

Notes: (1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000. (2) In Mexican pesos for MHAS; in dollars for HRS. (3) Access to any insurance available for each country. (4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent. (5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA). (6) Drinks less than 3 drinks on any occasion. (7) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months.

Table 5.2 shows that for the MHAS study, excluded individuals are statistically significantly older compared to included individuals (mean age excluded 74.95 vs. 72.30 for included). Also, a higher percentage of excluded individuals report being widowed and therefore a lower percentage of excluded adults have living arrangements that include a spouse in their composition. A significantly higher percentage of excluded adults have low wealth in Mexico (41.63% vs. 3.58%). Additionally, the percentage of adults reporting access to healthcare is almost 10% higher for excluded individuals compared to included individuals. Significant differences in BMI are also observed between both groups. A higher percentage of excluded individuals are underweight (5.11% vs. 2.76%). However, a higher percentage of included individuals are obese (18.68% vs. 15.58%). Overall the included group reports lower rates of risky behaviors than the excluded group as evidenced with a higher percentage of adults with at risk drinking in the excluded group and a smaller percentage of adults exercising compared to the included group. The percentage of adults reporting poor and fair SRH is higher in the excluded group compared to the included group (74.30% vs. 69.38%, respectively). Finally a significantly higher percentage of included adults report currently working compared to excluded adults (30.23% vs. 23.03%). No significant differences are observed in mean years of education, number of children alive, location, being sick as a child, or ever smoking between included and excluded individuals.

Table 5.3 shows that for the HRS study, excluded individuals are also significantly older compared to included individuals (mean age excluded 78.47 vs. 73.80 for included). Additionally, the excluded group has lower mean years of education compared to the included group (10.88 vs. 12.32, respectively). Also, the included group has a higher mean number of children alive compared to the excluded group. The percentage of women is higher than the percentage of men in both groups for HRS, however the percentage of women in the included group is significantly higher in the included group compared to the excluded group (59.45% vs. 51.23%, respectively). Significant differences are also observed by marital status and living arrangements. The percentage of married and widowed adults among the excluded group is higher compared to the included group. The percentage of individuals reporting living only with their spouse is higher for the included group, but the percentage living with their spouse and someone else and with someone different from their spouse is higher for the excluded group. The excluded group is less wealthy with 46.84% of adults falling in the lowest tertile compared to 30.09% for the included group. There is a higher percentage of underweight individuals in the excluded group while the percentage of obese adults is higher in the included group (6.19% of underweight in excluded group vs. 2.01% in included group; 18.45% obese in included group vs. 12.95% in excluded group). Similar to what is observed in the MHAS cohort, the picture of health behaviors is mixed. Even though excluded individuals report ever smoking more (58.79% vs. 56.34%), included adults report higher rates of at risk drinking. Additionally, the percentage of adults who exercise is also higher in the included group. Poor SRH is noticeably higher among excluded individuals with almost 50% of the sample reporting either poor or fair SRH compared to only 23% of the included sample. Finally, the percentage of older adults the currently work at time of interview is almost 10% higher in the included group. Non-significant differences are observed in healthcare access where 98% of adults in both groups have healthcare access, almost twice as many compared to the MHAS cohort. The difference in rates of being sick as a child is also not statistically different between the groups.

In conclusion, differences between those excluded from the study and those included in the study are similar in both countries. Some differences observed are: widowhood is more prevalent in the included HRS cohort while widowhood is more prevalent in the excluded MHAS cohort; extended families (i.e. living with spouse and someone else) is higher for the excluded HRS cohort while extended families are more prevalent in the included MHAS cohort; and the included HRS cohort was healthier during childhood while the excluded MHAS cohort was healthier during childhood.

Table 5.3: Comparison of baseline characteristics between included and excluded respondents over 65 in the HRS study from the sample with direct interviews in both waves (n = 9,048[a])

Variable	Excluded[b] (n=2,481)		Included (n=6,567)		p-value
	n[c]	Mean (SD)	n[c]	Mean (SD)	
Age (mean)	2,481	78.47(8.34)	6,567	73.80(6.53)	<.0001

Education (years)	2,472	10.88(3.64)	6,556	12.32(3.05)	<.0001
Number of Children Alive (mean)	2,445	3.06(2.28)	6,513	3.17(2.12)	<.0001
	n[c]	**%**	**n[c]**	**%**	**p-value**
Gender					<.0001
Women	1,271	51.23	3,904	59.45	
Men	1,210	48.77	2,663	40.55	
Marital Status					<.0001
Single	61	2.46	151	2.30	
Married/Union	1,356	54.66	4,134	63.01	
Divorced	950	38.29	1,855	28.27	
Widowed	114	4.59	421	6.42	
Location (1)					0.1200
Rural	752	30.32	1,881	28.65	
Urban	1,728	69.68	4,685	71.35	
Living Arrangements					<.0001
Alone	814	32.82	1,878	28.61	
With Spouse	1,091	43.99	3,545	54.00	
Spouse + Other	259	10.44	583	8.88	
With Other	316	12.74	559	8.51	
Wealth (11)					<.0001
Low	1,162	46.84	1,976	30.09	
Medium	747	30.11	2,240	34.11	
High	572	23.06	2,351	35.80	
Healthcare Access (yes)	2,430	98.78	6,488	98.96	0.4600
SRH					<.0001
Poor	557	22.46	353	5.38	
Fair	662	26.69	1,178	17.94	
Good	705	28.43	2,141	32.61	
Very good	390	15.73	2,112	32.17	
Excellent	166	6.69	781	11.90	
BMI in kg/m2 (mean)					<.0001
Underweight	152	6.19	131	2.01	
Normal	1,181	48.09	2,523	38.80	
Overweight	805	32.78	2,649	40.74	
Obese	318	12.95	1,200	18.45	
Sick as Child (yes)	157	6.33	385	5.86	0.4100
Eversmoke (yes)	1,445	58.79	3,678	56.34	0.0400
At Risk Drinking					<.0001
Yes	82	3.31	266	4.05	
No	703	28.35	2,857	43.51	
Doesn't Drink	1,695	68.35	3,444	52.44	
Exercise (yes)	584	23.55	2,903	44.22	<.0001
Currently Working (Yes)	242	9.80	1,253	19.10	<.0001

[a] Non-Hispanic White Adults over 65 included at baseline including proxies and non-proxies;
[b] Excluded= proxies, lost to follow-up, adults in nursing homes and dead between waves over 65 years of age; c Sample size varies due to missing data
Notes:

(1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000
(2) In Mexican pesos for MHAS; in dollars for HRS
(3) Access to any insurance available for each country
(4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent.
(5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA);
(6) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months.

Resilience Construct

The prevalence of the different components used to create the four domains at baseline for both studies is presented in Table 5.4. From this point on, a sample composed of individuals with complete information in both waves for each study (3,606 adults in MHAS and 6,567 adults in HRS) will be used. These domains and components will then be used to calculate the resilience scores as explained in the methods section. For physical health, a higher percentage of adults report worsening health, diabetes, and significant weight loss is observed in the MHAS cohort compared to the HRS cohort. On the other hand, the HRS cohort reported a higher prevalence of hypertension, cancer, lung disease, stroke, arthritis, and a higher percentage was hospitalized in the two years before baseline.

In the second domain, functional status, the prevalence of adults without any difficulty in activities of daily living (ADLs) is high for both studies (84.46% for MHAS and 85.00% for HRS). These percentages result in a slightly higher prevalence of any ADLs disability (difficulty with one or more ADLs) in the HRS cohort compared to the MHAS cohort. However, when the prevalence of disability in two or more ADLs is analyzed, the percentage of adults with disability in two or more ADLs is higher in MHAS compared to HRS. When ADLs are analyzed individually (data not shown), dressing is the ADLs where most adults report difficulty in both the MHAS (9.50%) and the HRS (7.37%). Similarly, eating is the ADLs with the lowest percentage of disability in both studies (2.20% for

MHAS and 1.51% for HRS). A different picture is observed for IADLs disability. The percentage of adults with no difficulty in IADL is almost 10% lower in MHAS compared to HRS. If difficulty in one or more IADLs is analyzed, the prevalence of IADL disability is always higher for the MHAS cohort compared to the HRS cohort. When IADL are analyzed individually (data not shown), shopping is the IADLs were the highest percentage of adults report disability in both studies (12.58% in MHAS and 6.04% in HRS). Similarly, taking medications is the IADL where the lowest percentage of adults report disability in both studies (3.86% in MHAS and 1.37% in HRS). Finally prevalence of mobility disability is much higher in MHAS compared to HRS (33.35% vs. 18.44%).

The third domain, mental status is made up of only two components: cognitive score and depressive symptoms. In the methods section, I explained that the cognitive score is the sum of the only two cognitive tasks that were measured the same way in both studies. As seen in Table 4, the mean cognition score for the MHAS cohort is more than 13% lower than the mean score for the HRS cohort. The mean number of depressive symptoms is also higher for the MHAS cohort however the difference is not as large as for the cognition score (2.65 for MHAS vs. 2.88 for HRS). In summary, mental status for older adults in Mexico is worse compared to their US counterparts.

Table 5.4: Prevalence at baseline of the different components of the four domains for the MHAS and HRS cohorts

Domains and Components	**MHAS (2001) n=3,606[a]**		**HRS (2000) n = 6,567[b]**	
	n[c]	**%**	**n[c]**	**%**
Physical Health				
Worsening Health (1)	1,363	37.89	1,586	24.26
Hypertension	1,481	42.35	3,461	53.58
Diabetes	579	16.52	978	14.97
Cancer	62	1.77	1,018	15.56
COPD	268	7.64	628	9.68
Stroke	118	3.37	388	5.96
Arthritis	925	26.38	4,172	64.70
Significant Weight Loss (2)	971	27.96	428	6.62
Hospitalization (3)	395	10.98	1,727	26.32

Pain	1,570	43.59	1,728	26.32
	n[c]	**%**	**n[c]**	**%**
Functional Status				
ADL Disability (4)				
0	3,039	84.46	5,580	85.00
1	268	7.45	582	8.87
2	111	3.09	201	3.06
3	63	1.75	101	1.54
4	51	1.42	51	0.78
5	34	0.94	39	0.59
6	32	0.89	11	0.17
IADL Disability (5)				
0	2,969	82.70	6,014	91.61
1	322	8.97	350	5.33
2	183	5.10	146	2.22
3	58	1.62	43	0.65
4	58	1.62	12	0.18
Mobility Disability (6)	1,197	33.35	1,207	18.44
	n[c]	**%**	**n[c]**	**%**
Social function				
Doesn't do volunteer work (7)	3,198	88.88	4,240	64.60
Thinks religion is not important (8)	934	26.02	2,294	35.00
No Friends in Neighborhood	711	19.82	1,697	25.99
No one to count on (9)	1,290	36.90	2,750	45.62
	n[c]	**%**	**n[c]**	**%**
Mental Status				
Cognition Score (10)	3,394	39.27(19.06)	6,567	52.62(17.80)
Depressive Symptoms (11)	3,576	2.65(2.22)	6,566	2.88(1.19)

[a]Includes adults over 65, with direct interviews in both waves; [b]Includes Non-Hispanic White respondents over 65 with direct interviews in both waves; [c]Sample size varies due to missing data

Notes: (1) For both studies question asks respondents to rate health in the previous two years in a 5 point scale (much better - much worse); I dichotomized response as somewhat worse+much worse vs. the rest. (2) Loss of 5kg in past two years for MHAS and 10 lbs or more for HRS. (3) In MHAS question is number of nights spent in hospital in past year, HRS asks in the past 2 years; dichotomized as 0 vs. 1 or more. (4) Number of ADLs where difficulty is reported. (5) Number of IADLs where difficulty is reported. (6) Yes to either difficulty climbing a flight of stairs or walking one block. (7) MHAS asks about any time spent doing volunteer work in the past 2 years, HRS asks about the last 12 months. (8) Five-item scale, dichotomized as not important vs. the rest. (9) MHAS asks for friends to count on when sick for daily activities; HRS asks if serious health care problem if they can count of some to care for basic needs. (10) MHAS uses list of 8 words; HRS uses 10 words. Divided both by number of words to create scale 0-100. (11) MHAS originally has 9 items, I only use 7 items that are identical in both studies.

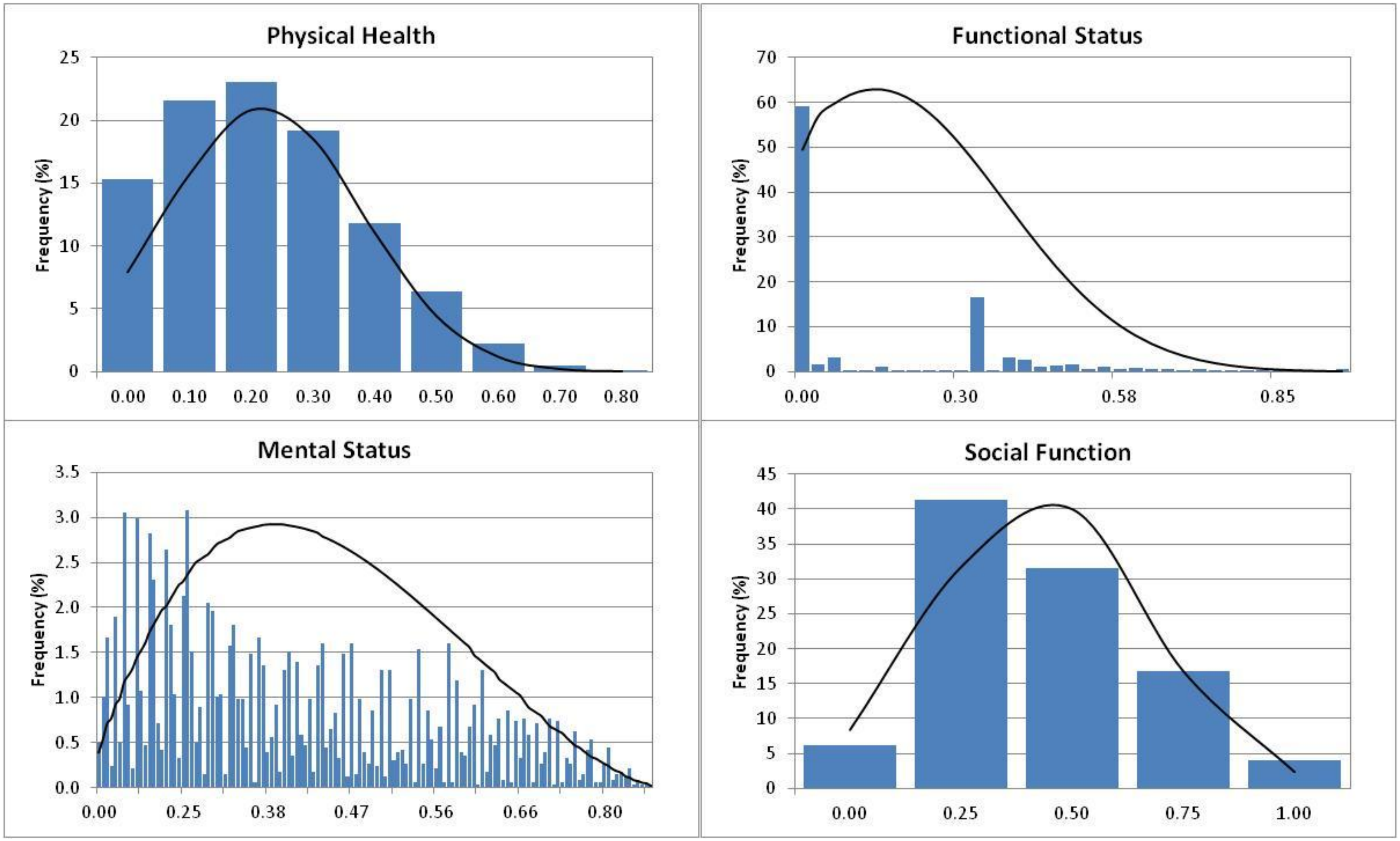
In the fourth and last domain, social function, the percentage of adults who report doing volunteer work in the US is considerably higher compared to Mexico. While in the US more than 35% of adults do volunteer work, this percentage does not even reach 20% in Mexico. However, there are important cultural, social and economic differences between both countries that explain part of these dissimilarities and they will be discussed later. In addition, the percentage of adults who do not consider religion an important part of their lives is almost 10% higher in the US compared to Mexico. Finally, social support and social networks are stronger in Mexico than in the US. The percentage of adults reporting no friends in the neighborhood is 5% higher in the US and the percentage of adults reporting having no one to count on is 8.7% higher in the US compared to Mexico. The 8.7% difference in the social support question may be partially explained by how the question was worded in each study. This will be discussed later. In summary, except for volunteer work, the MHAS cohort appears to have better social function than the US cohort.

5.3 Validation results

Domain distribution

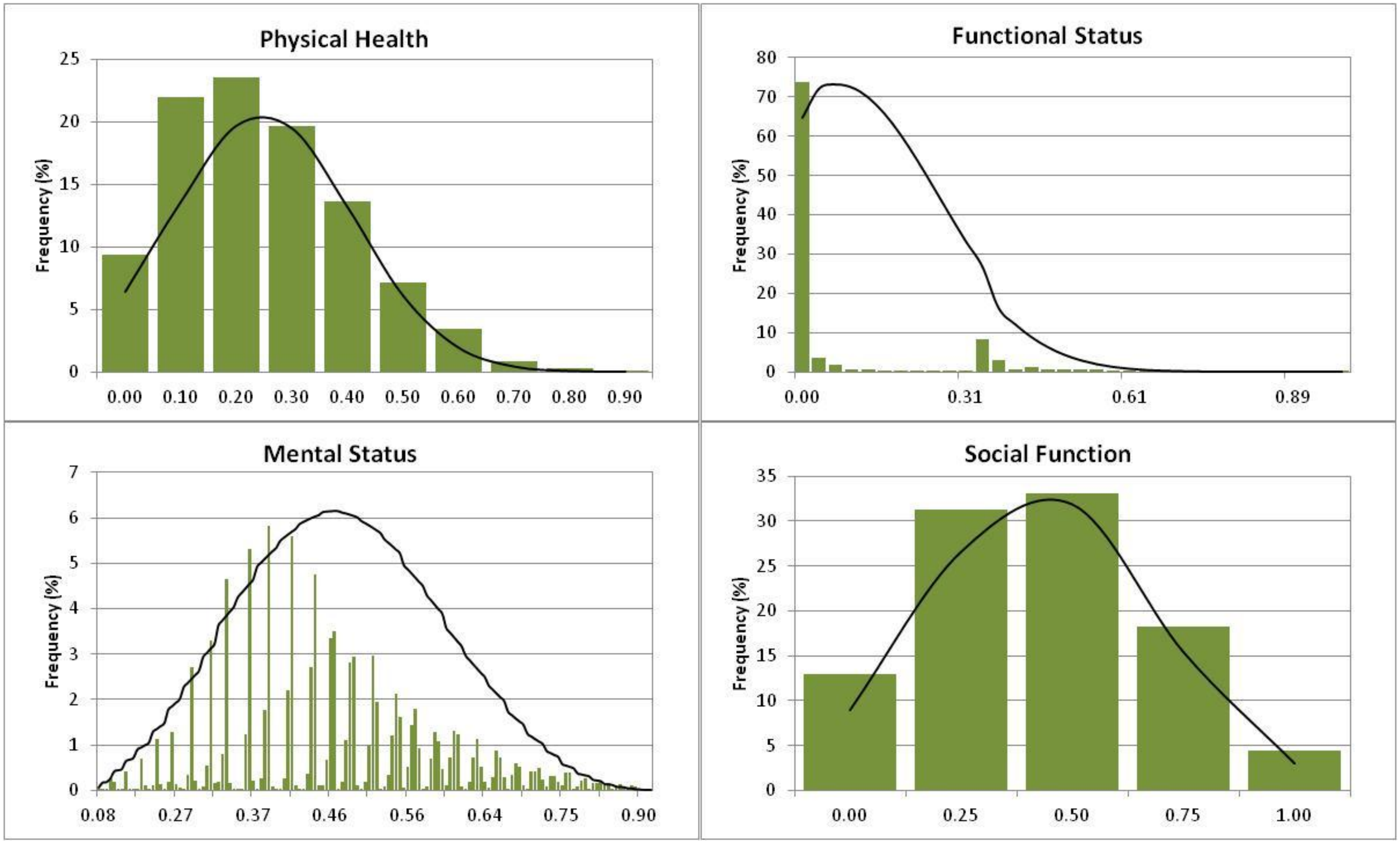
Figure 5.1a shows the distribution of the four domains for the MHAS cohort and Figure 5.1b is for the HRS cohort. It is clear from these histograms that none of the domains is normally distributed in either study. As previously explained in the methods section this determines how data is analyzed for this study. It is also important to note that despite the differences in both studies the distribution pattern for all domains is very similar for MHAS and HRS.

Figure 5.1a: Distribution of the total score for each domain at baseline among individuals over 65 with complete information in both waves of the MHAS study (n=3,606)



Note: Scores for each domain range from 0 to 1, where 0 indicates having no problems with any component (healthy) and 1 implies having problems with all components (Unhealthy) (See Table 4.2 for list of components).

Figure 5.1b: Distribution of the total score for each domain at baseline among individuals over 65 with complete information in both waves of the HRS study (n=6,567)



Note: Scores for each domain range from 0 to 1, where 0 indicates having no problems with any component (healthy) and 1 implies having problems with all components (Unhealthy) (See Table 4.2 for list of components).

Domain Correlation

Table 5.4 describes the four domains and compares the prevalence of the different components between the studies. In Figures 5.1a and 5.1b it is seen that the four domains are not normally distributed in either study. The next questions are how correlated are these domains and can they be used to measure resilience? The matrix resulting from the Spearman correlation coefficients between the domains at baseline and follow-up for the MHAS cohort is presented in Table 5.5. Even though there is no rule of thumb on what cut points to use to define if a correlation is weak, moderate or strong, some authors have suggested the following guidelines: $0<|r|<0.3$ weak correlation, $0.3<|r|< 0.7$ moderate correlation and $|r|>0.7$ strong correlation (Sokal & Rohlf, 1995). On Table 5.5 a positive and moderate correlation exists between physical health, physical function and mental status at baseline. However, the correlation between social function and the other domains is negative and weak. When correlations between baseline and follow-up are analyzed, a positive moderate correlation is still observed between physical health and physical function, but the correlation between mental status and these domains becomes weak but remains positive. The correlation coefficient for social function remains negative and weak between baseline and follow-up. The test of significance indicates that the null hypothesis of the four domains being independent in this population can be rejected ($p<0.05$).

Table 5.6 shows a similar matrix to the one presented in Table 5.5, for the HRS study. One major difference is that the only correlation that is positive and moderate when comparing domains is between physical and functional health. Another difference is that the correlation between mental status and physical and functional health is always weak and positive. The final major difference is that between social function and the other domains is that the correlation is always weak for HRS and unlike the MHAS cohort it is always positive.

Table 5.5: Coefficient matrix resulting from Spearman correlation analyses between the four domains at baseline and the four domains at baseline and follow-up in the MHAS cohort (n=3,606[a])

		Baseline Physical Health	Baseline Physical Function	Baseline Mental Status	Baseline Social Status	Follow-up Physical Health	Follow-up Physical Function	Follow-up Mental Status	Follow-up Social Status
Baseline	Physical Health	1.00	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
		3345c	-	-	-	-	-	-	-
	Physical Function	0.37[b]	1.00	-	-	-	-	-	-
		<.0001[c]	-	-	-	-	-	-	-
		3,323[d]	3,581	-	-	-	-	-	-
	Mental Status	0.33	0.31	1.00	-	-	-	-	-
		<.0001	<.0001	-	-	-	-	-	-
		3,148	3,358	3,373	-	-	-	-	-
	Social Status	-0.05	0.00	0.04	1.00	-	-	-	-
		0.0019	0.9169	0.0133	-	-	-	-	-
		3,236	3,451	3,262	3,470	-	-	-	-
Follow-up	Physical Health	0.49	0.29	0.24	-0.01	1.00	-	-	-
		<.0001	<.0001	<.0001	0.6817	-	-	-	-
		3,250	3,465	3,270	3,358	3,488	-	-	-
	Physical Function	0.31	0.41	0.24	-0.02	0.38	1.00	-	-
		<.0001	<.0001	<.0001	0.2637	<.0001	-	-	-
		3,321	3,554	3,350	3,445	3,462	3,579	-	-
	Mental Status	0.24	0.24	0.42	0.00	0.34	0.33	1.00	-
		<.0001	<.0001	<.0001	0.8705	<.0001	<.0001	-	-
		3,215	3,433	3,251	3,329	3,351	3,436	3,457	-
	Social Status	-0.04	-0.02	0.02	0.28	-0.05	0.00	0.03	1.00
		0.0447	0.2305	0.3620	<.0001	0.0060	0.9929	0.1440	-
		3,252	3,480	3,283	3,373	3,390	3,484	3,371	3,505

[a]Adults over 65, with direct interviews in both waves; [b]Spearman Correlation Coefficients; [c]Prob > |r| under H0: Rho=0; [d] # of Observations

Table 5.6: Coefficient matrix resulting from Spearman correlation analyses between the four domains at baseline and the four domains at baseline and follow-up in the HRS cohort (n=6,567[a])

		Baseline				Follow-up			
		Physical Health	Physical Function	Mental Status	Social Status	Physical Health	Physical Function	Mental Status	Social Status
Baseline	Physical Health	1.00	-	-	-	-	-	-	-
			-	-	-	-	-	-	-
		6068c	-	-	-	-	-	-	-
	Physical Function	0.43[b]	1.00	-	-	-	-	-	-
		<.0001[c]		-	-	-	-	-	-
		6,051[d]	6,545	-	-	-	-	-	-
	Mental Status	0.26	0.29	1.00	-	-	-	-	-
		<.0001	<.0001		-	-	-	-	-
		6,068	6,545	6,566	-	-	-	-	-
	Social Status	0.07	0.10	0.10	1.00	-	-	-	-
		<.0001	<.0001	<.0001		-	-	-	-
		5,541	5,973	5,984	5,984	-	-	-	-
Follow-up	Physical Health	0.74	0.37	0.22	0.05	1.00	-	-	-
		<.0001	<.0001	<.0001	0.0001		-	-	-
		5,769	6,223	6,243	5,699	6,244	-	-	-
	Physical Function	0.43	0.60	0.29	0.10	0.44	1.00	-	-
		<.0001	<.0001	<.0001	<.0001	<.0001		-	-
		6,033	6,511	6,528	5,958	6,210	6,529	-	-
	Mental Status	0.24	0.28	0.57	0.10	0.25	0.34	1.00	-
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001		-
		6,066	6,543	6,564	5,982	6,242	6,527	6,565	-
	Social Status	0.07	0.09	0.10	0.63	0.08	0.12	0.11	1.00
		<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	
		5,084	5,480	5,490	5,186	5,232	5,474	5,489	5,491

[a]Non-Hispanic White adults over 65, with direct interviews in both waves; [b]Spearman Correlation Coefficients; [c]Prob > |r| under H0: Rho=0; [d]# of Observations

How the domains predict events

Now that the analyses have shown the distribution of the four domains and the level of correlation between them, it is of interest to determine if each domain is associated with common and important outcomes such as poor self-reported health (SRH) and death as part of the validation process. Table 5.7 summarizes the results from logistic regression models estimating the odds of poor SRH at follow-up by each of the domains at baseline for the MHAS cohort. Poor physical health, poor physical function, poor mental status and poor social function at baseline significantly increase the odds of poor SRH at follow-up ($p<0.05$). The increase in odds is highest for the physical health domain and smallest for the social function domain.

The logistic regression model for death by the four domains shows that poorer physical health, functional status and mental status at baseline increase the odds of death at least four times compared to individuals with better scores ($p<.0001$). Poor social function also increases the risk of death but this risk increase is not statistically significant ($p=0.77$).

Table 5.8 shows the results of the logistic regression models for poor SRH for the HRS cohort. Similar results to those presented in Table 5.7 are observed. Poor score at baseline in all four domains significantly increases the odds of poor SRH at follow-up ($p<0.01$). Again the highest increase in odds is observed in the physical health domain and the smallest increase is observed in the social function domain. The results of the logistic regression model for death by the four domains in the HRS cohort are also very similar to those of the MHAS cohort with the exception that poor social function at baseline also significantly increases the odds of death at follow up. The p-value for the regression model in the four domains is <0.001 for the HRS cohort.

Table 5.7: Logistic regressions analyses of poor self-reported health or death at follow-up by the score in each domain at baseline for the MHAS cohort

Logistic regression analysis of poor SRH at follow-up (n=3,039)			
Domain at baseline	Estimate	Standard Error	p-value
Intercept	-2.98	0.15	<.0001
Physical Health	2.66	0.31	<.0001
Physical Function	1.01	0.21	<.0001
Mental Status	2.13	0.26	<.0001
Social function	0.17	0.19	0.3834
	Odds Ratio	95% Confidence Interval	
Physical Health	14.23	[7.68 ; 26.36]	
Physical Function	2.74	[1.83 ; 4.11]	
Mental Status	8.45	[5.12 ; 13.95]	
Social function	1.18	[0.81 ; 1.72]	
c Statistic = 0.72; 95% CI (0.70-0.74)			
Logistic regression analysis of death at follow-up (n=3,532)			
	Estimate	Standard Error	p-value
Intercept	-4.07	0.23	<.0001
Physical Health	1.45	0.46	0.0016
Physical Function	1.48	0.28	<.0001
Mental Status	1.60	0.38	<.0001
Social function	0.08	0.29	0.7743
	Odds Ratio	95% Confidence Interval	
Physical Health	4.24	[1.73 ; 10.42]	
Physical Function	4.37	[2.55 ; 7.51]	
Mental Status	4.98	[2.35 ; 10.55]	
Social function	1.09	[0.62 ; 1.91]	
c Statistic = 0.67; 95% CI (0.65-0.69)			

Note:
Sample sizes for logistic regressions include adults over 65 with information at baseline and follow-up. Scores for each domain range from 0 to 1, where 0 indicates having no problems with any component (healthy) and 1 implies having problems with all components (Unhealthy) (See table 4.2 for list of components).

Table 5.8: Logistic regressions analyses of poor self-reported health or death at follow-up by the score in each domain at baseline for the HRS cohort

Logistic regression analysis of poor SRH at follow-up (n=5,766)			
Domain at baseline	Estimate	Standard Error	p-value
Intercept	-6.22	0.26	<.0001
Physical Health	4.65	0.36	<.0001
Physical Function	2.11	0.29	<.0001
Mental Status	3.37	0.42	<.0001
Social function	0.59	0.21	0.0057
	Odds Ratio	95% Confidence Interval	
Physical Health	105.07	[51.87 ; 212.81]	
Physical Function	8.27	[4.72 ; 14.47]	
Mental Status	29.07	[12.87 ; 65.68]	
Social function	1.81	[1.19 ; 2.75]	
c Statistic = 0.82; 95% CI (0.80-0.84)			
Logistic regression analysis of death at follow-up (n=6,401)			
	Estimate	Standard Error	p-value
Intercept	-4.83	0.23	<.0001
Physical Health	1.48	0.34	<.0001
Physical Function	1.53	0.29	<.0001
Mental Status	2.41	0.40	<.0001
Social function	0.76	0.20	0.0002
	Odds Ratio	95% Confidence Interval	
Physical Health	4.41	[2.28 ; 8.54]	
Physical Function	4.61	[2.62 ; 8.10]	
Mental Status	11.11	[5.08 ; 24.30]	
Social function	2.14	[1.44 ; 3.18]	
c Statistic = 0.69; 95% CI (0.68-0.70)			

Note:
Sample sizes for logistic regressions include Non-Hispanic White adults over 65 with information at baseline and follow-up. Scores for each domain range from 0 to 1, where 0 indicates having no problems with any component (healthy) and 1 implies having problems with all components (Unhealthy) (See table 4.2 for list of components)

5.4 The adverse events

Event type

So far, analyses have described the cohorts from both studies, the resilience construct and the validation process to support using this construct to measure resilience. I have also computed correlation coefficients between the four domains for each study and found that important events like death can be predicted using this construct. The sample size has varied in these analyses because analyses have either used all respondents over 65 at baseline (Tables 5.2 and 5.3) or respondents over 65 with non-proxy interview at baseline (Tables 5.1, 5.7 and 5.8 and Figure 5.1) or respondents included with complete information in both waves (Tables 5.4, 5.5 and 5.6). From this point forward analyses will focus on individuals from both studies that have complete information both at baseline and follow-up. Of interest is to analyze recovery among those that experience at least one event. This is the group where I will be able to observe resilience.

Included in the methods section is an explanation of why the three adverse events included in the models were selected and how the variables were created. Table 5.9 shows the frequencies and percentages of different combinations of the three events. The first thing to note is that the percentage of adults who experience at least one event in Mexico is 35.36% compared to 26.17% for the HRS cohort. This represents a 9.19% difference between Mexico and the US. The second thing to note is that for both studies, most older adults experiencing and adverse event experience only one of the events, not a combination. In other words, if we add the percentage of adults reporting only a serious fall and only a heart attack and only widowhood, the result is 52.39% of Mexican older adults. Similarly, 59.12% of older adults in the US experienced a single event. If to these percentages we add older adults reporting change in marital status to a category different from widowhood that had a serious falls, the percentage increases to 85.99% for MHAS and to 81.91%. In other words, adults who had a heart attack for the most part did not have a serious fall and did not become widowed. The same applies for widowhood and serious falls in both studies.

Serious falls is the most prevalent event with 28.06% of adults in the MHAS reporting suffering only falls and 15.76% of adults in the HRS sample only reporting them. The least prevalent event is heart attack with 2.64% of Mexican adults and 4.87%

of US adults reporting them. Based on this information I decided to control for type of event in my models rather than stratifying by type of event. I explained this in depth in the methods section.

Comparison between those with event and those without event

Now that I have identified that most adults experience a single event, it is important to describe the differences between those who had at least one event compared to those who did not experience any event. Tables 5.10 and 5.11 summarize these differences for each study. It is observed in Table 5.10 that older adults in Mexico who experience an adverse event are significantly older, are mostly women, have lower SES as indicated by a higher percentage in the lower tertile of wealth and education, and a higher percentage were sick as a child compared to those who did not have an event ($p<0.01$). Additionally, a higher percentage of adults with an event report poor and fair SRH (77.71% for those with event compared to 64.84% for those without event; $p<.0001$). Also, the percentage of adults working in the group with event was significantly lower compared to the group without an event (24.63% vs. 33.29%; $p<.0001$). Interestingly, the group without an event had higher rates of ever smoking, higher rates of at risk drinking and higher rates of adults exercising compared to the event group. However, these differences were only significant for the smoking variable ($p=0.001$). Finally, at the end of the table, the mean score for each of the four domains at baseline is compared between the event and no-event groups. Statistically significant differences are observed for all domains where individuals who had an event report worse mean scores in all domains compared to those who did not experience an event except for the social function domain. This will be discussed this further in the next chapter.

Table 5.9: Frequency and percent of event combinations among adults over 65 who had at least one event

MHAS		
Event	**n**	**Percent**
Only Serious Fall (1)	452	35.56
Only Heart Attack	36	2.83
Heart Attack + Serious Fall	18	1.42
Heart Attack + Mild Fall (2)	3	0.24
Only Widowhood	178	14.00
Widowhood + Serious Fall	89	7.00
Widowhood + Mild Fall	31	2.44
Widowhood + Heart Attack	2	0.16
Widowhood + Heart Attack + Serious Fall	2	0.16
Other Marital Status(3) + Serious Fall	430	33.60
Other Marital Status + Heart Attack	11	0.87
Other Marital Status + Heart Attack + Serious Fall	21	1.65
Other Marital Status + Heart Attach + Mild Fall	2	0.08
Total Number of Adults with at least one event(4)	1,275	35.36
Total Sample Size	3,606[a]	100.00

HRS		
Event	**n**	**Percent**
Only Serious Fall	492	28.60
Only Heart Attack	138	8.02
Heart Attack + Serious Fall	28	1.63
Heart Attack + Mild Fall	14	0.81
Only Widowhood	387	22.50
Widowhood + Serious Fall	95	5.52
Widowhood + Mild Fall	33	1.92
Widowhood + Heart Attack	19	1.10
Widowhood + Heart Attack + Serious Fall	5	0.29
Widowhood + Heart Attack + Mild Fall	3	0.17
Other Marital Status	1	0.06
Other Marital Status + Serious Fall	392	22.79
Other Marital Status + Heart Attack	79	4.59
Other Marital Status + Heart Attack + Serious Fall	23	1.34
Other Marital Status + Heart Attack + Mild Fall	11	0.64
Total Number of Adults with at least one event	1,719	26.17
Total Sample Size	6567[b]	100.00

[a]Includes adults over 65, with direct interviews in both waves; [b]Includes Non-Hispanic White respondents over 65 with direct interviews in both waves.

Notes: (1) Serious fall refers to falls that require medical attention, (2) Mild falls refer to falls that do not require medical attention (3) Other marital status refers to individuals who were deemed widowed before baseline interview, those that were divorced at baseline and then report to be widowed at follow-up and those were there is disagreement in marital status between both waves (for example divorced at baseline and single at follow-up). (4) At least one of the following events: widowhood, serious falls or heart attack.

Table 5.10: Comparison between individuals experiencing an event compared to those with no event, MHAS 2001 (n=3,606[a])

Variable	Event[b] (n=1,275) n[c]	Percent	No Event (n=2,331) n[c]	Percent	p-value
Age					0.0004
65-69	459	36.00	968	41.53	
70-74	356	27.92	672	28.83	
75-79	261	20.47	409	17.55	
80+	199	15.61	282	12.10	
Gender					<.0001
Women	834	65.41	1,086	46.59	
Men	441	34.59	1,245	53.41	
Education (years)					0.0004
Low	726	56.94	1,178	50.54	
Medium	412	32.31	828	35.52	
High	137	10.75	325	13.94	
Location (1)					0.1100
Rural	440	34.51	866	37.15	
Urban	835	65.49	1,465	62.85	
Wealth (2)					0.0080
Low	522	40.94	833	35.74	
Medium	396	31.06	775	33.25	
High	357	28.00	723	31.02	
Healthcare Access (yes) (3)	613	48.42	1,104	47.52	0.6100
Sick as child (yes) (4)	172	13.74	231	10.05	0.0010
Ever Smoke (yes)	541	42.43	1,129	48.45	0.0010
At Risk Drinking (5)					0.1000
Yes	53	4.17	118	5.07	
No	233	18.32	479	20.57	
Never Drinks	986	77.52	1,732	74.37	
Exercise (Yes) (6)	317	25.00	645	27.85	0.0700
Self-reported Health					<.0001
Poor	358	28.10	424	18.21	
Fair	632	49.61	1,086	46.63	
Good	252	19.78	688	29.54	
Very good	21	1.65	96	4.12	
Excellent	11	0.86	35	1.50	
Currently Working (yes)	312	24.63	771	33.29	<.0001
	n[c]	**Mean(SD)**	**n[c]**	**Mean(SD)**	**p-value**
Physical Health Baseline (7)	1,187	0.26(0.16)	2,158	0.20(0.15)	<.0001
Functional Status Baseline (7)	1,270	0.20(0.25)	2,311	0.13(0.21)	<.0001
Mental Status Baseline (7)	1,190	0.42(0.19)	2,183	0.36(0.19)	<.0001
Social function Baseline (7)	1,225	0.41(0.23)	2,245	0.44(0.24)	0.0030
# Children alive (8)	1,205	6.12(3.09)	2,156	6.10(3.12)	0.6600

[a] Includes adults over 65, with direct interviews in both waves; [b] Event = at least one of the following adverse events: widowhood, heart attack, serious fall; [c] Sample size varies due to missing data

Notes: (1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000 (2) In Mexican pesos for MHAS; in dollars for HRS. (3) Access to any insurance available for each country. (4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent. (5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA); (6) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months. (7) The score range is from 0 - 1 where 1 implies alterations in all components of the domain (unhealthy) and 0 implies no alterations (healthy). Therefore higher mean score is worse. (8) Number of children alive at baseline interview.

Table 5.11 shows the same information summarized in the previous table but for the HRS cohort. Older adults in the US who experience an adverse event are also significantly older, are mostly women, have lower SES as indicated by a higher percentage in the lower tertile of wealth and education, and a higher percentage were sick as a child compared to those who did not have an event (p<0.05). Additionally, a higher percentage of adults with an event also report poor and fair SRH (32.23% for those with event compared to 20.19% for those without event; p<.0001). Also, the percentage of adults working in the group with the event was significantly lower compared to the group without an event (20.74% vs. 14.48%; p<.0001). Regarding health behaviors, adults without an event have significantly higher rates of ever smoking and at risk drinking, but they also have significantly higher rates of exercise compared to the group with an event (p<0.05). Finally, when mean scores in the four domains are compared between the event and no-event group, the mean score is higher in all four domains among the group with an event, however the difference is not statistically significant for the social function domain (p=0.16).

Table 5.11: Comparison between individuals experiencing an event compared to those with no event, HRS 2000 (n=6,567[a])

Variable	Event[b] (n=1719) n[c]	Percent	No Event(n=4848) n[c]	Percent	P-value
Age					<.0001
65-69	439	25.52	1,719	35.47	
70-74	371	21.57	1,295	26.72	
75-79	427	24.83	991	20.45	
80+	483	28.08	842	17.37	
Gender					<.0001
Women	1,173	68.20	2,731	56.34	
Men	547	31.80	2,116	43.66	
Education (years)					0.0010
Low	459	26.69	1,182	24.39	
Medium	669	38.90	1,750	36.10	
High	592	34.42	1,915	39.51	
Location (1)					0.4300
Rural	480	27.91	1,401	28.91	
Urban	1,240	72.09	3,445	71.09	
Wealth (2)					<.0001
Low	627	36.45	1,349	27.83	
Medium	563	32.73	1,677	34.60	
High	530	30.81	1,821	37.57	
Healthcare Access (yes) (3)	1,708	99.42	4,780	98.80	0.0300
Sick as child (yes) (4)	118	6.86	267	5.51	0.0400
Ever Smoke (yes)	912	53.55	2,766	57.33	0.0100
At Risk Drinking (5)					<.0001
Yes	49	2.85	217	4.48	
No (6)	645	37.50	2,212	45.64	
Never Drinks	1,026	59.65	2,418	49.89	
Exercise (Yes) (7)	662	38.49	2,241	46.25	<.0001
Self-reported health					<.0001
Poor	164	9.54	189	3.90	
Fair	390	22.69	788	16.26	
Good	544	31.65	1,597	32.96	
Very good	468	27.23	1,644	33.92	
Excellent	153	8.90	628	12.96	
Currently Working (yes)	249	14.48	1,004	20.74	<.0001
	n[c]	**Mean(SD)**	**n[c]**	**Mean(SD)**	**p-value**
Physical Health Baseline (8)	1,569	0.29(0.17)	4,499	0.23(0.16)	<.0001
Functional Status Baseline (8)	1,713	0.13(0.21)	4,832	0.07(0.16)	<.0001
Mental Status Baseline (8)	1,720	0.50(0.14)	4,846	0.46(0.12)	<.0001
Social function Baseline (8)	1,515	0.43(0.27)	4,469	0.42(0.26)	0.1600
# Children alive (9)	1,701	3.13(2.09)	4,812	3.19(2.13)	0.2000

[a]Includes Non-Hispanic White respondents over 65 with direct interviews in both waves;
[b]Event = at least one of the following adverse events: widowhood, heart attack, serious fall;
[c]Sample size varies due to missing data.
Notes: (1)Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000 (2) In Mexican pesos for MHAS; in dollars for HRS. (3) Access to any insurance available for each country. (4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent. (5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA). (6) Drinks less than 3 drinks on any occasion. (7) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months. (8) The score range is from 0 - 1 where 1 implies alterations in all components of the domain (unhealthy) and 0 implies no alterations (healthy). Therefore higher mean score is worse. (8) Number of children alive at baseline interview

It is important to highlight certain differences observed when comparing both countries. The gender distribution is different between both countries. The event group is composed mostly of women in both countries (65.41% in MHAS and 68.2% in HRS). Conversely, the no-event group is composed mostly of men in MHAS but mostly of women in HRS (53.41% of men in MHAS and 43.66% of men in HRS). The mean score for the social function domain is higher for the event group in HRS while it is higher in the no-event group in MHAS. The difference for the social function domain in HRS however is not statistically significant.

Cross-sectional analysis for those with event

This section contains the results from linear regression models predicting baseline score in each of the four domains by the different covariables. These results will show where individuals start to better understand recovery in the longitudinal analyses that will be present later. Table 5.12 shows the results of the linear regression models predicting the score in each of the four domains by the different covariables among older Mexican adults with at least one event. Being a man is significantly associated with better scores in the physical health domain while poor SRH is associated with poorer score in the same domain(p<.0001). Furthermore, older age, living in an urban setting, and reporting poor SRH are all associated with poorer score in the functional status domain. On the other hand, more exercise is associated with better score in the functional domain (p=0.003). For the mental status domain, older age and poor SRH are associated with poorer score in the domain (p<.0001). In contrast, higher wealth is associated with better score in the mental status domain (p=0.02). Finally, men have significantly poorer scores in the social function domain compared to women (p<.0001). Living in an urban location also predicts poorer scores in this domain (p=0.01). Also, being sick as a child predicts better scores in the social function domain (p=0.03).

Table 5.13 presents the results from linear regression models predicting score in the four domains by the different covariables for the HRS cohort. Being sick as a child and poor SRH predict poor score in the physical health domain (p<.001). In contrast, higher wealth and more exercise are associated with better physical health (p<0.05). Furthermore, men, those with older age, those who report being sick as a child and those with poor SRH had significantly poorer functional status (p<.001). In contrast, higher wealth, not having at risk drinking and exercising more are associated with better functional status (p<0.05). Finally, urban location, having fewer children, ever smoking and drinking significantly predicted poor social function while exercising predicted better social function (p<0.05).

Table 5.12: Linear regression of each domain at baseline by covariables at baseline for those with at least one event in the MHAS study (n=1,275)

	Physical Health Baseline*(n=1,159)			Functional Status Baseline(n=1,232)			Mental Status Baseline(n=1,154)			Social function Baseline (n=1,188)		
	β	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**
Intercept	0.23	0.05	<.0001	-0.23	0.08	0.0045	0.20	0.06	0.0024	0.38	0.08	<.0001
Age	0.00	0.00	0.9830	0.01	0.00	<.0001	0.00	0.00	<.0001	0.00	0.00	0.9500
Education	0.00	0.00	0.0713	0.00	0.00	0.1848	-0.01	0.00	<.0001	0.00	0.00	0.7405
Gender (Men)	-0.04	0.01	<.0001	-0.03	0.02	0.0620	-0.01	0.01	0.2663	0.06	0.02	<.0001
Location (Urban) (1)	0.01	0.01	0.5258	0.03	0.01	0.0381	-0.01	0.01	0.5790	0.04	0.02	0.0099
# Children Alive (≤1)	0.00	0.01	0.8715	0.00	0.02	0.9753	-0.01	0.02	0.6992	-0.02	0.02	0.4749
Wealth (2)												
Low	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Medium	-0.01	0.01	0.3618	-0.01	0.02	0.4439	0.00	0.01	0.9760	0.00	0.02	0.9251
High	-0.01	0.01	0.6113	-0.01	0.02	0.7566	-0.03	0.01	0.0223	-0.01	0.02	0.7314
Healthcare Access (Yes) (3)	0.02	0.01	0.0757	0.01	0.01	0.4021	-0.02	0.01	0.0982	-0.01	0.01	0.7214
Sick as Child (Yes) (4)	0.02	0.01	0.0914	0.03	0.02	0.1254	0.01	0.01	0.5337	-0.04	0.02	0.0294
Ever Smoke (Yes)	0.00	0.01	0.9074	-0.01	0.01	0.6422	-0.02	0.01	0.0841	-0.01	0.02	0.4678
At Risk Drinking (5)												
Yes	0.00	0.02	0.9331	-0.04	0.03	0.2256	-0.03	0.03	0.2496	-0.05	0.03	0.1659
No (6)	0.00	0.01	0.9900	-0.02	0.02	0.1740	-0.01	0.01	0.3678	0.02	0.02	0.1978
No Drinking	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Exercise (Yes) (7)	0.01	0.01	0.4912	-0.05	0.02	0.0034	-0.01	0.01	0.3392	-0.03	0.02	0.0610
Self-reported health (Poor)	0.14	0.01	<.0001	0.16	0.01	<.0001	0.11	0.01	<.0001	0.00	0.02	0.9174

* Scores for each domain range from 0 -1, where 0 indicates having no problems with any component (healthy) and 1 implies having problems with all components (Unhealthy) (See table 4.2 for list of components)

Notes: (1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000; (2) In Mexican pesos for MHAS; in dollars for HRS; (3) Access to any insurance available for each country; (4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent; (5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA); (6) Drinks, but not more than three drinks per occasion; (7) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months.

Table 5.13: Linear regression of each domain at baseline by covariables at baseline for those with at least one event, in the HRS study (n=1,719)

	Physical Health Baseline* (n=1,546)			**Functional Status Baseline (n=1,690)**			**Mental Status Baseline (n=1,696)**			**Social function Baseline (n=1,496)**		
	β	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**
Intercept	0.22	0.07	0.0027	-0.18	0.08	0.0300	0.33	0.06	<.0001	0.40	0.13	0.0018
Age	0.00	0.00	0.1630	0.00	0.00	<.0001	0.00	0.00	<.0001	0.00	0.00	0.0951
Education	0.00	0.00	0.8402	0.00	0.00	0.1413	-0.01	0.00	<.0001	0.00	0.00	0.2486
Gender (Men)	0.00	0.01	0.9498	0.04	0.01	0.0004	-0.02	0.01	0.0200	-0.03	0.02	0.0531
Location (Urban) (1)	0.00	0.01	0.9304	0.01	0.01	0.1755	-0.02	0.01	0.0258	0.04	0.02	0.0177
# Children Alive (≤1)	0.00	0.01	0.8823	0.01	0.01	0.5138	-0.01	0.01	0.3544	0.05	0.02	0.0034
Wealth (2)												
Low	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Medium	-0.03	0.01	0.0110	-0.05	0.01	<.0001	-0.01	0.01	0.2257	-0.03	0.02	0.0864
High	-0.03	0.01	0.0047	-0.05	0.01	<.0001	-0.02	0.01	0.0124	0.00	0.02	0.8242
Healthcare Access (Yes) (3)	0.00	0.05	0.9380	0.03	0.06	0.6513	-0.03	0.04	0.5198	-0.08	0.09	0.3828
Sick as Child (Yes) (4)	0.01	0.00	0.0008	0.02	0.00	<.0001	0.01	0.00	0.0325	0.00	0.01	0.7926
Ever Smoke (Yes)	0.01	0.01	0.0834	0.02	0.01	0.1019	0.01	0.01	0.1157	0.08	0.01	<.0001
At Risk Drinking (5)												
Yes	0.00	0.02	0.9219	-0.01	0.03	0.7730	-0.01	0.02	0.7699	0.09	0.04	0.0193
No (6)	0.00	0.01	0.9038	-0.01	0.01	0.4571	-0.02	0.01	0.0056	0.03	0.01	0.0214
No Drinking	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Exercise (Yes) (7)	-0.06	0.01	<.0001	-0.07	0.01	<.0001	-0.03	0.01	<.0001	-0.06	0.01	0.0001
Self-reported health (Poor)	0.19	0.01	<.0001	0.22	0.02	<.0001	0.08	0.01	<.0001	0.02	0.03	0.3664

* Scores for each domain range from 0 -1, where 0 indicates having no problems with any component (healthy) and 1 implies having problems with all components (Unhealthy) (See table 4 for list of components)

Notes: (1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000; (2) In Mexican pesos for MHAS; in dollars for HRS; (3) Access to any insurance available for each country; (4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent; (5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA); (6) Drinks, but not more than three drinks per occasion; (7) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months.

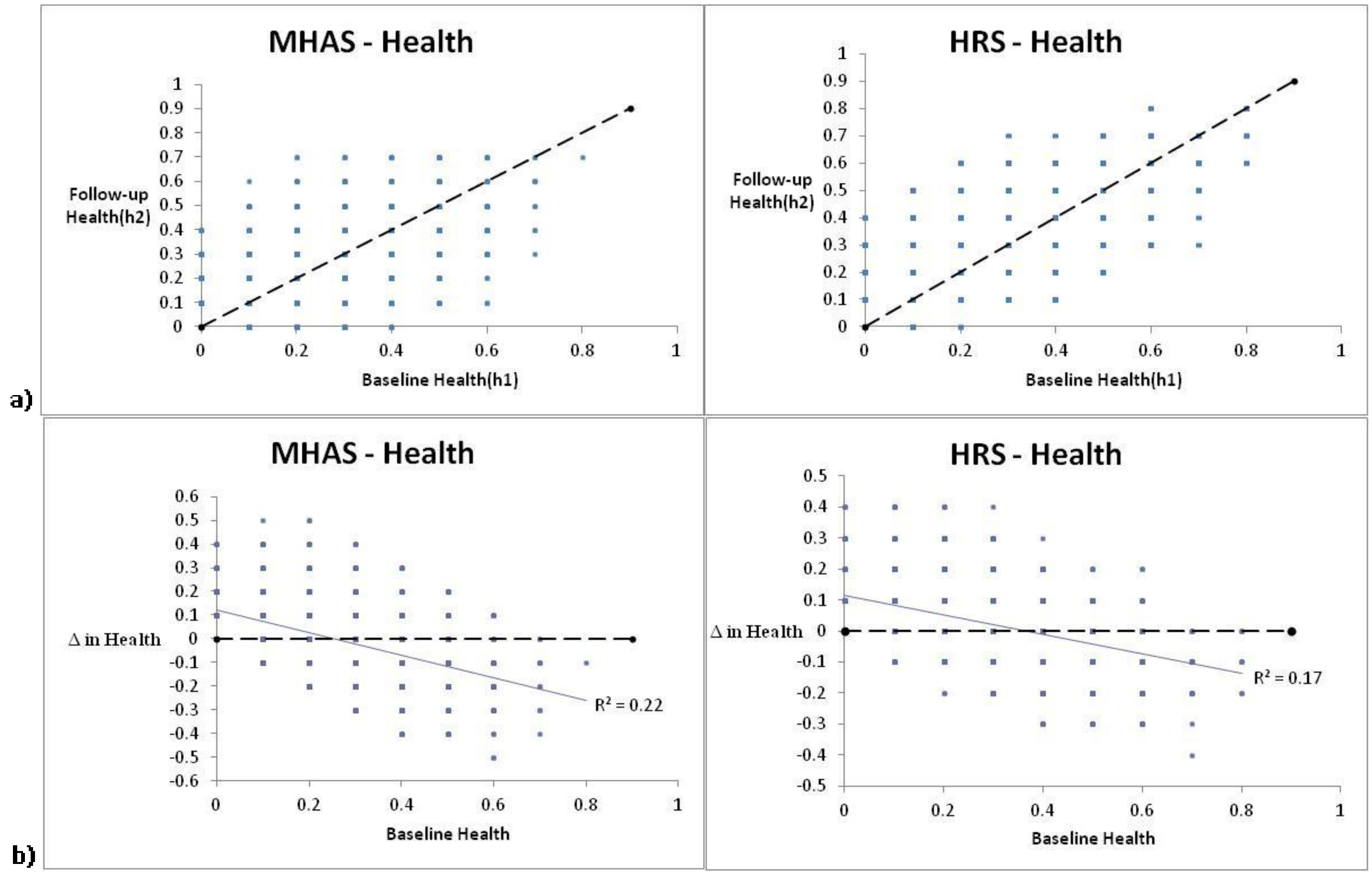
5.5 Change in domain score and recovery

Most adults recover

Figure 5.2 is divided in two parts. This figure is included to show the relationship between baseline status and follow-up status. The health domain is used as an example but the other domains have a very similar pattern. Figure 5.2a shows the relationship between health at baseline (h1) and health at follow-up (h2). The dashed line represents the diagonal where adults who had no change between baseline and follow-up health scores fall. All individuals below the diagonal do better and those above the diagonal do worse over time. Based on the resilience definition presented in earlier chapters, individuals with the same score or a better score are considered to be more resilient while those with a worse score are considered to be less resilient. The group that stays the same (those on the diagonal) and recovers (those below the diagonal) is larger than the group that doesn't recover for both studies. This is a remarkable finding.

Furthermore, Figure 5.2b shows that when the relationship between baseline score and the difference between baseline and follow-up is analyzed, as the baseline score increases, meaning that individuals start worse-off, they recover more. This may be confusing initially but Figure 5.2a shows that the number of resilient individuals is quite large. The horizontal dashed line in Figure 5.2b represents those individuals who had the same score at both time points, again the number of individuals who recover is larger than the number of individuals who worsen. The continuous line represents the regression line for the data in each study. This line shows that the more aspects that are wrong with an individual (worse baseline health), the more aspects the individual can recover from. Therefore, all negative coefficients shown in the below represent recovery while all positive coefficients represent absence or decreased recovery.

Figure 5.2: Scattered plots showing the relationship between baseline and follow-up health scores and between baseline score and change in health score for both studies.



Notes: Scores for h1 and h2 range from 0 -1, where 0 indicates having no problems (healthy) and 1 implies having problems with all components (Unhealthy) (See table 4.2 for list of components). Scores for h2-h1 range from -1 to 1, where values < 0 indicate there is improvement in the domain score between waves (recovery), where 0 indicates no change in domain score between waves (recovery) and 1 indicates worsening of domain score between baseline and follow-up (worse health).

Even though I use the score difference as an interval variable because of conceptual and statistical advantages, I also dichotomized the difference score for each domain and gave a value of 1 to all individuals scoring 0 or less (resilient). Individuals scoring higher than 0 were coded as 0 (less resilient). Using this variable I identified rates for each score difference in both studies. The percentage of resilient individuals is higher for all domains in both studies than the percentage of individuals with a score greater than 1 as shown in the figures above. In addition, the percentage of resilient individuals is higher for every domain in the HRS cohort compared to the MHAS cohort.

PREDICTORS OF RECOVERY

Table 5.14 summarizes the results from general linear regression models predicting change in each of the four domains by the different covariables for the MHAS cohort. First, baseline scores for each domain are included in the regression equations. Others have shown that if the theory suggests an underlying relationship between baseline score and the change score, then the model is more powerful when the baseline score is included (Allison, 1990). Second, baseline score for each domain is the single most powerful predictor of score change for all domains ($p<.0001$). It was also found that moderate drinking and an early event are associated with recovery in the health domain ($p<.05$). Alternatively, if the event is a heart attack or if SRH is poor, less recovery is observed in the health domain ($p<0.05$). Furthermore, exercising is associated with recovery in the functional domain ($p=0.02$), while older age, and poor SRH are associated with no recovery in this domain ($p<0.01$). Also, higher education, higher wealth, and an early event are associated with recovery in the mental domain ($p<0.05$). Instead, older age, poor SRH and either widowhood or serious fall, are associated with poor recovery in the mental domain ($p<0.01$). Finally, if the event was widowhood or a serious fall, better recovery was observed for the social domain while older age, poor SRH and urban setting reduce recovery for this domain.

Table 5.15 summarizes the results from linear regression models for change in each of the four domains by the different covariables for the HRS cohort. It is important to note that for this cohort as well, baseline score for each domain was the strongest predictor of recovery for all domains. In the HRS cohort, exercising and urban location were associated with recovery in the health domain ($p<0.05$). Instead, having a later event, the event being either a serious fall or a heart attack, significantly predicted no recovery for this domain ($p<0.05$). Furthermore, moderate drinking and exercising significantly predicted recovery for the functional domain ($p<0.05$). Yet, older age, or the event being a heart attack or a serious fall and poor SRH significantly predicted no recovery for the functional domain ($p<0.01$). Mental status recovery was significantly predicted by higher education, moderate drinking and exercising ($p<0.05$). In comparison, older age, being sick as a child, poor SRH, widowhood and mild falls were significantly associated with no recovery ($p<0.05$). Finally, higher wealth was the only covariable associated with recovery for the social function domain while urban location, fewer children, and ever smoking were associated with no recovery in this domain.

Differences in Resilience between countries

I will now highlight important differences and similarities observed in predictors of recovery between the US and Mexico in Tables IV.14 and IV.15. First, early event is a protective factor only for the MHAS cohort. Second, late event and fewer children are risk factors only for the HRS cohort. With respect to event type, the three events are significant predictors against recovery for both studies but in different domains. Interestingly, there are four indicators that appear as protective factors in one study and risk factors in the other study for certain domains: widowhood, falls, sick as child and urban location. This point will be discussed in the next chapter.

Table 5.14: Linear regression models for difference in each domain by covariables controlling for domain score at baseline, MHAS (n=1,275[a])

Parameter	Δ Physical Health (n=1128)[b] β	SE	p-value	Δ Functional Status (n=1222) β	SE	p-value	Δ Mental Status (n=1115) β	SE	p-value	Δ Social Function (n=1157) β	SE	p-value
Intercept	0.15	0.06	0.0064	-0.30	0.09	0.0006	0.12	0.07	0.1013	0.05	0.10	0.5658
Age	0.0002	0.00	0.7915	0.01	0.00	<.0001	0.003	0.00	0.0003	0.005	0.00	<.0001
Education	-0.002	0.00	0.1929	-0.003	0.00	0.1118	-0.01	0.00	<.0001	0.002	0.00	0.3569
Gender (Men)	-0.01	0.01	0.5508	-0.03	0.02	0.1209	0.005	0.01	0.7252	0.03	0.02	0.0783
Location (Urban) (1)	-0.01	0.01	0.5924	-0.01	0.02	0.6002	-0.01	0.01	0.2741	0.07	0.02	<.0001
# Children Alive (≤1)	-0.01	0.01	0.2696	-0.01	0.02	0.5275	0.01	0.02	0.5884	-0.04	0.02	0.0500
Wealth (2)												
Low		Ref			Ref			Ref			Ref	
Medium	0.002	0.01	0.8735	-0.004	0.02	0.8102	-0.03	0.01	0.0283	-0.02	0.02	0.3198
High	-0.02	0.01	0.0630	-0.02	0.02	0.2098	-0.04	0.01	0.0046	-0.02	0.02	0.2363
Healthcare Access (Yes) (3)	-0.01	0.01	0.3439	-0.02	0.01	0.2593	-0.003	0.01	0.7916	0.003	0.02	0.8531
Sick as Child (Yes) (4)	-0.01	0.01	0.5250	-0.03	0.02	0.1394	-0.03	0.01	0.0541	-0.07	0.02	0.0014
Ever Smoke (Yes)	0.004	0.01	0.6656	-0.0001	0.01	0.9964	0.02	0.01	0.0589	0.01	0.02	0.5923
At Risk Drinking (5)												
Yes	-0.02	0.02	0.3813	-0.05	0.03	0.1404	0.03	0.03	0.3401	0.03	0.04	0.4783
No	-0.02	0.01	0.0309	-0.01	0.02	0.5868	-0.02	0.01	0.0917	0.03	0.02	0.1504
Never Drink		Ref			Ref			Ref			Ref	
Exercise (Yes) (6)	-0.01	0.01	0.1453	-0.04	0.02	0.0236	0.00	0.01	0.6942	0.0004	0.02	0.9825
Self-reported health (Poor)	0.02	0.01	0.0401	0.06	0.02	0.0005	0.07	0.01	<.0001	0.04	0.02	0.0296
Event Before Baseline (Yes) (7)	-0.03	0.01	0.0046	-0.03	0.02	0.0735	-0.04	0.02	0.0164	-0.01	0.02	0.5750
Event Between Waves (Yes) (8)	-0.01	0.01	0.4619	-0.01	0.02	0.4492	0.02	0.01	0.1668	-0.02	0.02	0.2793
Event Heart Attack (Yes)	0.05	0.02	0.0091	0.05	0.03	0.1155	0.03	0.02	0.2524	-0.05	0.03	0.1161

Event Widowhood												
Yes	-0.01	0.02	0.4706	0.01	0.03	0.7057	0.06	0.02	0.0046	-0.06	0.03	0.0258
No		Ref			Ref			Ref			Ref	
Other	0.003	0.01	0.7669	-0.01	0.02	0.7426	-0.01	0.01	0.2683	-0.01	0.02	0.7631
Event Falls												
Yes	0.002	0.02	0.9299	0.05	0.03	0.0846	0.05	0.02	0.0237	-0.07	0.03	0.0276
No		Ref			Ref			Ref			Ref	
Other	0.02	0.03	0.4165	0.04	0.04	0.3261	-0.02	0.03	0.6205	0.03	0.05	0.4935
Total Score at Baseline	-0.52	0.03	<.0001	-0.60	0.03	<.0001	-0.69	0.03	<.0001	-0.76	0.03	<.0001
R2		0.27			0.27			0.37			0.37	
Mean Change Score		-0.004			0.030			0.070			0.050	
Model p-value		<.0001			<.0001			<.0001			<.0001	

[a]Includes adults over 65, with complete information at baseline and follow-up that experienced at least one of the following events: widowhood, heart attack, serious fall; [b]Sample size varies fall all domains due to missing data

Notes:

(1)Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000

(2) In Mexican pesos for MHAS; in dollars for HRS

(3) Access to any insurance available for each country

(4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent.

(5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA);

(6) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months.

(7) Any of the three events occurred in the two years prior to baseline interview; reference group is having event both before and after baseline

(8) Any of the three events occurred between interviews; reference group is having event both before and after baseline

Table 5.15: Linear regression models for difference in each domain by covariables controlling for domain score at baseline, HRS (n=1,729[a])

	Δ Physical Health (n=1462)			Δ Functional Status (n=1678)			Δ Mental Status (n=1696)			Δ Social Function (n=1241)		
Parameter	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**	**β**	**SE**	**p-value**
Intercept	0.06	0.06	0.2862	-0.18	0.08	0.0283	0.22	0.05	<.0001	-0.004	0.12	0.9759
Age	0.0002	0.00	0.7386	0.004	0.00	<.0001	0.002	0.00	<.0001	0.002	0.00	0.0561
Education	0.001	0.00	0.3112	-0.001	0.00	0.5277	-0.01	0.00	<.0001	0.003	0.00	0.1754
Gender (Men)	0.01	0.01	0.2036	-0.004	0.01	0.6947	-0.01	0.01	0.0603	-0.01	0.01	0.3784
Location (Urban) (1)	-0.02	0.01	0.0173	-0.01	0.01	0.4351	0.01	0.01	0.3702	0.03	0.01	0.0404
# Children Alive (≤1)	0.003	0.01	0.7312	0.02	0.01	0.0792	0.01	0.01	0.4062	0.03	0.01	0.0440
Wealth (2)												
Low		Ref			Ref			Ref			Ref	
Medium	-0.003	0.01	0.6754	0.01	0.01	0.3775	-0.01	0.01	0.4280	-0.02	0.01	0.2807
High	-0.01	0.01	0.2079	-0.01	0.01	0.4295	-0.01	0.01	0.2240	-0.04	0.02	0.0155
Healthcare Access (Yes) (3)	-0.01	0.04	0.8894	-0.02	0.06	0.7765	-0.03	0.04	0.3343	-0.03	0.08	0.6893
Sick as Child (Yes) (4)	0.003	0.00	0.3223	0.002	0.00	0.5756	0.01	0.00	0.0194	0.01	0.01	0.3326
Ever Smoke (Yes)	0.01	0.01	0.2741	0.01	0.01	0.5281	0.004	0.01	0.5424	0.03	0.01	0.0371
At Risk Drinking (5)												
Yes	-0.01	0.02	0.5343	0.002	0.03	0.9498	-0.04	0.02	0.1200	0.02	0.03	0.5612
No	-0.01	0.01	0.3761	-0.02	0.01	0.0096	-0.01	0.01	0.0200	-0.01	0.01	0.5518
Never Drink		Ref			Ref			Ref			Ref	
Exercise (Yes) (6)	-0.02	0.01	0.0097	-0.05	0.01	<.0001	-0.01	0.01	0.0118	-0.01	0.01	0.2809
Self-reported health (Poor)	0.004	0.01	0.6914	0.04	0.02	0.0168	0.02	0.01	0.0370	-0.01	0.02	0.6951
Event Before Baseline (Yes) (7)	-0.01	0.01	0.2729	-0.01	0.01	0.4756	-0.02	0.01	0.0466	-0.001	0.02	0.9709
Event Between Waves (Yes) (8)	0.02	0.01	0.0129	0.03	0.01	0.0428	0.01	0.01	0.1158	-0.01	0.02	0.6949
Event Heart Attack (Yes)	0.06	0.01	<.0001	0.05	0.02	0.0031	0.02	0.01	0.1317	-0.01	0.02	0.6463
Event Widowhood												

Yes	0.01	0.01	0.6084	0.02	0.02	0.3169	0.03	0.01	0.0021	0.004	0.02	0.8562
No		Ref			Ref			Ref			Ref	
Other	-0.003	0.01	0.6976	0.03	0.01	0.0124	0.01	0.01	0.1193	0.002	0.02	0.9130
Event Falls												
Yes	0.04	0.01	0.0004	0.05	0.02	0.0025	0.01	0.01	0.2049	0.03	0.02	0.1935
No		Ref			Ref			Ref			Ref	
Other	0.03	0.02	0.0617	0.02	0.02	0.5132	0.04	0.02	0.0148	0.03	0.03	0.3402
Total Score at Baseline	-0.36	0.02	<.0001	-0.37	0.02	<.0001	-0.58	0.02	<.0001	-0.39	0.02	<.0001
R2		0.23			0.17			0.32			0.22	
Mean Change Score		0.020			0.040			0.009			-0.020	
Model p-value		<.0001			<.0001			<.0001			<.0001	

[a]Includes Non-Hispanic white adults over 65, with complete information at baseline and follow-up that experienced at least one of the following events: widowhood, heart attack, serious fall; [b]Sample size varies fall all domains due to missing data

Notes:

(1)Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000

(2) In Mexican pesos for MHAS; in dollars for HRS

(3) Access to any insurance available for each country

(4) MHAS asks serious health problems before age 10 as dichotomous variable; HRS asks categorical question (excellent-poor) before age 16 I dichotomized as poor+fair vs. good+very good and excellent.

(5) Individuals drinking 3 or more drinks on any occasion are considered to have at risk drinking behavior (NIAAA);

(6) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months.

(7) Any of the three events occurred in the two years prior to baseline interview; reference group is having event both before and after baseline

(8) Any of the three events occurred between interviews; reference group is having event both before and after baseline

In the health domain it is important to highlight that heart attack is associated with lower recovery for both studies. Regarding the functional status domain, both studies share one factor that promotes resilience, exercise, and share two factors that prevent resilience, old age and poor SRH. Higher education is a significant predictor of resilience for both cohorts in the mental domain. Also, older age, poor SRH, widowhood and falls were significant predictors against recovery in both cohorts for the mental domain. Additionally, for the HRS cohort only, health behaviors dominate resilience in the mental domain as observed by moderate drinking and exercising significantly predicting resilience. For the social domain, urban location is a risk factor preventing recovery for both cohorts.

5.6 Resilience in populations without an event

Can the study's resilience measure be applied to a population without an event?

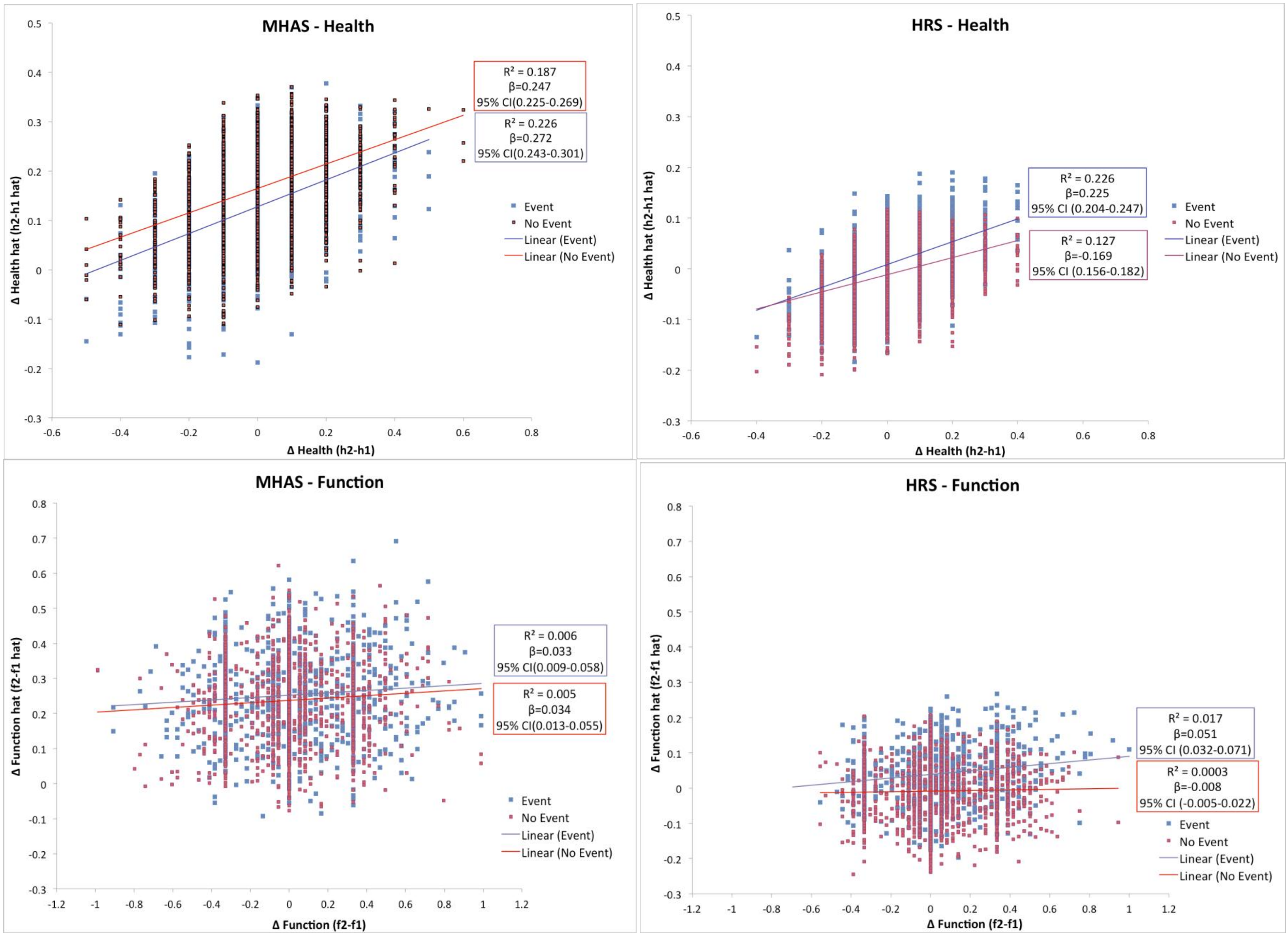
So far in this chapter the data have provided support for the validity of the resilience measure. To go a step further, it is important to show the results of a validation process that suggests the construct can be used in a population who has not suffered any of the events that were selected. This is important because information on resilience among those without these events can then translate into interventions that clinicians can use to enhance resilience among older adults before they suffer them. As explained in the methods section, resilience was estimated in the group without an event for each domain using the point estimates obtained from the event group. In Figure 5.3 estimated resilience for each domain is plotted by the score in each domain at baseline. The domains are organized side by side for both studies for comparison purposes. The blue points and lines correspond to data for individuals who had an event (at least one of the three events previously described). The red points and lines correspond to data for individuals who did not have an event. The r^2, intercept and confidence intervals for each line are presented for comparison purposes.

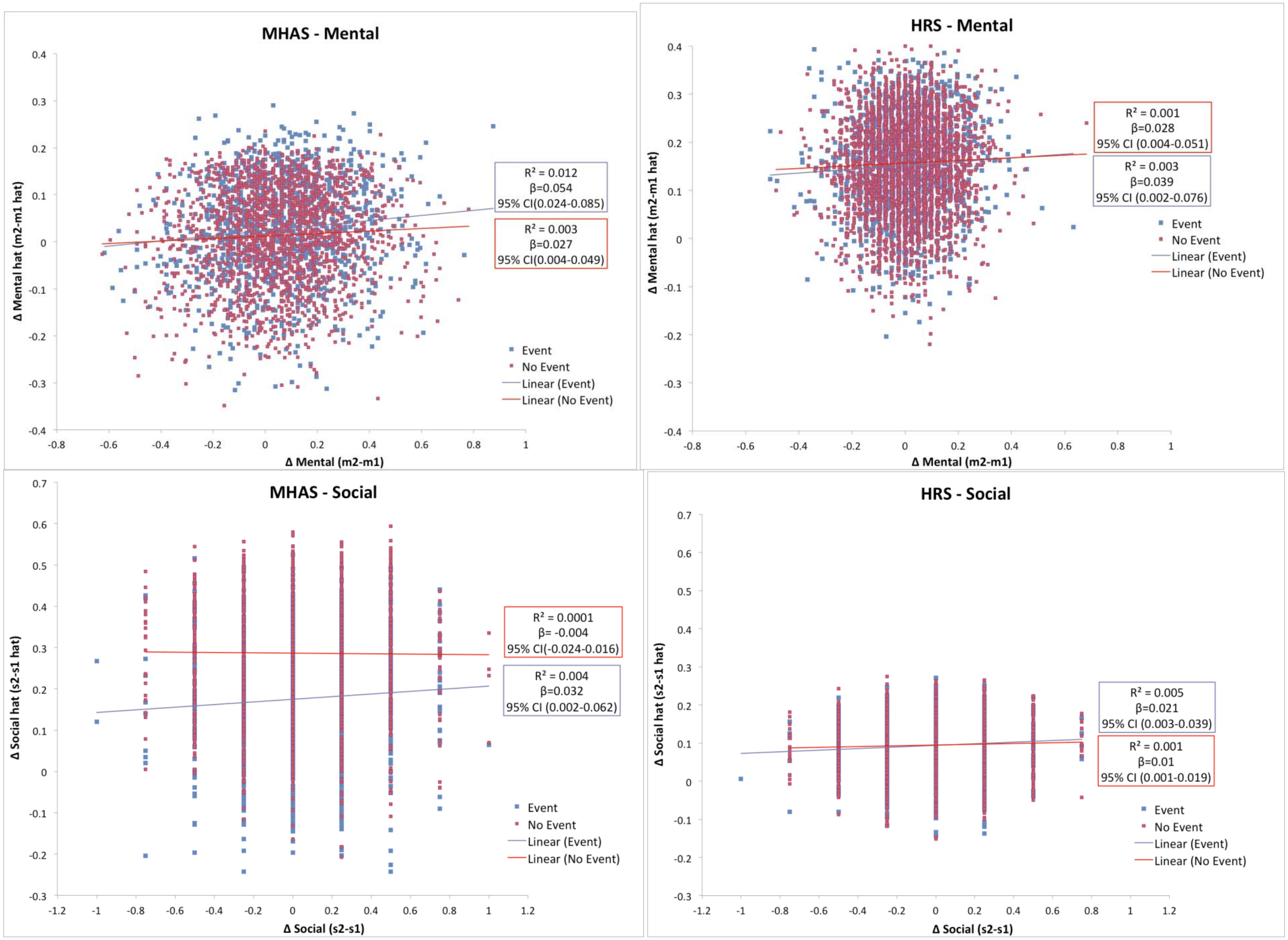
For the health domain, it is clear from the first graph on Figure 5.3 that there is no significant difference in the ability of my construct to predict resilience between those with and without an event in the MHAS study. This holds true for the functional domain in MHAS, for the mental domain in MHAS and HRS and the social domain in both studies. For the health and functional domains in HRS, the confidence intervals do not overlap, meaning that the lines for those with an event and no event are different. This difference, however, is not very large. Therefore, for the most part, the resilience construct can be used to estimate resilience in populations without the events selected for this study. With this information one can conclude that the factors that promote recovery for the population with an event, also promote recovery in the population without the event. The same holds true for indicators that prevent recovery.

5.7 RESILIENCE SUMMARY

Now that analyses have shown that the construct to estimate resilience before and after individuals suffer events, it is possible now to summarize the factors that promote resilience and those that prevent resilience for the four domains in both studies. Table 5.16 summarizes the protective factors that promote resilience and the risk factors that prevent resilience stratified by domain and cohort. This list only includes statistically significant indicators that either promote or prevent resilience. This table can be used by healthcare providers to obtain additional information and design interventions that can help promote resilience.

Figure 5.3: Scattered plots comparing measured change in each domain to estimated change in each domain for the group with event and the group without event. Estimates calculated using coefficients from the regression equation for individuals with at least one event





Note: For all graphs, blue data points and lines correspond to information for the group with at least one event; red points and lines correspond to the group without an event.

For example, consider a clinician is evaluating an older community dwelling man in Mexico and finds that he has functional impairments. The clinician will then design a rehabilitation plan to deal with the impairments. Based on the information on Table 5.16, the provider knows that a well structured exercise regime will increase the chance of recovery for this man. The provider also knows that the older this man is, the more assertive the treatment must be because older age is associated with less recovery in the functional domain. Finally, the healthcare provider should assess self-reported health because better SRH is associated with resilience in the functional domain. In summary the provider's plan should include a well structures exercise plan and a plan to improve or maintain better SRH. The same can be done for any older adult in the US. Clinicians can use the table to identify protective factors that can enhance resilience and risk factors that will prevent resilience and include them in the therapeutic plan.

In summary, this dissertation has identified a way of measuring resilience based on a validated clinical model (CGA) than can be applied to individuals undergoing one of three adverse events. It has also shown that this methodology can be used for older adults without an event. Among those without an event, the data presented here can enrich information available and help design better healthcare plans that enhance resilience. Additionally, protective factors that enhance resilience and risk factors that prevent resilience were identified using data from two nationally representative studies of older adults in the US and Mexico.

Table 5.16: Summary of protective and risk factors for both studies

	Δ Physical Health		Δ Functional Status		Δ Mental Status		Δ Social Status	
Protective Factors[a]	**MHAS**	**HRS**	**MHAS**	**HRS**	**MHAS**	**HRS**	**MHAS**	**HRS**
Higher education					✓	✓		
Urban location (1)		✓						
Higher wealth (2)					✓			✓
Early event (3)	✓				✓			
Moderate Drinking (4)	✓			✓		✓		
Sick as child (5)							✓	
Exercise (6)		✓	✓	✓		✓		
Serious Falls							✓	
Widowhood (7)							✓	
Risk Factors[b]								
Older age			✓	✓	✓	✓	✓	
Sick as child						✓		
Ever smoking								✓
Poor SRH	✓		✓	✓	✓	✓	✓	
Late event (8)		✓						
Heart Attack	✓	✓		✓				
Widowhood					✓	✓		
Serious Falls		✓		✓	✓	✓		
Urban location (1)							✓	✓
Fewer Children								✓

[a]Protective factors are defined as factors with a negative beta coefficient for at least one domain in either study and a p-value < 0.05; [b]Risk factors are defined as factors with a positive beta coefficient for at least one domain in either study and a p-value < 0.05

Notes: (1) Rural in MHAS defined as locations with <100,000 people; in HRS defined as locations with <250,000. Urban location was a protective factor for the physical domain in the HRS study but it was a risk factor for the social domain in both cohorts. (2) In Mexican pesos for MHAS; in dollars for HRS. (3) Any of the three events (heart attack, widowhood, and serious fall) if occurred in the two years prior to baseline; reference group is having event both before and after baseline. (4) Moderate drinking defined as having < 3 drinks on any occasion (NIAAA). (5) MHAS asks serious health problems before age 10 (yes vs. no); HRS asks categorical question (excellent-poor) before age 16, The variable was dichotomized as poor+fair vs. good+very good and excellent. This variable was a protective factor for the social domain in MHAS and a risk factor for the mental domain in HRS. (6) MHAS asks about physical activity three or more times per week in the last two years, HRS asks about the past 12 months. (7) Widowhood is protective for MHAS in the social domain and risk factor for both studies in the mental domain. (8) Any of the three events if it occurred between interviews; reference group is having event both before and after baseline.

Chapter 6 Discussion and Conclusions

This chapter discusses the findings of this study. The data is initially summarized. Then, the data is analyzed in the light of the resilience literature available. Implications of our findings for aging research, the resilience literature and care of older adults are then presented. Finally, limitations of the study are listed and future studies are described.

6.1 Summary of Findings

The conceptual framework of this study is presented in Chapter 1. This framework advocates moving away from the biomedical model and into different models such as the biopsychosocial model when studying aging. It also promotes recovery as an important outcome worth investigating when examining the aging process. This framework also makes a case for conducting cross-national comparisons of resilience in the US and Mexico. In Chapter 2, the Mexican Health and Aging Study (MHAS) and the Health and Retirement Study (HRS) were described along with reasons for using these datasets to study resilience. The inclusion process was also described for selecting the sample and how an “ideal” study would allow us to better investigate resilience. Then in Chapter 3, the methodology behind the analyses was extensively explained. Of interest was how the dependent variable was created and how the covariables were coded. Finally in Chapter 4, the results of the analyses were presented, starting with descriptive statistics, then validation summaries and finally regression analyses.

In summary, the results presented in Chapter 4 show that the HRS cohort is older, has higher SES and better overall health compared to the MHAS cohort. Instead, the MHAS cohort seems to be more socially engaged and have more support available than the HRS cohort. Within each cohort, comparisons between included and excluded subjects show that the included group is composed mostly of women, younger individuals, individuals with higher SES and better health compared to the excluded cohort. Of the three selected adverse events, most individuals only experience one of them in the study period. Serious falls is the most frequent event, followed by widowhood and finally heart attack. As expected for both cohorts, compared to individuals who experienced at least one of the three events, those who did not experience an event are younger, have higher SES, were healthier during childhood, report better health and have better mean scores in three of the four domains at baseline. However, individuals without an event have higher smoking rates, higher at risk drinking rates and interestingly, higher exercise rates.

The longitudinal analyses of change in score for the four domains show some interesting findings. First, the percentage of adults who maintain or improve their score is larger than the percentage of adults who worsen between both waves in both cohorts. Second, within each cohort, the predictors of resilience (unchanged or improved score) are different for each domain. Third, between studies, there is also variation in the predictors of resilience for the same domain. Fourth, the score for each domain at baseline is the single most important predictor of resilience.

Finally, the data presented here demonstrates that the study's approach can be used to obtain additional information among older adults who have not experienced any of the adverse events. This information can be used for counseling purposes to improve resilience after these events occur.

6.2 Tying it all back to the hypotheses

The study was designed around three specific aims: Aim 1 - Develop a theoretical model of resilient aging applicable to diverse older adult populations; Aim 2 - Construct a resilience score using four domains that provide a comprehensive evaluation of older adults; Aim 3 - Determine which domains at baseline are associated with recovery for both populations. All of these aims have been accomplished with the methods and findings presented in the dissertation.

Several specific hypotheses were proposed related to these aims. For the first aim it was hypothesized that the predictors of resilience would be different in Mexico and the US. Tables 5.14 and 5.15 clearly show that the predictors of resilience are not only different between both cohorts but also different for the four domains in each country. It was also hypothesized that gender would play a different role in resilient aging for Mexico and the US. In the cross-sectional analyses (Table 5.13), male gender was associated with better score at baseline in the physical domain in MHAS and in the mental domain in HRS. Conversely, female gender was associated with better score at baseline in the social domain for MHAS and the functional domain in HRS. However, gender was not a significant predictor of resilience for either cohort in the longitudinal analyses. Based on my review of the literature, there are no studies on resilience in older adults that focuses on gender differences. However, given the differing social roles of older men and women in Mexico and the US (Angel et al., 2009), and evidence from the resilience literature in younger individuals (Bun Lam & McBride-Chang, 2007), it was expected that gender would predict resilience differently in the US and Mexico. Better information on psychological aspects of recovery might allow us to see such differences in future studies.

It was also hypothesized for the first aim that life-course experiences would play an important role in differences observed in resilient aging between Mexico and the US. Results from the regression models show that those older adults who were sick as a child had significantly different resilience compared to those who were not sick. These findings support reports from the resilience literature that suggest exposures earlier in life help build-up resilience that can then be used when a new event is experienced (Britton et al., 2008; Fry & Debates, 2010; Masten, 2007). This might be the case for those individuals who were sick as children. Physiological and psychological changes due to poor health as children helped them recover from adverse events in older adult life. Finally, it was hypothesized in the first aim that recovery from different events would vary by country. This hypothesis was not directly addressed because the three adverse events were aggregated to select a group with at least one event that were stratified by the four domains. However, the data partially supports this hypothesis. As seen in Table 5.14 and 5.15, heart attack is a risk factor preventing recovery in the health domain for both studies but it only predicts lower recovery in the functional domain in the HRS cohort. Similar findings are observed for widowhood and serious falls. From this information it is apparent that recovery from each event is different within and between countries.

For the second aim it was hypothesized that the validity and reliability of the study's approach to resilience would be similar in both population groups. From the longitudinal results it is apparent that even though the protective and risk factors vary by domain and between countries, the overall assessment of resilience is similar for both cohorts. This is a very important finding given the large social and cultural differences between Mexico and the United States. First, the distribution of scores for each domain is very similar for both studies (See Figure 5.2). This means that despite prevalence rates being different, in the analyzed population the scores are distributed similarly for both countries. Another hypothesis was that the resilience measure would significantly predict important adverse outcomes in both population groups. Logistic regression models shown in the previous chapter confirm this hypothesis. In these models the odds of poor self-reported health or death at follow-up were significantly higher for those with poorer scores at baseline in three of the four domains. Finally, it was hypothesized that the different domains would be similar for both population groups. The correlation coefficient matrix presented for each study in the previous chapter confirms that this hypothesis is true for both countries. In conclusion, despite limitations imposed by the data, the constructed resilience measure predicts adverse events in both population groups, has a similar distribution in both groups and its components have a similar correlation matrix in both countries.

In the last aim, it was hypothesized that recovery rates in the US would be higher in relation with domains measuring health and functional status and that recovery rates in Mexico would be higher in relation with the social function domain. As discussed in the previous chapter, recovery rates were higher in all four domains for the HRS cohort. However, the findings did show patterns where the health and functional scores for the HRS cohort were higher, while social scores were higher for the Mexican cohort. Limitations due to the complexity and number of measures available to construct the mental status domain, affected the study's ability to examine resilience in the mental domain. However, with the information available it is apparent that education is an important protective factor for both cohorts, while age, poor SRH and widowhood are important risk factors for both cohorts in the mental domain. Finally, it was hypothesized that the recovery measure would be a better fit for older adults in the US compared to the cohort in Mexico. From Tables 5.7 & 5.8 the c-statistic for the logistic model analyzing death was the same for both cohorts, meaning that the model fits both datasets well. Using the same criteria, this model seems to be a better fit for the HRS cohort than the MHAS cohort when the outcome variable is self-reported health.

6.3 WHAT THE DATA SUPPORTS

There is evidence to support moving away from the Biomedical Model and into alternatives such as the Biopsychosocial Model to better understand and improve health. If the analyses were limited to the health and functional domains, the study would not have identified that education, wealth, childhood health and location play an important role in resilience. It would have also missed the fact that type and timing of event have an effect on domains that include mostly biomedical factors and a different effect on domains that include psychosocial factors. Therefore, a multi-dimensional approach to recovery provides richer and more useful information that can ultimately be used to enhance resilience in older adults.

Investigators have shown that for a given individual an adverse event affects physical, psychological and social domains differently (Hildon et al., 2010). Others have shown that coping, adaptation and resilience are less affected in the mental domain compared to the physical and functional domains in old age (Foster, 1997). Limiting the analyses to the physical and functional domains would in turn affect our understanding of resilience and probably underestimate the ability of older adults to recover. The results also support what other researchers have found about the significant effect of psychosocial factors on health outcomes, even after controlling for confounding health variables. For example, using data from the MONICA/KORA study in Germany, a prospective cohort study that started in 1984, researchers reported that living alone increases the risk of diabetes. They also show that social isolation changes inflammatory markers that predict poor outcomes in depressed older adults (Hafner et al., 2011; Meisinger et al., 2009). The same research group is currently conducting a prospective study in a sub-sample of the cohort and hypothesizes that psychosocial factors play a leading role in resilience and successful aging that can be explained by neuroendocrine, cardiovascular and inflammatory changes triggered by these factors (Lacruz et al., 2010).

Results from this study also provide evidence to support using a comprehensive assessment as an analytical approach to studying successful aging and resilience. A comprehensive approach that includes multiple domains and analyzes how different factors affect these domains can provide useful information for both clinical interventions and research. The one-dimensional approach widely used by clinicians has failed to address important problems faced by older adults (Inouye et al., 2007; Scanlan, 2005; Stuck & Iliffe, 2011). A multidimensional approach to the diagnosis and treatment of geriatric syndromes such as falls has proven more effective, increases patient satisfaction and improves health outcomes compared to more traditional approaches (Inouye et al., 2007; Stuck et al., 1993; Tinetti et al., 1995; Tinetti & Kumar, 2010). Hence, researchers who study aging should approach research questions related to resilience in a multidimensional manner that might prove to be more effective.

Results from the current study also provide evidence to support including resilience as an important research outcome. As previously stated, the risk of adverse events steadily increases with age. Thus, the current approach to aging research where negative outcomes such as death and disability are the main focus may not be the best approach because it lacks older adult's ability to recover from adverse events (De Alfieri & Borgogni, 2010; Fry & Debates, 2010; Lamond et al., 2008). If instead the focus is on factors that promote recovery and allow older adults to return to their baseline function, despite adverse events, I might be able to find more effective interventions that have a larger impact on the well-being of older adults (De Alfieri & Borgogni, 2010; Fry & Debates, 2010; Lamond et al., 2008; Schoon, 2006).

6.4 Discussion of the findings

Differences between countries – Descriptive Statistics

It is important to highlight some differences observed between the US and Mexico in the descriptive analyses and present some plausible explanations for them. First, important differences are shown in disability rates for both countries. Previous data reported that disability rates in Mexico were higher compared to disability rates in Mexican-Americans residing in the US (Patel et al., 2006). Since disability rates of Mexican-Americans have usually been reported to be higher compared to Non-Hispanic whites (Ostchega et al., 2000). it has been supposed that disability rates in the US are lower than disability rates in Mexico. Recent studies, however, have shown that this supposition is incorrect (Hayward et al., 2010; Wong et al., 2010). Data from this dissertation supports the more recent research data and shows that comparison of disability rates must be done carefully because different types of disability provide different information. In the data, ADL disability is 0.64% lower in Mexico compared to the US when data is dichotomized as no disability and any disability (0 vs. 1 or more). However, as the sum of disabilities increases, Mexican older adults show a higher prevalence of disability than their US counterparts. A different picture is observed for IADL disabilities with Mexican adults having IADL disability rates 8% lower than their US Non-Hispanic White counterparts. Again, as the sum of IADL disabilities increase, Mexicans have higher rates than US older adults. In contrast, when mobility disability is evaluated, Mexican older adults have significantly higher disability rates compared to US older adults.

The resilience literature can partially explain these differences. Since older adults in Mexico are exposed to lower SES and poorer health standards from young ages, they develop compensatory characteristics that may protect them against developing disability (Curtis & Cicchetti, 2003; Fry & Debates, 2010). Conversely, older adults in the US are not exposed to these hardships while they are young and therefore may have fewer opportunities to develop protective factors that enhance functional status in old age.

In the social domain, important differences are also observed between Mexico and the US. In Mexico, older adults have larger social networks. Religion is also more important in Mexico compared to the US. However, volunteering is more common in the US cohort. These differences are expected given the work, cultural and economic characteristics of each population group. Traditionally Mexico, like many Latin American countries, has a structure with large families and extended households where more individuals are available to provide care for older adults. Nursing homes are uncommon in Mexico and the literature shows that older adults are usually cared for by family members in their homes (Mendez-Luck et al., 2009; Wong et al., 2010; Wong & Palloni, 2009). Therefore, social networks are an essential part of older adult health in Mexico.

After examining the data in this study, people may wonder why if social networks are an essential part of older adult health in Mexico, having fewer children was only a significant predictor decreasing resilience in the HRS cohort. As stated in the conceptual framework, social function is divided into two components: 1) social capital and 2) the current social function. Social networks are only one of the indicators that make up current social function. Social capital and social support might moderate the effect of social networks, not allowing us to observe a significant effect. Additionally, since social networks tend to be smaller in the US, more importance is given to number of children, partially explaining my results. Finally, the difference in the importance of religion reported in both studies might also provide some "advantages" to older adults in Mexico. Researchers have shown that religiosity plays an important role in adaptation among older adults (Consedine et al., 2004). However, there is still controversy on whether the benefits derived from religiosity are direct or are the result of alternative mechanisms related to other characteristics such as health behaviors, coping mechanisms or marriage (Benjamins & Buck, 2008; Parker et al., 2002; Waite & Lehrer, 2003).

Resilience differences and similarities between both countries

The percentage of individuals who have no change or a better score for the different domains at follow-up is larger than the percentage of individuals with decline in score between waves for both countries. These results support most of the data presented in Chapter 1 that advocates for a change in the current research paradigm where negative outcomes prevail over positive outcomes. If more people remain the same or improve after an event why do researchers and clinicians focus mostly on those that worsen?

These results also raise important issues related to differences in recovery in developing countries compared to developed countries. As reported in the results section, recovery rates for the HRS cohort are higher in every domain. This means that despite differences in predictors of recovery for the different domains, living in a developed country seems to enhance overall resilience. Higher SES leading to better access to healthcare, better infrastructure and better life-course conditions appear to make resilience more likely. An alternative explanation is that my approach to resilience is a better fit for the HRS cohort than it is for the MHAS cohort and that higher recovery rates are simply a result of using measurements that have been designed for the US population. Still there is not enough evidence to support this.

Implications of resilience rates

From the results of the regression analyses I can conclude that exercise is an important protective factor for individuals in the US predicting recovery in three of the four domains. I can also conclude that poor SRH is an important risk factor in Mexico, predicting poor recovery in the four domains. These findings provide useful information that can be used to enhance resilience in older adult populations. Researchers have found that self-reported successful aging is a stronger predictor of quality of life than variables from biomedical and psychological models (Bowling & Dieppe, 2005; Callahan & McHorney, 2003; Phelan et al., 2004). How older adults perceive their health is an important piece of information that is often overlooked.

Additional findings like the similar rates of resilience among Mexican and US older adults is very important for health policy. I followed a validation process that resulted in similar findings for both countries. Correlation coefficients between cohorts are similar and odds ratios of poor SRH and death are also similar. This increases confidence that even though the study's measurement is not perfect, a similar concept is being analyzed in both cohorts. Moreover, these findings suggest that despite the hardships present in Mexico, older adults are able to reach similar rates of resilience. Factors that are not measured in the models are probably influencing resilience and there is a need to explore additional paths to resilience that can explain these rates.

Also, some of the findings summarized in Table IV.16 point to important differences in resilience for both cohorts. Widowhood, falls, urban location and sick as a child are reported as both protective and risk factor. Widowhood and falls were only protective for the MHAS cohort and only in the social domain. Researchers have found that social support and social networks are most important in times of crisis (Berkman, 1983; Berkman, 1986; Berkman, 2000; Berkman & Syme, 1979; Due et al., 1999; Glass & Maddox, 1992). Therefore, recovery in the social domain for older Mexican adults appears to be linked to occurrence of adverse events that force individuals into mobilizing available resources to maintain independence and good quality of life. Regarding location, urban location is a protective factor for the HRS cohort in the physical domain, but is a risk factor for both cohorts in the social domain. Others have reported that even though there is usually better access to healthcare resources in urban settings, provision of care tends to be easier and of better quality in the more rural settings (Glasgow, 2000; Lee & Lassey, 1980; Salinas et al., 2010; Wanless et al., 2010). It is therefore plausible that urban location works for resilience in some domains but not in others.

Finally, one of the most worrisome findings of this study is the significantly high rates of serious falls reported in both cohorts: 28.06% in MHAS and 15.76% in HRS. These rates are similar to national rates were the prevalence is usually reported around 30% (Reyes-Ortiz et al., 2005; Shumway-Cook et al., 2009). This might be attributed to the study's exclusion of proxy and institutionalized adults from the analyses. Apart from the importance of the rates, serious falls was a significant predictor preventing recovery for three out of four domains in the HRS cohort, but only for one domain in the Mexican cohort. It is therefore important to keep in mind that, at least for the US, risk of fall assessment is an important preventive measure. The risk factors for falls are well understood and there is enough evidence supporting structured plans for rehabilitation of adults with serious falls (Ensrud et al., 2007; Faber et al., 2006; Tinetti et al., 1995; Tinetti, 2003; Tinetti & Kumar, 2010). All this information can be used to foster resilience and help older adults who fall.

6.5 Limitations

This study has six important limitations. First, neither the HRS nor the MHAS studies were designed to measure resilience. Therefore the data are missing variables that would better characterize this concept. However, it was possible to analyze recovery rates consistently in two cohorts from two countries with important differences. Second, the analyses use differences in four domains as a proxy to measure resilience. Even though this is an innovative and straight-forward way to measure resilience further validation of this approach is needed. Third, because of the low prevalence of some of the events selected, it was not possible to analyze recovery from each event separately. Aggregation of existing data or addition of new data might provide more robust ways to analyze each event separately. Fourth, even though the MHAS study was designed after the HRS, there are still differences between both datasets that can be affecting the results. For example, the wording of some questions could affect estimations. In the design phase of this study, efforts were made to select variables that were comparable in both studies. In the few cases where that was not an option, the variables were recoded to make them as comparable as possible. Fifth, we are only including Non-Hispanic Whites in the HRS. Non-Hispanic Whites have unique health characteristics not always shared by other race/ethnic groups. However, we selected this group because at the time of interview it represented the majority of older adults. Additionally, Non-Hispanic Whites are believed to have benefited the most from living in a developed country. Sixth, since only two time points of data were included, the data could not be analyzed with traditional longitudinal analysis techniques. Hence, the analytical approach opted to control for timing of event. This is a valid approach, but more time points would provide additional important information.

6.6 Conclusions

In conclusion, the study designed a reliable and valid approach to resilience that can be used in different population groups. Using this approach, the data found that resilience is different for the MHAS and HRS cohorts. It has also shown that including four domains as part of a comprehensive evaluation of older adults provide useful information about resilience that can be used in the community setting. Resilience rates in both countries are high, suggesting that aging research focused on positive aspects such as recovery might be a better approach compared to the more negative approach that is currently used in most aging research.

6.7 Future studies

This study has helped identify areas of improvement for future research on resilience. For example, more extensive analysis determining whether or not equal weighting for all domains is the best way to analyze the data, could help us construct a better measurement. Also, exploratory analysis to identify additional components that may improve the domains would be helpful. Using my approach in other population groups would further validate this construct. Analyzing additional waves of data would allow us to use traditional longitudinal analyses and choose the best approach to analyze resilience. With more data, stratified analyses for each event independently can also provide additional and more specific information.

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Vita

Rafael Samper-Ternent was born in Bogotá, Colombia to Manuel Samper Alum and Ana María Ternent de Samper on July 24th, 1978. He is married to Alejandra Michaels-Obregon, has a two year old son, Gabriel, and his second son will be born in December 2012. Rafael graduated High School from Colegio Los Nogales in Bogotá, Colombia. He served his mandatory military service year in the army between 1996 and 1997. He was then admitted to Medical School at Pontificia Universidad Javeriana in Bogotá, where he earned his MD degree in 2004. He completed his Social Service and then worked for two years at Fundación Cardio Infantil, a private clinic in Bogotá, as a Physician of the Geriatrics Unit and Physician of the International Office.

Rafael then applied to a Visiting Scholar position offered by the WHO/PAHO Collaborating Center on Aging and Health of the Sealy Center on Aging at the University of Texas Medical Branch in Galveston (UTMB). He was accepted to this position and moved to Galveston with his wife in August of 2007. He was a Visiting Scholar for six months and was then offered a research position under the supervision of Kenneth J. Ottenbacher, PhD. Rafael's experience as a Visiting Scholar led him to enroll in the Clinical Science Graduate Program to pursue his PhD degree at UTMB in 2008. He successfully completed his required courses and was admitted to Candidacy in December 2010.

During his time as a graduate student, Rafael was awarded several scholarships and recognitions. First, he was recognized as a Fellow of the Sealy Center on Aging in 2008. He was then awarded the Herzog Educational Enrichment Award four years in row starting in 2009. In 2009 he was also awarded the Charles F. Otis Endowed Award for Clinical Research Scholarship Award. The following year he was awarded the Peyton and Lydia Schapper Endowed Scholarship and the Zelda Zinn Casper Scholarship Award. In 2011, Rafael received the Don W. Micks Scholarship in Preventive Medicine and

Community Health, the Emily E. Dupree Endowed Award for Excellence in Rehabilitation Sciences and the GSBS Associates Christina Fleischmann Travel Award. Finally, in 2012 he was awarded the Zhou Sisters Great Expectations Scholarship Award and the Curtis W. Lambert Scholarship Award. This Thesis represents the completion of his graduate work.

Education

M.D., December 2004, Pontificia Universidad Javeriana, Bogotá, Colombia

Publications

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Gerst K, Samper-Ternent R. Successful aging: application of a model for older Mexican Americans. Poster presented at the IX Colombian Congress of Gerontology and Geriatrics and published in the Journal of the Colombian Association of Gerontology and Geriatrics. Bogotá, Colombia; April 28 - May 1, 2010

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