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FACETS OF SOCIOECONOMIC POSITION AND THE ONSET AND PROGRESSION OF FUNCTIONAL LIMITATION IN MEXICO

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FACETS OF SOCIOECONOMIC POSITION AND THE ONSET AND PROGRESSION OF FUNCTIONAL LIMITATION IN MEXICO

by

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Dedication

To my family, Rogelio Sáenz, Judith Linneman, Daniel Sáenz, and Jesse Sáenz for all of the support they have provided me throughout my education. To all of the friends that I have made at UTMB for the friendship, guidance, and distraction they have offered. To my dog, Patches. To Galveston, I will miss so many things about this strange little island (besides the humidity). To Kay Varela, for her love and support throughout the process of writing this dissertation. And finally, to José Alfredo Jiménez. Through your music, your passion and spirit will live on forever.

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Facets of Socioeconomic Position and the Onset and Progression of Functional Limitation in Mexico

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The association between lower socioeconomic position and poor health has been observed across countries and health outcomes. Socioeconomic position is often measured by education, income, wealth, and occupation which are often treated as interchangeable. Less work has studied how these measures differ in their associations with health. In the United States, lower education is reported to increase the onset of functional limitation while lower income predicts functional deterioration. I apply this framework to a developing country, Mexico, to determine, by birth cohort, how measures of socioeconomic position throughout the life-course affect the onset and progression of functional limitation. Data comes from Waves 1-3 of the Mexican Health & Aging Study (MHAS), a longitudinal household-based sample of Mexican adults (age 50+) and their spouses. Interviews were conducted in 2001, 2003, and 2012 (n=15,186). Socioeconomic variables included education, occupation, income, and wealth. Functional limitation is assessed using Nagi and Activities of Daily Living (ADL) items. Onset and progression between waves is modeled using multinomial probit regression. Lower education was

associated with developing functional limitations across sex and birth cohorts but these associations were only present in urban areas. Financial resources including income and wealth did not predict functional limitation onset or progression after accounting for educational. Rather, those with lower educational attainment were more likely to experience functional deterioration although this was restricted to urban areas and was stronger among females than males. Being in a higher decile of wealth was associated with a lower likelihood of worsening functional limitation only among the older old. Among older Mexican adults, the lower educated seem more likely to develop a functional limitation and to deteriorate faster than their higher educated counterparts. Socioeconomic gradients were stronger in urban areas and educational gradients in functional limitation progression were stronger among women. The education-functional limitation onset association is consistent with previous studies in the United States. However, the often lack of an association between financial resources and functional deterioration differs from previous studies in the United States. Compared to developed societies, educational attainment may play a more significant role in disablement in Mexico.

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Chapter 1: Background and Literature Review

BACKGROUND ON DISABILITY:

The most recent estimates from the World Health Organization suggest that over one billion people (approximately 15%) are living with a form of disability at the global level. This is a significant increase from the estimate of 10% only 40 years prior in 1970 (World Health Organization 2010). This is largely due to increases in life expectancy across populations and the higher odds of disability associated with old age (Blackwell and Tonthat 2002). Given current rates of aging, global disability rates are projected to continue to increase in the near future at the global level (World Health Organization 2010). Understanding how disabilities develop, improving quality of life, and developing interventions to reduce burdens on healthcare systems require approaches that examine specific cohorts of individual countries that have aged in unique environments and have experienced common circumstances.

I adopt a conceptualization of functional limitation in physical terms that stems from the disablement process which conceptualizes disability in terms of impairments in one's ability to perform in social roles or societally expected ways. In particular, the disablement process acknowledges the progression from underlying pathologies and chronic conditions, to impairments in body systems which may have repercussions in functioning, to functional limitations in tasks, and finally to disablement as inability to perform in one's social roles. Of particular importance for this analysis, the disablement process is adaptable and acknowledges the roles of predisposing factors as well as extra and intra-individual factors (including social and demographic) which may accelerate or impede the process of disablement (Verbrugge and Jette 1994).

While many studies have focused on disability, fewer have focused on Mexico, Latin America, or developing countries in general (Palloni, Pinto-Aguirre, and Pelaez 2002; Reyes-Ortiz et al. 2006). Understanding disability in developing countries is integral for public health as many developing countries in Latin America are experiencing rapid aging (Wong and Palloni 2009). Population aging has largely been the result of substantial declines in mortality from 1930 to 1990 across Latin America (Palloni et al. 2002) which can be attributed in a large part to declines in infectious disease mortality (Palloni and Lu 1995). As many developing countries have aged without the institutional infrastructure to support the elderly and with declines in family support for the elderly (Palloni et al. 2002; Wong and Palloni 2009), understanding disability and the factors that lead to disability in developing countries will become increasingly important with growing demand for healthcare services among disabled adults.

Previous research on disability in Latin America has found a relatively high prevalence of disability among older adults (age 60+) in Brazil (Coelho Filho and Ramos 1999), Chile (Díaz et al. 2003) and Cuba (Tello Velázquez et al. 2001). An additional study (Reyes-Ortiz et al. 2006) examined rates of Instrumental Activities of Daily Living (IADL) and Activities of Daily Living (ADL) disability in Buenos Aires, Bridgetown, Sao Paulo, Santiago, Havana, Mexico City, and Montevideo using the Health, Well-Being and Aging in Latin American and the Caribbean (SABE) Study and reported a prevalence of IADL limitations ranging from 17% in Montevideo to as high as 57% in Sao Paulo among those age 85+, and the prevalence of ADL disability ranging from 24% in Bridgetown to as high as 52% in Santiago for the same age group.

Focusing on Mexico in particular, a study using the Mexican Health and Aging Study (MHAS) estimated the prevalence of ADL disability among those 65+ to be approximately 16% (Patel et al. 2006) while others have estimated the age-standardized prevalence of ADL disability among older adults in Mexico to be 10.6%, a slightly lower prevalence than in the United States (11.5%) (Gerst, Michaels-Obregon, and Wong 2011). An additional study using the SABE estimated the prevalence of ADL disability in Mexico to be 14% among those 60-74 years of age and 36% among those 75+ years of age (Palloni et al. 2002). Importantly, disability is often the result of underlying chronic conditions (World Health Organization 2010). Research in Latin America has demonstrated the association between chronic conditions and disability (Reyes-Ortiz et al. 2006) while researchers in Mexico, in particular, have found higher odds of disability among those reporting diabetes, strokes, and heart attacks. Mexico is also experiencing rapid rises in non-communicable disease as well as population aging (Rivera et al. 2002). The rapid aging of the Mexican population, coupled with the increasing prevalence of many chronic conditions including diabetes suggest that increases in disability prevalence are likely to occur throughout the following decades in Mexico (Patel et al. 2006; Reyes-Ortiz et al. 2006).

While the prevalence of disability has been increasing at a global level, much of the research has focused on delineating the complex pathways through which individuals become disabled. One common research area involves socioeconomic disparities in disability (Amaducci et al. 1998; Grundy and Glaser 2000; Guralnik et al. 1993; Herd, Goesling, and House 2007; Robert and House 1996; Taylor 2010; Zimmer and House 2003). The evidence suggests that individuals of lower socioeconomic position may be at

a greater risk of developing disability. However, the majority of these studies have focused on samples taken from developed countries. The timely importance of research on socioeconomic disparities in disability in developing countries is made clear by several trends. First, many developing countries in Latin America are experiencing rapid aging. Second, with rapid aging, the prevalence of disability is likely to increase. This increase may have substantial impacts on the healthcare systems of many developing countries as institutional support systems for the elderly are often scarce or lacking. Finally, socioeconomic disparities in disability have not been researched in developing countries to the extent that they have in developed countries. These trends point to a clear necessity to understand the socioeconomic determinants of disability and the pathways through which individuals become disabled in developing countries.

INTRODUCTION TO SOCIOECONOMIC STATUS-HEALTH RESEARCH:

Socioeconomic status (SES) has been studied extensively and is considered to be a fundamental cause of disease (Link and Phelan 1995; Phelan et al. 2004). The association between lower SES and negative health has been observed across multiple countries and numerous health outcomes. To illustrate this point, studies of SES and mortality in 22 countries across Europe found nearly ubiquitous socioeconomic gradients in mortality and self-assessed health (Mackenbach et al. 2008). The relationship between SES and health is not only present in many countries, it is also present across various domains of health including functional limitations (Minkler, Fuller-Thomson, and Guralnik 2006), chronic diseases including cardiovascular diseases (Clark et al. 2009; Cox et al. 2006), hypertension (Stamler et al. 1992), diabetes (Rabi et al. 2006; Robbins et al. 2005), mental health (Hudson 2005; Zimmerman and Katon 2005), and self-rated

health (Laaksonen, Rahkonen, Martikainen, et al. 2005). Lower education is also a risk factor for disability among older Italian adults (Amaducci et al. 1998) and in the United States (Guralnik et al. 1993). The presence of socioeconomic gradients in health across many countries and health outcomes suggests that more research must be done to improve health and health equality at a global level.

While a great body of literature has described the association between SES and health outcomes, fewer studies have focused on the pathways leading to the development of disease. Research has suggested that SES may operate through various mechanisms including *education* (Deaton and Paxson 2001; Lleras-Muney 2005) by improving health knowledge, shaping opportunities throughout the life-course, and improving health behaviors (Laaksonen, Rahkonen, Karvonen, et al. 2005; Lantz et al. 1998) as people with lower socioeconomic standing may have poorer health behaviors due to limited knowledge and resources. Others have suggested that socioeconomic status impacts health through higher levels of *stress* (Evans and Kim 2007; Evans and Schamberg 2009; Lantz et al. 2005). This has been shown by (Evans and Kim 2007), who illustrated how longer time periods spent in poverty were associated with higher levels of cortisol (a marker of stress) and poorer stress regulation. Salivary cortisol, in turn, is associated with atherosclerosis (Dekker et al. 2008) and cardiovascular risk. This provides a clear biological mechanism through which socioeconomic standing may impact health. Others have studied the way in which the residence of those of lower socioeconomic standing in less favorable *neighborhoods* may impact health (Booth, Pinkston, and Poston 2005; Chuang et al. 2005) via mechanisms such as stress, low neighborhood walkability, and a shortage of healthy food options. Other mechanisms include health knowledge (Kenkel

1991; Winkleby and Cubbin 2003) as well as income and wealth (Pollack et al. 2007) which may provide better access to healthy foods, safer environments, and healthcare.

While the impact of SES on disease is frequently studied in the literature, a critical issue that arises when analyzing the SES-health relationship is the choice of SES variables. SES is frequently represented by its facets (education, occupation, income, and wealth). As many researchers treat SES as a control variable, these facets are often treated as synonymous measures (Grundy and Holt 2001) with little regard to the differences that may exist in the relationships between individual facets of SES and health. While these constructs are indeed interrelated, each measure has unique properties. Research which has attempted to compare the independent effects of facets of SES on health among middle age United States adults has found education to be a stronger predictor of cardiovascular disease than income and occupation (Winkleby et al. 1992) and that income and education may be more important predictors of mortality at low and high levels of SES respectively (Backlund, Sorlie, and Johnson 1999). Other research using a sample of middle age Norwegian adults has found income and occupation but not education to be related to ill-health (somatic illness, work potential, and nervous condition symptoms) (Dahl 1994). Many have urged researchers to conduct more nuanced analyses by carefully considering the unique populations and health outcomes that are evaluated when choosing measures of SES in health research (Braveman et al. 2005; Grundy and Holt 2001; Shavers 2007).

CONTRASTING EDUCATION AND INCOME:

Previous research has highlighted the importance of careful consideration of measures of SES by demonstrating differences between education and income and their

relationships with health. However, research which examines how education and income are related with *stages* of disease has been limited. To understand the pathways through which SES impacts health, it is important to delineate how individual facets of SES are associated with both the onset (if and when people develop a health condition) and the progression of health conditions including chronic conditions and functional limitations (whether the health condition improves, worsens, or is reversed). Analyses such as these require the use of longitudinal data which may be the reason for the scarcity of research, especially in developing countries. However, longitudinal studies in the United States have found important differences in the relationships between facets of SES and stages of disease (onset and progression).

I begin by presenting the results of studies from the United States. Using the Americans Changing Lives study, previous researchers have demonstrated that, among United States adults age 25 and over from 1986 to 1994, lower educational attainment was associated with an increased likelihood of the onset of health problems including functional limitations while lower income was associated with an unfavorable progression of health problems including functional limitations among adults in the United States (Zimmer and House 2003). The data were re-analyzed in 2007 and similar results were observed with the more recent data (from 1986-2001) (Herd et al. 2007). Additional studies using the Duke Established Population for the Epidemiologic Study of the Elderly found somewhat similar results. Education seemed to delay disability onset but only income was associated with disability progression (Taylor 2010).

At an international level, studies have found differing results regarding facets of socioeconomic position and the onset and progression of disability and all studies have

focused on developed countries. Research from the United Kingdom using the Retirement Surveys found education but not income to be related to the onset of physical disability among older adults, while neither education nor income were related to the progression of disability (Grundy and Glaser 2000). Using data from Leicestershire, United Kingdom, others have found no relationship between income and disability onset among older adults (Matthews et al. 2005). Alternatively, research in Denmark using the Danish Intervention Study on Preventive Home Visits has suggested that higher values of financial assets are associated with decreased odds of disability onset (Nilsson, Avlund, and Lund 2010). In the Netherlands, past studies have shown income gradients in disability onset among women using the Longitudinal Aging Study of Amsterdam (Groenou, Deeg, and Penninx 2013). These contrasting results suggest the need for international research focusing on specific nations. Understanding how different facets of SES are related with different stages of disease may shed light on the pathways between SES and functional limitation and may guide more targeted interventions.

Previous literature has suggested many explanations as to why education and income are related to disease onset and progression respectively. Focusing first on the former, education is often measured through years of formal education and categorized into levels that are meaningful for the context in which they are measured. For example, categories such as primary, elementary, and high school education may differ across countries. Formal education may have a pronounced relationship with disease onset given that many forms of ill-health in adulthood are the result of diverse exposures throughout the life-course. As education is often determined earlier in the life-course, education shapes exposures to risk factors for extended periods of time which leads to the onset of

disease in old age. Education may act on disease onset through better use of preventive medicine, health behaviors, stressors, environmental and physical hazards in the home and neighborhood, and psychological factors (Zimmer and House 2003). Others have theorized that education may operate through cognition to improve health behaviors, use of preventive measures, utilization of healthcare, and a greater ability to choose residential and employment opportunities with fewer health risks (Mirowsky and Ross 2003). Several of these factors (health behaviors, stress, and use of preventive medicine in particular) may influence the prevalence of disabling chronic diseases among those with lower education. Viewed through the disablement process framework (Verbrugge and Jette 1994), lower educational attainment may put individuals at higher risk for certain pathologies which may increase the likelihood of functional limitation. That is, the life-course life-styles of the lower educated may lead to a higher prevalence of chronic conditions which may ultimately lead to increased functional limitation risk.

Current income differs from education in that it reflects current socioeconomic position and represents the resources available to treat and counteract health problems. Income represents the value of financial resources that one receives over a given unit of time. In this way, income represents the flow of economic resources to a household or an individual. Income may affect functional limitation progression through various pathways including access to healthcare. More specifically, income may provide access to rehabilitation services or treatments for disability and may improve the ability of older adults to modify their environment to avoid physical hazards (Herd et al. 2007) and falls. In this way, older adults may be able to mobilize their resources to counteract the functional limitation *directly*. Additionally, individuals with higher income may use these

financial resources to comply with recommendations from medical professionals in the event of disease diagnosis. For example, if chronic conditions are the root of one's physical disability, income may be used to access medications to control *chronic conditions* and to prevent further progression of the disability. Finally, income may impact one's *perception* of actions that may slow, prevent, or even reverse disability. Through the well-studied Health Belief Model (Baum 1997), lower income may impact how one perceives the ratio of the perceived benefits to perceived barriers (financial cost) of particular treatments, medications, and rehabilitation. Those with a higher income may tend to experience lower perceived barriers and may be more likely to determine that the health and physical benefits of rehabilitation and treatment for disabling pathologies outweigh the financial costs of these interventions.

LIMITATIONS OF PREVIOUS ANALYSES OF SES FACETS AND DISEASE STAGE:

Most research systematically contrasting associations between education and disease onset and between income and disease progression has not addressed the importance of lifetime occupation and accumulated wealth. First, the inclusion of occupation in SES health frameworks is vital as occupations put workers at differential risks of stress (Sheena Johnson et al. 2005) and disability (Li, Wu, and Wen 2000). Education is a form of human capital such that people invest in their education with the hope that this investment will pay off in the future (Becker 1975). For this reason, people may invest in their education and then use their education to become more marketable to employers in favorable occupations including those with less demand for physical labor, more control over working conditions, and less psychological stress. Thus, it may be that education impacts disease onset by shaping access to occupations with salubrious

qualities. By ignoring the role of occupation, previous researchers may miss one of the critical pieces connecting education to the onset of health problems.

Similarly, the importance of wealth has not consistently been addressed in previous analyses of education and disease onset or income and disease progression. Wealth, or the value of accumulated assets, represents a stock which may play an important role in combating health shocks (Wenzlow et al. 2004) by providing the means to access costly healthcare and treatments beyond income. Positive associations between wealth and health have been demonstrated for self-rated health, disability, and many chronic conditions among US adults (Robert and House 1996) and mortality among British civil servants (Marmot, Kogevinas, and Elston 1987). Along these lines, wealth may be associated with a more favorable progression of chronic conditions and functional limitations beyond income.

Income and wealth both represent financial capital that can be mobilized to obtain goods and services and each should provide a favorable progression of health conditions. However, income and wealth are unique in that wealth is a stock while income is a flow. Further, income may not reflect the current financial means available to *older* adults. In this way, wealth should provide a more favorable progression of disability beyond its association with income. For example, even if older individuals are receiving very little income, assets such as land, automobiles, homes, and businesses can be sold if money is needed. In the event of a functional limitation, one may sell these assets to achieve access to resources that may counteract the functional limitation in the ways highlighted for income. Wealth may be used to counteract functional limitation (1) directly by providing access to healthcare, rehabilitation, and the ability to modify one's environment, (2) by

providing access to medications and treatment options to control chronic conditions and prevent further progression of functional limitation and (3) by influencing one's perceptions of the costs of treatment options.

Importantly, wealth often reflects a less liquid resource. For example, in most cases, one must sell high value assets such as homes and cars to obtain goods and services. In this way, wealth cannot be mobilized as rapidly as income. Despite this limitation, wealth may be a more important indicator of financial resources in old age as income is often very low and often does not fully capture the economic resources available to older adults (Wong and Espinoza 2014). Wealth in old age then also represents the accumulated value of assets that have been invested in and acquired throughout the life-course. For these reasons, wealth may be a particularly effective measure of financial wellbeing for the elderly.

CONCEPTUAL FRAMEWORK:

The conceptual framework for this analysis is grounded in life-course epidemiology by acknowledging the importance and patterning of exposures and risk factors throughout the life-course to understand old age wellbeing. Indeed, understanding the impact of education, occupation, income, and wealth on late life functional limitation risk inherently necessitates the use of a life-course framework as education is often determined early in the life-course and is a powerful predictor of occupation, income, and wealth throughout life. Further, as the pathways through which individuals develop disabilities are often complex and disabilities frequently present in old age, it is vital to delineate these processes using data across the life-course. Too often, researchers are limited by data that does not contain information on characteristics throughout the life-

course that may impact functional limitation in late life. This analysis uses an accumulation of risk (chain of risk with additive effects) model (Kuh and Shlomo 2004). This framework posits that risk factors for functional limitation throughout the life-course are correlated, patterned sequentially, and directly and indirectly create accumulations of risk. As mentioned earlier, the health belief model also provides an excellent theoretical framework for understanding the reasons that individuals at different levels of the socioeconomic spectrum do or do not engage in health promoting activities. I will also draw from the health belief model in my conceptual framework to describe how income and wealth may influence one's likelihood of choosing treatment and rehabilitation options. Finally, I will draw from previous research connecting SES to health. In particular, I draw from research that has systematically addressed how education and income may impact functional limitation onset and progression in different ways.

Focusing first on education and its effect on functional limitation onset, I argue that lower education is predictive of an earlier onset of functional limitation through a variety of mechanisms. First, through a life-course perspective, education may impact functional limitation onset indirectly through occupation. Those with lower education enter the labor force with a more limited range of occupational options. In particular, those with fewer years of formal education may be restricted to more physically demanding blue collar occupations which may increase the likelihood of developing physical disabilities in late life. The risk of physical disability may be increased by engaging in unskilled and blue collar labor (Li et al. 2000). Many unskilled blue collar occupations may require intense physical demand and repetitive movements that may lead to future problems in physical function and disability (Månsson et al. 1998).

Workers in occupations that do not require educational credentials may also have little job control which has been shown to be associated with pathologies including coronary heart disease (Marmot et al. 1997). Thus, low education may impact functional limitation through occupation due to the association between low job control and pathologies that may lead to functional limitation. The lower educated may then be at a higher risk of functional limitation through both the intense physical labor associated with some blue collar labor as well as the chronic conditions for which low job control may put workers at risk. Further, the conceptual framework for functional limitation onset is informed by research on the disablement process (Verbrugge and Jette 1994) by arguing that education is a risk factor for certain pathologies that may lead to functional limitation. Thus, low education may impact functional limitation onset through negative health behaviors and chronic conditions. Individuals with less education may have less health knowledge and poorer health behaviors (Cutler and Lleras-Muney 2010) which may lead to a higher prevalence of chronic conditions. Finally, it may be that this higher prevalence of chronic conditions may be what ultimately disadvantages those with lower education in terms of functional limitation.

Last, I anticipate that education will have an effect on functional limitation onset even after accounting for the variables along the hypothesized pathways. Through a fundamental cause perspective, educational attainment represents access to a broad array of health promoting resources that can be used to prevent or delay the onset of functional limitations in old age (Link and Phelan 1995; Phelan et al. 2004). Such resources may include knowledge, prestige, agency, and power which are flexible and used in deliberate ways to improve health. In the context of functional limitation, as novel interventions

have emerged to control disabling non-communicable diseases such as diabetes, the privileged strata of society have been favorably positioned to know of, access, and utilize these interventions effectively. Further, as education represents access to a broad array of resources which are flexible and can be used in complex ways to promote health, simply statistically accounting for the factors linking education to health at a particular time does not fully capture the multifaceted manner in which education affects disability. Educational attainment also represents a greater sense of agency or perceived ability to control one's health situation and problems. The conceptual model for the functional limitation onset is shown below in **Figure 1**.

Next, I argue that lower income and wealth will act in similar ways to predict a less favorable progression of functional limitation. Income and wealth both represent the financial resources one has available. From a disablement process perspective, intra-individual factors may accelerate or impede the progression of the disablement process. To the extent that people will invest in health and that their disabilities can be managed and improved, both income and wealth can be used to slow down and possibly improve the progression of chronic diseases and functional limitation. Income and wealth may be used to counteract functional limitation by providing access to healthcare which may enable medications, treatments, and rehabilitation. Additionally, in the cases of functional limitations for which chronic conditions are the underlying cause, those with greater income and wealth may be able to treat and manage chronic conditions more effectively to gain a more favorable progression of functional limitation.

While income and wealth may be used to access treatment and rehabilitation options directly, financial resources may also be used to purchase healthcare which may

cover rehabilitation and treatment options. The conceptual framework for functional limitation progression also borrows from the Health Belief Model (Baum 1997) by arguing that having more financial resources (higher income and wealth) will impact one's perception of the ratio of the perceived benefits to perceived barriers (financial cost) of particular treatments, medications, and rehabilitations which may slow or reverse the progression of functional limitation. Income and wealth may each predict a more favorable progression of functional limitation beyond the other and are unique facets of socioeconomic status. However, given the focus on older adults, wealth may have a stronger association with functional limitation progression as income is often low in old age. The conceptual model for the functional limitation progression is shown below in **Figure 2**.

Figure 1: A Conceptual Model for the Onset of Functional Limitation

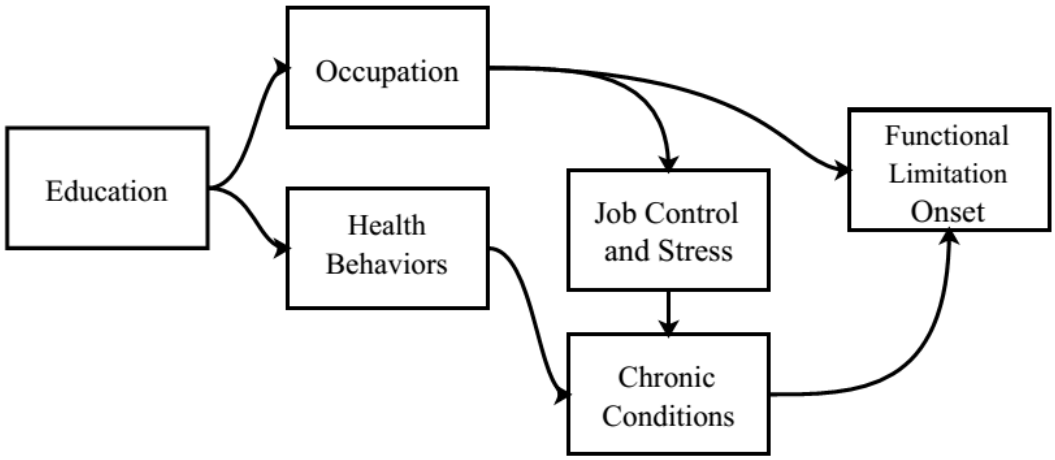
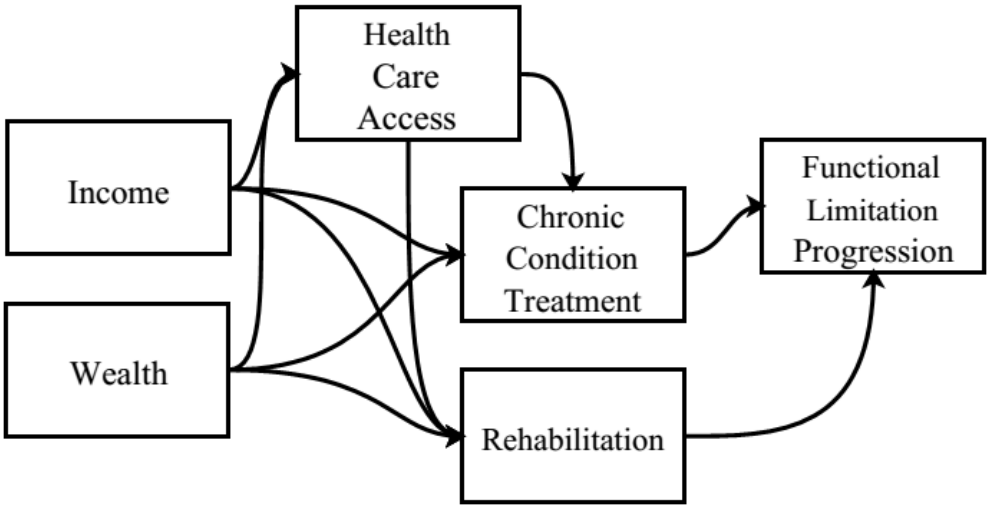


Figure 2: A Conceptual Model for the Progression of Functional Limitation



THE IMPORTANCE OF MEXICO AND THE UNIQUE CASE OF DEVELOPING COUNTRIES:

While previous research has examined the relationship between facets of SES and stages of disease in the United States, it is important to consider the unique contexts of other nations including developing countries. International studies are important due to the existence of large cultural and contextual differences across countries. Individual nations may also differ substantially in terms of public policy, healthcare quality and availability, as well as the meaning of socioeconomic position and facets of socioeconomic position. These differences may prevent researchers from generalizing findings beyond borders. The importance of considering the unique case of Mexico stems from several factors (which are discussed in further detail below) including 1) considering the unique case of a developing country, 2) demographic and epidemiologic change across Mexican cohorts, 3) policy change in Mexico, and 4) the uncertainty of future care for the elderly which are outlined below.

Unfortunately, the majority of the research on SES and health has focused on developed countries. The lack of research attention in developing countries may be attributed partly to shortages in available data in many developing countries. What is known, however, is that developing countries are unique contexts that must be studied outside of the developed country framework. While lower SES is often associated with worse health in developed countries, the picture is not always as clear in developing countries. In fact, SES-health gradients in developing countries including those in Latin America are often found to be weaker than those found in developed countries. While SES and health may be inversely associated in early stages of economic development, as countries achieve higher levels of economic development, these gradients may show the

standard positive association witnessed in developed countries (Frenk et al. 1991; Riosmena and Dennis 2012). In fact, a review of the literature on SES and obesity conducted in 1989 found that, among developing countries, higher SES was often associated with *higher* levels of obesity (i.e. worse health). The authors explained these findings by the physical labor and shortages of food among the poor and a greater spending power among the rich to purchase processed and calorie rich foods (Sobal and Stunkard 1989). However, an additional review was conducted in 2004 with largely different results. (Monteiro et al. 2004) re-examined the SES-obesity association 15 years later and found that, in many cases, SES and obesity were not associated or were associated in similar ways to developed countries. This change may be due to the progression of the epidemiologic transition in developing countries.

Others have argued that developing countries must be studied because the mechanisms through which SES impacts health are likely to change as economic development occurs. For example, SES might be associated with health through healthcare access but this association may change with economic development. In earlier stages of development, healthcare quality may have been poor for everyone. With economic development, however, the overall quality and *range* of healthcare quality may increase. Although healthcare in general may improve, the affluent populations are the ones who are likely to gain the most from healthcare improvements leading to socioeconomic-health gradients (Smith and Goldman 2007). Altogether, these results suggest that 1) socioeconomic-health gradients in developing countries may differ from developed countries in important ways, and 2) we must continue to study the socioeconomic-health gradients of developing countries as economic development

occurs. Education may then be an important marker of socioeconomic standing for health in developing countries where higher income and wealth may represent access to unhealthy foods and behaviors and may not always produce access to improved healthcare.

POLICY CHANGE IN MEXICO:

The older population in Mexico has aged during a century of not only demographic change but policy change as well, much of which has stemmed from the implementation of the Mexican Constitution of 1917 following the Mexican Revolution. Of key interest to the current study are policies that have impacted the health, education, occupation, and income arenas. In the health arena, health insurance has traditionally been strongly connected to participation in formal labor markets through several programs including the *Instituto Mexicano de Seguro Social* (IMSS) and the *Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado* (ISSSTE) leaving many workers in the informal labor sector without health insurance (Bosch, Cobacho, and Pagés 2012). One major policy change that has occurred more recently is *Seguro Popular*. *Seguro Popular* is a voluntary health insurance program that was enacted in 2003 to extend healthcare to the approximately 50 million uninsured Mexicans. *Seguro Popular* was launched in 2003 and went into effect gradually across states in early 2004 and was phased in until 2010 (Frenk et al. 2006). *Seguro Popular* covers 249 basic and preventive services as well as more expensive catastrophic services which are covered at the state and federal levels through a catastrophic service fund (Comisión Nacional de Protección Social en Salud and Secretaría de Salud 2006). *Seguro Popular* aimed to enroll the most impoverished persons and those with the least access to healthcare first

(Secretaría de Hacienda y Crédito Público de México 2003). *Seguro Popular* is funded at three levels: the federal level, the state level, and through individual contributions which are based on decile of income with the lowest 40% free of contributions (Frenk et al. 2006). In 2000, Mexico was ranked as low as 144 out of 191 by the World Health Organization in terms of healthcare system fairness, however, in 2010 approximately 90% of those who were uninsured prior to the program had obtained healthcare through *Seguro Popular* (Bosch et al. 2012).

For the educational arena, the Mexican educational system has also evolved through numerous educational policies and programs that have been enacted throughout the previous century. Together, these political, institutional, and legal changes have acted to gradually improve the education of successive generations of the Mexican population. The first major policy change of importance to the 20th century comes from the Constitution of Mexico which was enacted in 1917 following the Mexican Revolution. Under Article 3, education was declared to be secular, and elementary education was made mandatory. Under this same article, all education provided by the State was made free. The Mexican Ministry of Education was then formed in 1921 as a central organization in the Mexican education system. In 1944, the government of Mexico initiated a program to increase literacy which evolved over the following decades to incorporate community level economic development (Lacy 1994). Further commitment to improve education in Mexico is seen in the creation of the *Centro Regional para Educación Fundamental en América Latina* (regional training center for Fundamental Education) in 1950 which was intended to develop fundamental education, literacy, and education materials with a special emphasis on rural areas (Lacy 1994). In 1959, the

Eleven Year Plan was initiated by President Adolfo López Mateos. The program targeted elementary education and resulted in the development of schools and increases in the teaching workforce (Lacy 1994). These programs, together with increases in literacy at the population level, are evidence of a continued commitment to education. While other examples exist, these policies and programs undoubtedly shaped educational attainment among the current elderly population in Mexico and the cohorts born in the first half of the 20th century.

In the occupation arena, major policy changes have been implemented regarding working wages and the rights of workers to form unions. Prior to the Mexican Revolution, working conditions for Mexican laborers were intolerable. Workers often worked excessive hours a day for little pay. A paucity of land and the working conditions of the laboring class were key reasons for the revolution (Cormack and Barker 1933). Following the Mexican Revolution, Article 123 of the Mexican Constitution of 1917 was created to protect workers and improve working conditions. To this end, workers were given the right to organize and to strike. Article 123 also established a minimum wage as well as the eight hour work day. In fact, this marked the first occurrence of labor rights being acknowledged in a constitution at the global level (Zelek and de la Vega 1992). However, the promises outlined in Article 123 were far from realized in practice. For this reason, the *Ley Federal de Trabajo* (Federal Labor Law) of 1931 was enacted to implement the promises of Article 123 of the Mexican Constitution of 1917 and shifted much power to the laborer from the employer to provide protection to the less economically powerful (Cormack and Barker 1933). The 1931 Federal Labor Law remained for decades until it was reformed in 1970 to improve working conditions

(Zelek and de la Vega 1992). The latest labor reform went into effect in December of 2012.

Along with labor reforms, Mexico has created various programs which impact income and poverty. While a minimum wage was established in the Constitution of 1917, Mexico and Latin America exhibit extremely high levels of income inequality which has constrained economic development at a national level (Ferranti 2004). Mexico has relatively recently enacted a well known anti-poverty program involving income which is known as Prospera/PROGRESA/Oportunidades. Prospera/PROGRESA/Oportunidades is a conditional cash transfer program which began in 1997 and was designed to break the cycle of poverty by encouraging investment in human capital in the forms of education and health. Through this program, families receive cash transfers conditional on their children's school attendance and continued health clinic visits. The motivation behind this is that lower income families may not be able to afford to send their children to school because they may rely on their child's labor for income. Further, children's healthcare may be neglected or underused due to the cost and a possible lack of knowledge of the benefits of these investments. The program was then designed to supplement the opportunity costs of investment in education and health by providing cash transfers (Oportunidades 2004) and interrupt the intergenerational cycle of poverty. Positive results have been seen for children's schooling (Behrman, Parker, and Todd 2011) and certain health outcomes among older adults (Behrman and Parker 2013).

DEMOGRAPHIC AND EPIDEMIOLOGIC CHANGE IN MEXICO:

While it is important to consider the unique case of Mexico, it is equally important to understand trends across subsequent birth cohorts in Mexico due to

extensive demographic changes that have occurred in Mexico during the past century. First, Mexico along with Latin America is experiencing one of the fastest rates of aging world-wide (Wong and Palloni 2009). The percentage of the Mexican population over age 60 is projected to increase from 6% in 2000 to over 25% in 2050 (Wong and Palloni 2009). Population aging can be attributed to several factors including substantial mortality declines from 1930 to 1990 across Latin America (Palloni et al. 2002) which are due in a large part to declines in infectious disease mortality (Palloni and Lu 1995). Second, Mexico has experienced sharp fertility declines that began in the 1960s (Wong and Palloni 2009). The total fertility rate in Mexico was estimated to be approximately 5 children per woman in 1978 (Tuiran et al. 2002) and has declined largely as a result of the onset of family planning programs and the increased use of contraception to a current level of 2.3 children per woman in 2011 (Consejo Nacional de Poblacion 2011).

Along with population aging, Mexico has also experienced an epidemiologic transition as chronic diseases have increased to become major contributors to mortality while mortality from infectious diseases has declined. Influenza and pneumonia were the 2nd leading causes of mortality as late as 1970 among men 65 years and older. However, 30 years later in 2000, influenza and pneumonia had dropped to the 7th spot for leading causes of death (Chande 2014). Public health improvements and better sanitation have assisted in reducing the burden of infectious disease (Esrey et al. 1991). Alongside declines in infectious disease mortality, mortality from non-communicable diseases was increasing. The increase in mortality from chronic conditions can be made apparent by previous research which has demonstrated how the standardized mortality rates for acute myocardial infarction, diabetes, and hypertension increased 53%, 62% and 55%

respectively during only 18 years from 1980 to 1998 (Rivera et al. 2002). The increase in mortality from chronic diseases can be attributed not only to population aging, but also lifestyle changes including increases in sedentary lifestyles and increases in consumption of high fat, processed foods (Popkin 1994).

Mexico has also become increasingly educated. Over the previous century (as mentioned above), the Ministry of Education was created, education has become mandatory, and literacy rates and educational achievement have increased across Mexico and particularly so for females and in rural areas. For example, the average years of formal schooling has increased approximately 260% from 1970 to 2000 among rural women aged 26-30 (Wong and Palloni 2009) and the literacy rates for adult males and females have increased 247% and 325% respectively from 1900 to 1960 (Instituto Nacional de Estadística y Geografía 2016). A large rural to urban population shift has also occurred over the previous century in Mexico (Brea 2003). Over the 35 year period from 1960 to 1995, the population of Mexico City increased over three-fold and the population of Monterrey increased over four-fold (Garza 1999). Given these extensive demographic and policy changes, it is necessary to consider heterogeneity across birth cohorts who have aged in distinct contexts as unique population groups. As birth cohorts in Mexico are likely to have had unique experiences with the educational and occupational systems, I choose to analyze birth cohorts separately.

THE UNCERTAINTY OF FUTURE CARE FOR THE ELDERLY:

Finally, there is substantial concern over the care of the aging population in Mexico. As mentioned above, Mexico is experiencing rapid population aging but the population aging seen in Mexico has outpaced preparation. In other words, the Mexican

population has aged ahead of the development of institutional support systems for the elderly (Wong and Higgins 2007; Wong and Palloni 2009). Several demographic trends combine to create serious concerns over the healthcare of the elderly. A rapid rise in chronic conditions among a quickly expanding older segment of the population creates a growing demand for attention towards the elderly. Traditionally, much support for the elderly came from intergenerational families and social networks which have been demonstrated to have positive impacts on the health and wellbeing of the aged population (Bowling and Grundy 1998; Glaser et al. 2006). However, the sharp fertility declines in Mexico have created smaller family sizes and the shrinking of critical intergenerational support systems for the older population (Wong and Palloni 2009). The older Mexican population will require substantial economic, social, and research attention as Mexicans are living longer, with more chronic conditions, and with more disability. The emerging concern then, is who will take care of the growing elderly population?

AIMS & HYPOTHESES:

The goal of this research is to describe the pathways between SES and functional limitation by modeling the associations between individual facets of SES (education, occupation, income, and wealth) and stages of functional limitation (onset and progression) and to inform public health and policy in Mexico and other developing countries. The central hypothesis is that education will be related to onset of functional limitation while income and wealth will be related to the progression of functional limitation and that these associations will differ by birth cohorts in Mexico. In this dissertation, I will pursue the following aims:

AIM 1: To examine the fundamental causes of functional limitation by delineating the pathways between SES and functional limitation onset in the context of Mexico, and to determine how facets of SES differentially impact the onset of functional limitation. For this aim, I posit the following hypothesis:

> **HYPOTHESIS**: Lower education will be associated with a higher likelihood of functional limitation onset by shaping exposures throughout the life-course such as occupation, health knowledge, health behaviors, and chronic conditions before reaching old age.

AIM 2: To examine the socioeconomic predictors of the progression of functional limitation and the pathways between SES and functional limitation progression in the context of Mexico. I will test the association between financial resources in old age (including income and wealth) and the progression of functional limitation. For this aim, I posit the following hypothesis:

> **HYPOTHESIS**: Lower income and wealth will be associated with an unfavorable progression of functional limitation as higher income and wealth in old age may provide individuals with more capacity to access rehabilitation services, healthcare, and treatment of disabling pathologies.

AIM 3: To identify trends in SES-functional limitation relationships across subsequent birth cohorts that are defined by greater literacy and educational quality, more urban dwelling, and changing family structures by determining how the associations between facets of SES and stages of functional limitation differ across birth cohorts. For this aim I posit one hypothesis.

HYPOTHESIS: The associations between education and the onset, and between income and the progression of functional limitation will differ across birth cohorts that have aged in unique contexts and differed in terms of education, urban dwelling, and multigenerational households.

This analysis will contribute a novel theoretical model of SES and health which acknowledges the multiple facets of socioeconomic status for functional limitation and is informed by life-course epidemiology, the Health Belief Model, and the Disablement Process. Additionally, the results of this analysis will inform researchers interested in health inequalities and will support public health and health policy in Mexico and other developing countries experiencing similar demographic trends (aging, fertility declines, urbanization, and epidemiologic transitions). This project will advance previous research on the association between education and functional limitation onset, and income and functional limitation progression by addressing the theoretical importance of occupation and financial assets. Empirically, this analysis will also apply existing frameworks to a context in which they have not been applied, developing countries. Together, these results will assist researchers focusing on socioeconomic inequalities in functional limitation in other developing and rapidly aging countries.

Chapter 2: Data and Methods

To address the specific aims of this analysis:

AIM 1: To examine the fundamental causes of functional limitation by delineating the pathways between SES and functional limitation onset in the context of Mexico, and to determine how facets of SES differentially impact the onset of functional limitation.

AIM 2: To examine the socioeconomic predictors of the progression of functional limitation and the pathways between SES and functional limitation progression in the context of Mexico. I will test the association between financial resources in old age (including income and wealth) and the progression of functional limitation.

AIM 3: To identify trends in SES-functional limitation relationships across subsequent birth cohorts that are defined by greater literacy and educational quality, more urban dwelling, and changing family structures by determining how the associations between facets of SES and stages of functional limitation differ across birth cohorts.

I will structure my models based on the theoretical frameworks that I have argued and illustrate below in **Figure 1** and **Figure 2**.

DATA:

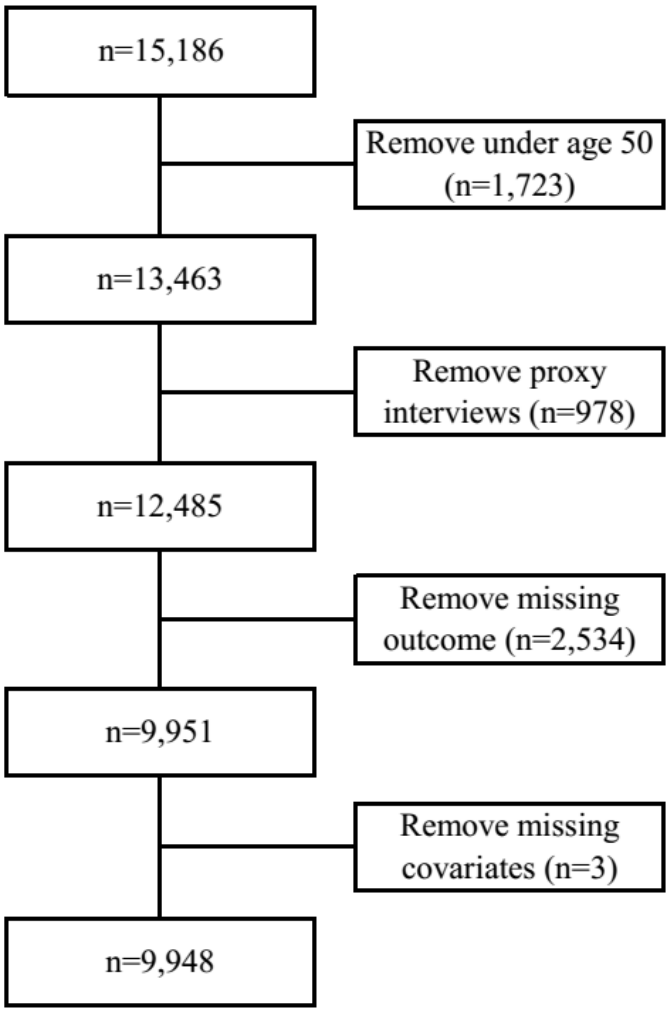
Data will come from the first three waves of the Mexican Health and Aging Study (MHAS) (Mexican Health and Aging Study 2012). The first wave of the MHAS was conducted in 2001, the second in 2003, and the third wave in 2012. The MHAS is a large, longitudinal, nationally representative study of older adults (age 50+) in Mexico and their spouses regardless of age. The first wave of the MHAS used the Encuesta Nacional de Empleo (ENE) to select 11,000 households which yielded an initial sample size of 15,186 with an over sample in high out-migration states (Durango, Guanajuato, Jalisco,

Michoacán, Nayarit & Zacatecas). The study was approved by the Institutional Review Boards or Ethics Committees of the University of Texas Medical Branch in the United States, the Instituto Nacional de Estadistica y Geografia (INEGI) and the Instituto Nacional de Salud Publica (INSP) in Mexico. The MHAS is partly sponsored by the National Institutes of Health/National Institute on Aging (grant number NIH R01AG018016). Data files and documentation are public use and available at www.MHASweb.org. The MHAS collects data across many domains including self-reported health, chronic conditions, economic characteristics at the individual and household levels as well as mental health. If respondents get married between waves, the new spouses are added to the sample. In the event of divorce or separation, both members of the former household are followed up as well. The MHAS has been described in greater detail elsewhere (Wong, Michaels-Obregon, and Palloni 2015; Wong, Michaels-Obregón, et al. 2015). All analyses are separated by cohort due to extensive demographic changes in Mexico over the previous century. A data driven cutoff is created using the median birth year to create two birth cohorts of relatively equal sample size (50-59, 60+ at baseline). It should be noted that while analyses are stratified by birth cohort, these "cohort" effects are confounded with age. That is, a difference in parameter estimates across birth cohorts may be the result of having aged in a unique context (a cohort effect) or differences in parameters as a result of age differences by birth cohort.

Respondents and spouses from the baseline sample who were age 50 or older with data on covariates (effectively eliminating proxy interviews) are included in the present study. The process through which the analytic sample size is reached is shown below in **Figure 3**. Only transitions from 2001-2003 are shown in the figure. It should be noted

that respondents who are missing information on the transitions from 2001-2003 may have information from the 2003-2012 time and be included as data for that interwave period.

Figure 3: Calculation of Analytic Sample Size for 2001-2003 Transitions



MEASURES OF SOCIOECONOMIC POSITION:

Measures of socioeconomic position in this analysis will include education, income, wealth, and life-course occupation. Education will be based on elementary education (6 years in Mexico). The number of completed years of formal education will be categorized as 0 years, incomplete elementary education (1-5 years), complete

elementary education (6 years), and more than elementary education (7+ years). Education is assessed in the first wave (2001) and not in later waves because education is assumed to be constant across waves as older adults (age 50+) are very unlikely to receive formal education in old age.

While the operationalization of education is more straightforward, the measurement of income in old age is more complicated, especially in the case of couples. The MHAS collects data at the individual level on each respondent's estimates of their current monthly income from various sources which are summed to obtain an estimate of total individual level income. As many cases have missing data, imputation techniques are used by the MHAS to provide a more complete set of information on the participant's income (Wong and Espinoza 2004). The quantification of income becomes complicated when analyzing households with two respondents (spouses) with combined income. For this reason, multiple techniques for income quantification will be utilized and evaluated. The multiple methods include: 1) using each respondent's *total individual income*; 2) using the sum of the spouses' incomes as a measure of *total couple's income*; 3) using the sum of both spouses incomes divided by two as a measure of *average individual income within the couple*, and 4) using the sum of both spouses incomes divided by the square root of two as a measure of *couple's income adjusted for economies of scale*. The last method is because spouses who live together have achieved economies of scale. While some products and services may not scale (roughly twice the amount of food will have to be purchased for two persons), other resources only need to be purchased once and shared (the couple will likely only have to purchase one refrigerator, bed, or kitchen table). This method (using the square root of two) has been used in previous analyses of

household income using the highly comparable United States Health and Retirement Study (HRS) (Bosworth and Burke 2014).

While each income quantification technique may have advantages and disadvantages depending on the outcomes and theoretical framework, each measure of income will be evaluated to determine whether similar results are obtained across estimation methods. If differences are observed across quantification techniques, a technique will be chosen based on the theory tested by the model. Additionally, wealth (which is assessed only at the couple level) will be operationalized as the sum of the reported value of businesses, real estate property, money in accounts and stocks, transportation, as well as an estimate of the value of all other assets. All income and wealth variables will be analyzed using various operationalizations including tertiles, quintiles, log-transformations, signed logarithms, and continuous deciles. Income and wealth are assessed by the MHAS in all waves but only income in 2001 and 2003 is used in the analysis.

Occupation is obtained by asking the respondent about the main job the respondent worked throughout his/her life. The responses to questions are categorized using the Mexican Classification of Occupations provided by INEGI (Mexican Health and Aging Study 2001). These categories are then collapsed into categories including *white collar* (generally professionals, supervisors, and administrative jobs), *blue collar*, and agricultural workers using classifications that are intended to represent jobs with similar characteristics including working conditions, benefits, income, and job security which are based on categorizations used in previous MHAS research (Wong and DeGraff 2009). The blue and white collar occupation variable has the benefit of not only capturing

relatively homogenous occupation categories but also may proxy the physical demand of occupations with blue collar occupations requiring more physically strenuous activities. Respondents who are missing on this variable are assigned a missing flag and retained for analyses. Detailed information regarding the classifications of occupations can be found elsewhere (Mexican Health & Aging Study 2012).

DEPENDENT VARIABLE: FUNCTIONAL LIMITATION:

Functional limitations are assessed at all waves and are captured using two scales which are combined to form an ordinal index of functional limitation (IFL) following previous work (Yang and George 2005). The IFL is created to capture transitions in functional limitations that are consistent with the disablement process (Verbrugge and Jette 1994). First, I use the Nagi scale (Nagi 1976) ranging from 0-5 which captures lower and upper body functioning as a measure of functional limitations that should theoretically precede ADL disability (Lawrence and Jette 1996; Verbrugge and Jette 1994; Yang and George 2005). Respondents report difficulty stooping, extending arms, pulling/pushing large objects, carrying objects, and picking up small objects. The answer choices are yes, no, can't do, and don't do. Respondents who report having difficulty with or not being able to perform each activity are coded as disabled while those who report no difficulty with each activity are coded as non-disabled. Respondents who report not doing the activity, refuse to answer the question, or not knowing are coded as missing. The questions for Nagi items are:

1) Because of a health problem, do you have difficulty with stooping, kneeling, or crouching?

2) Because of a health problem, do you have difficulty with reaching or extending your arms above shoulder level?
3) Because of a health problem, do you have difficulty with pulling or pushing large objects like a living-room chair?
4) Because of a health problem, do you have difficulty with lifting or carrying objects weighing over 5 kg, like a heavy bag of groceries?
5) Because of a health problem, do you have difficulty with picking up a 1 peso coin from the table?

Second, I use an Activities of Daily Living (ADL) scale (Katz et al. 1963) which captures more severe disability and ranges from 0-5 where respondents report trouble dressing, bathing, eating, getting out of bed, and using the toilet. While the ADL items have the same answer choices as the Nagi items, respondents are also asked whether they receive help in performing each of the ADL activities. Following the example of previous research, respondents who report problems performing the activity, not being able to perform the activity, or receiving help performing the activity are classified as disabled while those who report no problems performing the activity are considered non-disabled (Diaz-Venegas, De La Vega, and Wong 2015). Respondents who report not performing the activity and not getting help performing the activity, or not knowing or refusing to answer whether they can perform the activity are coded as missing. The ADL items are:

1) Because of a health problem, do you have difficulty with dressing including putting on shoes and socks?
2) Because of a health problem, do you have any difficulty with bathing or showering?

3) Because of a health problem, do you have any difficulty with eating, such as cutting your food?
4) Because of a health problem, do you have any difficulty with getting in or out of bed?
5) Because of a health problem, do you have any difficulty with using the toilet, including getting on and off the toilet or squatting?

While others have included Instrumental Activities of Daily Living (IADL) measures in their instruments (Taylor 2010), I do not include them as cultural biases exist in the items especially in the cases of using a telephone as telephones may be less common in developing countries and managing money where traditional gender roles in Mexico may indicate few women engaging in these activities. The Nagi (Crimmins and Saito 1993) and ADL (Hays et al. 1998) scales have demonstrated reliability and have been combined in previous work (Yang and George 2005). A higher value of the IFL indicates higher levels of disability and is intended to capture transitions from no noticeable limitation to functional limitation to disability. The coding of the IFL ensures that ADL classification over-rides Nagi classifications. The levels of the IFL are obtained as follows:

(1)=no limitations in Nagi items and no ADL limitations

(2)=1-4 Nagi limitations and no ADL limitations

(3)=5 Nagi limitations or 1 ADL limitation

(4)=2+ ADL limitations (regardless of Nagi limitations).

The values of the IFL were constructed based on cross-tabulations of the Nagi scale with the ADL scale at baseline (2001). Cross-tabulations showed increasing risk of ADL limitations with increasing numbers of Nagi items. The *first* level of the IFL is

intended to capture respondents with no noticeable physical limitation. Only respondents who report 0 limitations with Nagi items and 0 limitations with ADLs are considered to be without noticeable physical limitation. The *second* level of the IFL is constructed to include respondents with functional limitation that has not progressed to ADL disability. Respondents who report 1-4 limitations and 0 ADL limitations are included in this category. Respondents who report 5 Nagi limitations but 0 ADL limitations are not included in this category due to cross-tabulations between the number of Nagi limitations and a binary variable indicating whether the respondent reported 1 or more ADL limitation. Of respondents who reported 4 Nagi limitations, approximately half (49.5%) reported at least 1 ADL limitation. However, respondents who reported 5 Nagi limitations were considerably more likely to report 1+ ADL limitations (78.2 %) and are included in the third level of the IFL. The *third* level of the IFL is intended to capture respondents who have progressed to ADL limitation but may deteriorate further. Respondents with either 1 ADL limitation or 5 Nagi limitations and no ADL limitation are included in this level. Finally, the *fourth* level of the IFL captures the respondents who are severely disabled by including only the respondents with the highest levels of disability (2+ ADL limitations). The coding of each IFL category ensures that ADL limitations are weighed heavier than Nagi limitations. Respondents with 1 ADL limitation are classified as level 3 on the IFL while respondents with 2+ ADL limitations are classified as level 4 regardless of their reported number of Nagi limitations.

Cross-tabulations of the number of Nagi items with the presence of 1+ ADL limitations are shown in **Table 1** for Wave 1 (2001) while the frequency of the IFL at each wave is shown in **Table 2**. The IFL is created to resemble the levels of functional

limitation in previous studies contrasting the role of socioeconomic variables in the onset versus progression of functional limitation in the United States (Herd et al. 2007; Zimmer and House 2003). The frequency of the IFL at baseline by birth cohort/age group is shown in **Table 3** which suggests (as expected given the ages) a higher percentage of respondents in the older birth cohort at the higher levels of the IFL and a higher percentage of respondents in the younger birth cohort at lower levels of the IFL.

Table 1: Cross-tabulations of Number of Nagi Limitation with Presence of 1+ Activities of Daily Living (ADL) Limitation among Older (50+) Mexican Adults in the Mexican Health and Aging Study (MHAS) (2001) n=11,999

Number of Nagi Limitations	No ADL Limitation (Number, Row Percent)	1+ ADL Limitation (Number, Row Percent)
0	6,799 (99.6%)	25 (0.4%)
1	1,955 (92.4%)	160 (7.8%)
2	970 (85.2%)	169 (14.8%)
3	679 (68.9%)	307 (31.1%)
4	326 (50.5%)	320 (49.5%)
5	63 (21.8%)	226 (78.2%)

Table 2: Frequency of Categories of the Index of Functional Limitation (IFL) among Older (50+) Mexican Adults in the 2001, 2003 and 2012 Mexican Health and Aging Study.

IFL Value	Wave 1 (2001) (Number, Column Percent)	Wave 2 (2003) (Number, Column Percent)	Wave 3 (2012) (Number, Column Percent)
1	6,736 (55.7%)	6,364 (58.7%)	2,857 (38.7%)
2	4,032 (33.3%)	3,346 (30.9%)	2,894 (39.2%)
3	753 (6.2%)	643 (5.9%)	958 (13.0%)
4	576 (4.8%)	484 (4.5%)	674 (9.1%)
Sum:	12,097 (100.0%)	10,837 (100.0%)	7,383 (100.0%)

Table 3: Frequency of Categories of the Index of Functional Limitation (IFL) among Older (50+) Mexican Adults in the 2001 Mexican Health and Aging Study (MHAS) (n=12,097)

Level of Index of Functional Limitation (IFL)	Older Birth Cohort (n, Column Percent)	Younger Birth Cohort (n, Column Percent)
1	2,691 (45.8%)	4,045 (65.0%)
2	2,290 (39.0%	1,742 (28.0%)
3	467 (8.0%)	286 (4.6%)
4	423 (7.2%)	153 (2.5%)
Sum:	5,871 (100.0%)	6,226 (100.0%)

RELIABILITY AND VALIDITY OF THE INDEX OF FUNCTIONAL LIMITATION:

While the reliability and validity of the Nagi and ADL scales has been established, the IFL which I create has not been validated. To determine the convergent validity of a new measure, it is necessary to determine whether the novel measure is associated with constructs with which it should theoretically be related. Many researchers correlate new variables with "gold standards" for validation. Unfortunately, such gold standards (ADL and Nagi items) are used to construct the IFL. To establish convergent validity, I take advantage of a physical activity item in the MHAS. Respondents report whether "on average during the last two years, [they have] exercised or done hard physical work three or more times a week? (Includes various activities such as sports, heavy household chores, or other physical work)." If the IFL cutpoints are meaningful, one would expect the likelihood of engaging in intense physical activity to drop with each increase in the IFL. The results in **Table 3** show support for the IFL. With each increase in the IFL, respondents are less likely to report intense physical activity. Respondents with no noticeable limitation are over twice as likely to report intense physical activity

than respondents reporting 2+ ADLs. As for the reliability of the IFL, the Nagi (Crimmins and Saito 1993) and ADL (Hays et al. 1998) scales have been shown to be reliable in previous work. Since the IFL is a composite of the Nagi and ADL scales, the reliability of these scales should hold for the IFL.

Table 4: Likelihood of Reporting Intense Physical Activity 3+ Times Weekly in Previous 2 Years by Index of Functional Limitation (2001) (n=11,996).

Index of Functional Limitation Level	1	2	3	4
Percent Reporting Intense Physical Activity	38.3%	30.3%	25.9%	17.8%

STATISTICAL METHOD AND TRANSITIONS:

Following the example of (Herd et al. 2007), I treat each transition in the IFL as an individual observation. With three waves of data, respondents may contribute up to two observations representing transitions from $time_t$ to $time_{t+1}$. To account for the correlation of observations within individuals, all standard errors are calculated as robust standard errors with the Huber-White sandwich estimator. For models of functional limitation onset, I am only interested in respondents who are free of functional limitation at $time_t$. To this end, only respondents with a value of 1 on the IFL at $time_t$ are included and the possible transitions are based on the $time_{t+1}$ IFL as no functional limitation at $time_t$ to:

(1) functional limitation (IFL of 2 or higher)

(2) remain without functional limitation (IFL of 1)

For models of functional limitation progression, I am only interested in those with some level of existing functional limitation. Only respondents with a value of 2 or higher on the

IFL at $time_t$ are included. Transitions are based on their IFL at $time_{t+1}$, and include functional limitation at $time_t$ to

(1) more functional limitation (increase in IFL)

(2) less functional limitation (decrease in IFL)

(3) functional limitation remains the same (IFL at $time_t$ = IFL at $time_{t+1}$).

In addition to experiencing transitions in functional limitation status, study participants may also die over the 11-year follow up. For this reason, all models will also include transitions to mortality to address selective survival. Previous work on the impact of socioeconomic position on the onset and progression of functional limitation has highlighted the biases that failing to account for mortality may produce (Groenou et al. 2013) and this approach has been adopted by others (Herd et al. 2007; Zimmer and House 2003). Unfortunately, the presence of death as a transition creates difficulty in ordering transitions into an ordinal outcome variable. Death may be caused by accidents as well as unobserved disease (Herd et al. 2007). For this reason, the outcome categories for the onset and progression models will be treated as nominal. Multinomial models will be fit using the logit and the probit links.

One concern present with the multinomial logistic model is the Independence of Irrelevant Alternatives (IIA) assumption. In discrete choice theory, this assumption is that the presence or absence of an option should not impact the likelihood of a respondent "choosing" a particular option. In the context of the current analysis, the concept of "choice" can be extended to outcome categories. The proposed transition categories may give reason to suspect violation of this assumption. For example, the absence of the death transition may influence the likelihood of other transitions. If respondents cannot die,

they may be more likely to have an onset or worsening of functional limitation. The IIA in the multinomial logistic regression models will be tested using the Small & Hsiao (Small and Hsiao 1985) and Hausman (Hausman and McFadden 1984) tests. If this assumption is violated, the multinomial probit model will be used which allows the error terms for outcome categories to correlate, thus relaxing the IIA assumption. To account for differential lengths of follow up in transitions, I include a binary variable in all models to indicate which time period the transition represents (2001-2003 versus 2003-2012).

COVARIATES:

Demographic covariates in the analysis will include the respondent's age, sex, whether the respondent lived in a rural or urban area at baseline (community size greater than or less than 100,000 persons), and marital status which will be analyzed as married or in a consensual union, widowed, and other (divorced, separated, or never married). Health covariates will include the presence of self-reported doctor ever-diagnosed chronic conditions including cancer, stroke, diabetes, pulmonary conditions, heart attacks, and hypertension. Additionally, I will include measures of global self-rated health which will be categorized as good (reporting very good, excellent, or good health), fair, and poor. I will also include a binary variable to indicate whether the respondent had access to healthcare from any source. Health behavior covariates include smoking history (current, former, or never smoker) as well as binge drinking during the previous 3 months.

All covariates are time-varying in that observations representing transitions from Wave 1 to Wave 2 contain covariates measured in Wave 1 and observations representing

transitions from Wave 2 to Wave 3 contain covariates measured in Wave 2. Covariates are measured at the beginning of the interwave period to partially circumvent issues of reverse causality. For example, income may be determined by functional limitation if one is forced to resign from their profession as a result of a functional limitation. The measurement of financial resources at the beginning of the interwave period should then be robust to this reverse causation.

DESIGN AND STRUCTURE OF STATISTICAL MODELS (AIM 1):

Models predicting the onset of functional limitation will be ordered and structured specifically to study exposures across the life-course and their direct and indirect effects on functional limitation onset. The model structure is outlined below. Model 1 will include variables determined early in the life-course (age, sex, and education) while Model 2 will add variables that occur after early life and theoretically precede chronic conditions (occupation, marital status, and health behaviors including life-time smoking and current binge drinking). Model 3 will add variables that represent characteristics at the time of the survey including chronic conditions (diabetes, heart attacks, strokes, cancer, hypertension, and pulmonary conditions), access to healthcare, income and wealth. The baseline (reference) outcome for models of the onset of functional limitation will be those who remain without functional limitation between $time_t$ and $time_{t+1}$. Additionally, models were stratified by interwave period and interaction terms were created between variables and the interwave period to determine whether relationships between variables differed by interwave period. For the majority of covariates (including all socioeconomic variables), the interaction terms were not significant indicating that the combination of interwave periods is justifiable.

DESIGN AND STRUCTURE OF STATISTICAL MODELS (AIM 2):

I will begin by testing the raw effect of income without wealth (with and without adjustment for educational attainment) and then adding confounding variables which are not considered to be mediators between income and functional limitation progression including age, sex, education, marital status, occupation, health behaviors, and chronic conditions (diabetes, heart attacks, strokes, cancer, hypertension, and pulmonary conditions). I will then test the raw effect of wealth without income by including wealth (with and without adjustment for educational attainment) and then adding other variables which are not considered to be mediators between wealth and functional limitation progression (listed above). Finally, I will examine the effects of income and wealth (net of each other) by including both with the non-mediating variable list to determine whether either income or wealth have an effect above and beyond the other. If income and wealth demonstrate significant associations with functional limitation progression, each model will be evaluated with the inclusion of a dummy variable for any health insurance coverage to determine whether the effects of income and wealth are mediated by health insurance coverage. The baseline (reference) outcome for models of the progression of functional limitation will be those who remain with the same level of functional limitation between $time_t$ and $time_{t+1}$ (IFL at $time_t$ = IFL at $time_{t+1}$). Similar to models of functional limitation onset, sensitivity analyses were conducted by interwave periods for functional limitation progression. Again, interaction terms between socioeconomic variables and interwave period were not significant providing justification for the combination of interwave periods.

STRATIFICATION BY BIRTH COHORT (AIM 3)

To test whether the associations between individual facets of SES and stages of functional limitation differ by cohort, a dummy variable will be constructed representing whether a respondent is in the younger cohort (age 50-59 at baseline) or the older cohort (age 60+ at baseline). Interaction terms will be created between birth cohort and each individual measure of SES (education, income, and wealth). Regardless of statistical significance of the interaction terms, results of stratification by birth cohort will be produced and presented due to the extensive demographic changes that have occurred over the previous century in Mexico.

Chapter 3: Education and the Onset of Functional Limitation Results

FUNCTIONAL LIMITATION ONSET BETWEEN 2001 AND 2003:

I begin by presenting descriptive results showing what percentage of respondents with different characteristic in 2001 transition to each outcome in 2003 which are shown in **Table 5** (full descriptive in appendix). All respondents are free of functional limitation in 2001 and may progress to one of three outcomes: remaining free of functional limitation (72.0%), functional limitation onset (26.5%), or death (1.9%). Respondents are less likely to have an onset of a functional limitation with each increase in educational attainment category. Respondents with no education are approximately twice as likely to have an onset of functional limitation between 2001 and 2003 compared to those with beyond an elementary education. The likelihood of functional limitation onset also differed by sex with females reporting more functional limitation onset than males (32.1% versus 21.6%). Widowed respondents were also more likely than married respondents to report a transition to functional limitation between the first two study waves. For occupation, the respondents who reported that their main occupation throughout the life-course was a white collar occupation were the least likely to have an onset of a functional limitation compared to blue collar workers and those who worked primarily in agriculture or fishing occupations. The percent of respondents who experienced a functional limitation transition also differed by financial resources. With each increase in income tertiles, a decline in the percent reporting functional limitation onset was observed. Similar results were observed with household wealth. While I present results for transitions to mortality between the first two study waves, the percent who experienced mortality was small. This is for two reasons. First, the time between the

first two study waves was short (2 years) and second, the population followed for the onset of functional limitation at 2003 was free of functional limitation at 2001 making it a healthier sample.

Table 5 (Short): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2001 and 2003 (n=5,430).

	Remain N(%)	Onset N(%)	Death N(%)	Total N
No Education	714 (62.6)	396 (34.7)	31 (2.7)	1,141
1-5 Years	1,268 (69.7)	516 (28.4)	36 (2.0)	1,820
6 Years	795 (73.0)	280 (25.7)	14 (1.3)	1,089
7+ Years	1,107 (80.2)	249 (18.0)	24 (1.7)	1,380
Low Income Tertile	1,117 (66.0)	530 (31.3)	46 (2.7)	1,693
Mid Income Tertile	1,351 (71.4)	510 (26.9)	32 (1.7)	1,893
High Income Tertile	1,416 (76.8)	401 (21.8)	27 (1.5)	1,844
Low Wealth Tertile	1,101 (67.7)	486 (29.9)	40 (2.5)	1,627
Mid Wealth Tertile	1,363 (72.3)	479 (25.4)	43 (2.3)	1,885
High Wealth Tertile	1,420 (74.0)	476 (24.8)	22 (1.2)	1,918

Note: Percents as row percents. All respondents begin study period with no functional limitation. Respondents are classified as "onset" if they develop a functional limitation between study waves and "death" if the respondent dies between study waves.

FUNCTIONAL LIMITATION ONSET BETWEEN 2003 AND 2012:

I then present the descriptive results showing what percentage of respondents with different characteristics in 2003 transition to each outcome in 2012. Only respondents with no functional limitation in 2003 are included and descriptive results for the 2003-2012 transitions are shown in **Table 6**. Between 2003 and 2012, 39.9% of respondents remained free of functional limitation, 42.1% experienced the onset of a functional limitation and 18.1% died. The results on covariates are similar to those found in descriptive results of transitions between the first two study waves. Respondents with lower education were more likely to transition from no functional limitation to some

functional limitation between 2003 and 2012 as well. Females and widows were also more likely to develop a functional limitation between the 2nd and 3rd study waves. For occupation, results were similar to the previous descriptive results with white collar workers having the lowest percent developing functional limitation. Gradients in income and wealth were not clear. The middle income and wealth tertiles had the highest likelihood of developing a functional limitation between waves although differences by income and wealth tertiles were very small.

Table 6 (Short): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2001 and 2003 (n=5,137).

	Remain N(%)	Onset N(%)	Death N(%)	Total N
No Education	340 (30.6)	535 (48.2)	235 (21.2)	1,110
1-5 Years	660 (36.2)	796 (43.7)	367 (20.1)	1,823
6 Years	461 (45.2)	409 (40.1)	151 (14.8)	1,021
7+ Years	589 (49.8)	420 (35.5)	174 (14.7)	1,183
Low Income Tertile	614 (37.1)	703 (42.5)	339 (20.5)	1,656
Mid Income Tertile	683 (38.8)	757 (43.0)	319 (18.1)	1,759
High Income Tertile	742 (43.6)	692 (40.7)	268 (15.8)	1,702
Low Wealth Tertile	556 (36.8)	633 (41.8)	324 (21.4)	1,513
Mid Wealth Tertile	727 (39.6)	781 (42.5)	330 (18.0)	1,838
High Wealth Tertile	761 (42.9)	743 (41.8)	272 (15.3)	1,776

Note: Percents as row percents. All respondents begin study period with no functional limitation. Respondents are classified as “onset” if they develop a functional limitation between study waves and “death” if the respondent dies between study waves.

MODEL BUILDING:

First, I begin by testing the independence of irrelevant alternatives assumption of the multinomial logit model (MNLM) of functional limitation onset with both the Small & Hsiao (Small and Hsiao 1985) and Hausman (Hausman and McFadden 1984) tests. While the Small & Hsiao test indicates no violation of the assumption, the Hausman test

indicates a strong violation ($p<0.001$). Although these tests often conflict (Long and Freese 2006), I decide to use the multinomial probit model (MNPM) to circumvent the independence of irrelevant alternatives assumption. It should be noted that throughout models, the estimates obtained through the MNLM and the MNPM do not differ substantially.

Second, I construct various measures of income and wealth to account for the presence of households with two spouses. Measures of household income include 1) individual income, 2) total couple income (the combined total of the income of each spouse), 3) average income within the couple (the combined total divided by 2), and 4) the couple income adjusted for economies of scale (the combined total divided by the square root of 2). A similar approach was taken for wealth. As the income and wealth variables described above were all highly skewed, different quantifications of household income measures were tested including tertiles, quintiles, deciles, and log-transformations. Following previous research (Nilsson et al. 2010), income and wealth deciles were treated as continuous variables. Log-transformations were executed using signed logarithms to allow for log-transformations of data including negative and zero values. This process involves taking the logarithm of the absolute value of income and wealth variables plus one (to preserve the value of zeros) and multiplying by the original signs of the observations to reintroduce the negative values. Each measure of household income and wealth with each quantification method was introduced independently to the MNPM of functional limitation onset and the log likelihood was examined to determine how each measure fit the data.

Within household income and wealth measures, the different quantification methods showed similar results and did not differ in terms of the sign of their coefficients. For this reason, I chose to use the income and wealth deciles (treated as continuous) to avoid fitting models with too many parameters. Of the above measures of household income and wealth, the average income and wealth within the household fit the data best in terms of log likelihood. The following MNPMs of functional limitation onset then use deciles of average income and wealth within the household as measures of financial resources. Their coefficients then represent changes in probabilities associated with an increase in income/wealth decile. This measure has the advantage of preserving degrees of freedom and also accounting for diminishing marginal returns of financial resources. For example, the health benefits of an increase from 0 to 1000 pesos a month are likely to be far larger than an increase from 10,000 to 11,000 pesos a month. Due to the skewed nature of income and wealth distributions, increases in deciles take far more financial resources towards the higher end of the spectrum.

REGRESSION RESULTS FOR FUNCTIONAL LIMITATION ONSET: FULL SAMPLE:

I begin my analyses of the relationship between educational attainment and the onset of functional limitation in the older population (not stratified by sex or birth cohort). The non-stratified results are shown below in **Table 7** (the in-text table shows only parameters for transitions from no functional limitation to functional limitation, the longer version of the table in the appendix shows mortality transitions as well as other covariates of interest). As my models are structured to detect how parameter estimates are affected by the addition of variables further down the causal pathway, I structure my models by stages of the life-course. My first model (Model 1) only includes respondent

characteristics that are determined at birth or in early life (educational attainment, age, and sex). I also include the binary variable indicating whether the observation represents a transition from 2001 to 2003 or from 2003 to 2012 as well as rural/urban. In Model 1, respondents reporting no formal education, incomplete elementary education, or complete elementary education had a higher likelihood of developing a functional limitation compared to those with beyond an elementary education. A dose-response effect is seen as the likelihood of developing a functional limitation declined with each increase in educational attainment. I then calculate the predicted probabilities. Compared to respondents with beyond an elementary education (probability of onset=0.28), respondents with no education, incomplete elementary education, and complete elementary education have functional limitation onset probabilities 0.11, 0.07 and 0.06 higher respectively. Respondents who were older or were female were also more likely to transition from no functional limitation to functional limitation. Rural/urban location was not associated with functional limitation onset.

In Model 2, I add variables that should occur between early life and the time of the survey and should theoretically precede chronic conditions including marital status, main occupation throughout the life-course, life-time smoking history, and current binge drinking. The inclusion of the midlife variables attenuates the association between educational attainment and functional limitation onset but educational attainment remains a significant predictor of functional limitation. In terms of predicted probabilities, compared to respondents with beyond elementary education (probability of onset=0.29), having no education, incomplete elementary education, or complete elementary education increases the probability of functional limitation onset by 0.11 0.07 and 0.05 respectively.

No significant differences were observed by occupation category suggesting that occupation does not mediate the relationship between educational attainment and functional limitation.

Table 7 (Short): Multinomial Probit Model of Functional Limitation Onset among Older Mexicans in the Mexican Health and Aging Study (n=10,567 Transitions among 7,405 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.45 (0.06)	***	0.42 (0.07)	***	0.31 (0.07)	***
1-5 Years	0.33 (0.05)	***	0.29 (0.06)	***	0.18 (0.06)	**
6 Years	0.22 (0.06)	***	0.19 (0.07)	**	0.09 (0.07)	
Income Decile					-0.01 (0.01)	
Wealth Decile					0.00 (0.01)	

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, sex, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

In the final model, Model 3, I add late life variables including chronic condition count, self-rated health, financial resources (income and wealth), as well as healthcare coverage. The addition of the late life variables further weakens the educational attainment functional limitation onset associations. However, having zero years of formal education and having incomplete elementary education remained statistically significant predictors of functional limitation onset. In terms of predicted probabilities, compared to respondents with beyond elementary education (probability of onset=0.30), having no education, incomplete elementary education or complete elementary education increases

the probability of functional limitation onset by 0.09 0.05 and 0.03 respectively. Respondents reporting more chronic conditions and lower self-rated health were more likely to experience a transition to functional limitation. The association between educational attainment and functional limitation onset was weakened by the inclusion of chronic conditions although educational attainment parameters remained statistically significant.

While the MNPM was designed to predict functional limitation onset, respondents are also able to transition from no functional limitation to death between waves. Parameters are estimated for the association between each covariate and death. While these estimates are biased by not accounting for the timing of mortality events, I provide a brief summary of major predictors of mortality between survey waves. Education was not associated with death between waves after accounting for midlife variables (marital status, occupation, and health behaviors). In Model 3, older age, having lost a spouse, being a current smoker, reporting more chronic conditions, lower self-rated health, as well as being in a lower decile of income and wealth were significant predictors of transitions from no functional limitation to death between survey waves.

REGRESSION RESULTS FOR FUNCTIONAL LIMITATION ONSET: MALES:

While there were no statistically significant interactions between educational attainment and sex (results not shown), I proceed with stratification by sex given the differing educational and economic experiences of women and men in Mexico to determine whether educational attainment is related to functional limitation onset in similar ways across sex. I begin by presenting results for males in **Table 8** (once again, please see appendix tables for other transitions and covariates). In the early life model,

Model 1, educational attainment-functional limitation onset associations were consistent with models including both males and females. Respondents with zero years of formal education, incomplete elementary education, or complete elementary education were significantly more likely to develop a functional limitation between survey waves than those with beyond an elementary education. A similar dose response effect is observed with the likelihood of developing a functional limitation declining with each increase in educational attainment category. In terms of predicted probabilities, compared to respondents with beyond elementary education (probability of onset=0.22), having no education, incomplete elementary education, or complete elementary education increases the probability of functional limitation onset by 0.12 0.07 and 0.06 respectively.

In Model 2, while the inclusion of midlife variables did not dramatically alter the coefficient estimates for educational attainment, the standard error of educational attainment coefficients increased. In the full model (Model 3), the inclusion of late life covariates somewhat attenuated the educational attainment-functional limitation onset associations. I then calculate the predicted probabilities. Compared to respondents with beyond elementary education (probability of onset=0.22), having no education, incomplete elementary education, or complete elementary education increases the probability of functional limitation onset by 0.11 0.06 and 0.05 respectively. The educational attainment-functional limitation onset associations were somewhat weakened by the inclusion of chronic conditions and self-rated health. Results were similar to those obtained from the full sample. Having no education or having incomplete elementary education compared to having beyond an elementary education were associated with functional limitation onset in the expected direction. Respondents who were older,

reported more chronic conditions, or lower self-rated health were more likely to develop a functional limitation between survey waves. For mortality: lower educational attainment, higher age, being a widower, being a current smoker, reporting more chronic conditions, and reporting lower self-rated health were associated with death between survey waves.

REGRESSION RESULTS FOR FUNCTIONAL LIMITATION ONSET: FEMALES:

I then repeat my analyses for females. Results for female respondents are shown in **Table 9**. In the early life model (Model 1), females with lower educational attainment (zero years of formal education, incomplete elementary education, or complete elementary education) are more likely to transition to functional limitation compared to those with greater than an elementary education. Similar to males, educational attainment shows a dose-response relationship with functional limitation onset with an increased likelihood of developing functional limitation with each decrease in educational attainment. In terms of predicted probabilities, compared to respondents with beyond elementary education (probability of onset=0.36), having no education, incomplete elementary education, or complete elementary education increases the probability of functional limitation onset by 0.10, 0.08 and 0.05 respectively. In the midlife model (Model 2), the educational attainment coefficients were attenuated and having a complete elementary education lost statistical significance. In the late life model (Model 3), the educational attainment coefficients were further attenuated with the inclusion of chronic conditions and self-rated health. Only respondents reporting zero years of formal education had a significantly higher likelihood of developing a functional limitation. In terms of predicted probabilities, compared to respondents with beyond elementary

education (probability of onset=0.39), having no education, incomplete elementary education or complete elementary education increases the probability of functional limitation onset by 0.06, 0.03 and 0.01 respectively. Statistically significant predictors of functional limitation onset in the full model included having no formal education, reporting more chronic conditions, and reporting lower self-rated health. Predictors of death between survey waves for females were relatively similar to males. Female respondents who were older, widows, had more chronic conditions, reported lower self rated health, or were in lower deciles of income and wealth were more likely to experience mortality between survey waves.

Table 8 (Short): Multinomial Probit Model of Functional Limitation Onset among Older Mexican Males in the Mexican Health and Aging Study (n=5,578 Transitions among 3,789 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.46 (0.09)	***	0.46 (0.10)	***	0.37 (0.10)	***
1-5 Years	0.28 (0.07)	***	0.28 (0.09)	**	0.20 (0.09)	*
6 Years	0.23 (0.08)	**	0.23 (0.09)	*	0.15 (0.09)	
Income Decile					-0.01 (0.01)	
Wealth Decile					0.00 (0.01)	

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

To facilitate interpretation of parameters, a summary table of results for education and the onset of functional limitation in the full sample and by sex is provided below in

Table 10. Estimates are shown in terms of predicted probabilities of functional limitation onset (in fully adjusted models) and also by interwave period. Given the longer follow-up time in the second interwave period (2003-2012), the predicted probabilities of functional limitation onset are larger in this period. Importantly, a similar educational gradient is observed when observing both the first (2001-2003) and second (2003-2012) interwave periods and among males and females.

Table 9 (Short): Multinomial Probit Model of Functional Limitation Onset among Older Mexican Females in the Mexican Health and Aging Study (n=4,989 Transitions among 3,616 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.46 (0.08)	***	0.37 (0.10)	***	0.23 (0.10)	*
1-5 Years	0.38 (0.08)	***	0.29 (0.09)	**	0.15 (0.10)	
6 Years	0.22 (0.08)	*	0.14 (0.10)		0.02 (0.10)	
Income Decile					-0.01 (0.01)	
Wealth Decile					0.00 (0.01)	

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

Table 10: Summary Table of Education and Functional Limitation Onset Results by Sex and Interwave Period. Results Presented as Adjusted Predicted Probabilities.

	All		**Males**		**Females**	
Years of Education	2001-2003	2003-2012	2001-2003	2003-2012	2001-2003	2003-2012
7+ Years	23.38%	36.46%	17.77%	26.56%	30.12%	48.19%
6 Years	26.45%	40.06%	22.10%	32.52%	31.31%	48.23%
1-5 Years	26.45%	43.24%	20.99%	35.02%	32.46%	52.47%
0 Years	29.64%	47.49%	25.92%	39.68%	34.06%	56.14%

Note: Source: Author's own calculation using the Mexican Health and Aging Study using multinomial probit models (reference outcome is remaining without functional limitation, mortality is included as an additional outcome, n=7,405). Model also adjusts for age, sex, rural/urban, marital status, occupation, smoking, binge drinking, chronic condition count, self-rated health, income, wealth, and health insurance.

Chapter 5: Income, Wealth and the Progression of Functional Limitation Results

FUNCTIONAL LIMITATION PROGRESSION BETWEEN 2001 AND 2003:

I begin by presenting descriptive results showing what percentage of respondents with different characteristic in 2001 transition to each outcome in 2003. Descriptive results for transitions between Wave 1 and 2 are shown in **Table 11** (full descriptive in appendix). All respondents have some level of functional limitation at 2001. Respondents can transition to four categories including improvement of functional limitation (48.7%), remaining with the same level of functional limitation (34.5%), worsening functional limitation (10.6%), and death (6.2%). A gradual decrease in the percent of respondents reporting worsening functional limitation was observed for each increase in educational attainment. The percent reporting worsening functional limitation also differed by sex with females more likely to report an worsening level of functional limitation. Respondents who were not married or reported lower self-rated health were also more likely to report a worsening of functionality. For both income and wealth, those in the highest tertiles reported the lowest percentage with a worsening in functionality. Interestingly, functional limitation did not differ substantially by type of occupation. The percent reporting mortality is larger in the sample followed for functional limitation progression than the sample followed for functional limitation onset because the progression sample only includes respondents who have some functional limitation at $time_t$ resulting in a less healthy sample.

Table 11 (Short): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2001 and 2003 (n=4,518).

	Improve N(%)	Remain N(%)	Progress N(%)	Death N(%)	Total N
No Education	590 (44.7)	440 (33.4)	174 (13.2)	115 (8.7)	1,319
1-5 Years	829 (47.9)	605 (55.0)	197 (11.4)	100 (5.8)	1,731
6 Years	411 (53.8)	248 (32.5)	63 (8.4)	41 (5.4)	764
7+ Years	369 (52.4)	267 (37.9)	42 (6.0)	26 (3.7)	704
Low Income Tertile	817 (46.2)	569 (34.3)	216 (12.2)	136 (7.7)	1,767
Mid Income Tertile	758 (49.1)	505 (34.6)	161 (10.4)	92 (6.0)	1,545
High Income Tertile	624 (51.7)	428 (35.5)	100 (8.3)	54 (4.5)	1,206
Low Wealth Tertile	754 (45.4)	569 (34.3)	205 (12.3)	133 (8.0)	1,661
Mid Wealth Tertile	791 (51.4)	505 (32.8)	159 (10.3)	84 (5.5)	1,539
High Wealth Tertile	654 (49.6)	486 (36.9)	113 (8.6)	65 (4.9)	1,318

Note: Percents as row percents. All respondents begin study period with some functional limitation. Respondents are classified as "improve" if they experience an improvement in functionality between waves, "remain" if they remain at same level of functional limitation between waves, "progress" if they experience functional deterioration between waves, and "death" if the respondent dies between study waves.

FUNCTIONAL LIMITATION PROGRESSION BETWEEN 2003 AND 2012:

I then present descriptive results showing the percentage of respondents with different characteristics in 2003 who transition to each outcome category in 2012. Descriptive results for transitions between Wave 2 and 3 are shown in **Table 12**. Between 2003 and 2012, among respondents with some level of functional limitation in 2003, 18.4% had improvement in their functional limitation, 27.4% remained with the same level of functional limitation, 19.0% experienced a worsening of their functional limitation, and 35.2% died. Respondents with beyond elementary education had the lowest percent with worsening functional limitation. Females were also more likely to report worsening functional limitation. The percent reporting worsening functional limitation did not differ substantially by marital status, occupation, or financial resources.

However, it should be noted that the percent reporting an increase in functional limitation is also influenced by the percent who die between survey waves and death is influenced by socioeconomic variables. For example, for income and wealth, respondents in the highest tertiles die less frequently and mortality is lower among those with higher educational attainment.

Table 12 (Short): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2003 and 2012 (n=3,630).

	Improve N(%)	Remain N(%)	Progress N(%)	Death N(%)	Total N
No Education	157 (14.3)	239 (21.8)	224 (20.4)	477 (43.4)	1,097
1-5 Years	270 (19.1)	405 (28.7)	270 (19.1)	467 (33.1)	1,412
6 Years	116 (19.2)	176 (29.2)	125 (20.7)	186 (30.9)	603
7+ Years	125 (24.1)	173 (33.4)	72 (13.9)	148 (28.6)	518
Low Income Tertile	218 (15.3)	347 (24.3)	284 (19.9)	578 (40.5)	1,427
Mid Income Tertile	253 (20.6)	330 (26.8)	238 (19.4)	409 (33.3)	1,230
High Income Tertile	191 (20.1)	309 (32.6)	165 (17.4)	284 (29.9)	949
Low Wealth Tertile	233 (17.2)	312 (23.1)	231 (17.1)	577 (42.7)	1,353
Mid Wealth Tertile	237 (20.0)	325 (27.4)	246 (20.7)	380 (32.0)	1,188
High Wealth Tertile	195 (18.1)	354 (32.8)	212 (19.7)	318 (29.5)	1,079

Note: Percents as row percents. All respondents begin study period with some functional limitation. Respondents are classified as “improve” if they experience an improvement in functionality between waves, “remain” if they remain at same level of functional limitation between waves, “progress” if they experience functional deterioration between waves, and “death” if the respondent dies between study waves.

MODEL BUILDING:

I begin by testing the independence of irrelevant alternatives assumption of the multinomial logit model (MNLM) of functional limitation progression with both the Small & Hsiao (Small and Hsiao 1985) and Hausman (Hausman and McFadden 1984) tests. Similar to the models of functional limitation onset, the Small & Hsiao test indicates no violation of the IIA assumption while the Hausman test indicated a strong

violation of the IIA assumption. I then chose in favor of the multinomial probit model to relax the IIA assumption and to maintain methodological comparability with the functional limitation onset MNPM. Throughout my analyses, however, the results of the MNPM are similar to the results of the MNLM.

The process through which I construct the income and wealth variables did not differ from the method described in Chapter 3. I utilize deciles of household income and wealth variables and examine model fit using log likelihood to determine the best household income and wealth measures for the progression of functional limitation. For models of progression, average income within the couple was the best measure of household income while total couple wealth was the best measure of wealth.

REGRESSION RESULTS FOR INCOME AND FUNCTIONAL LIMITATION PROGRESSION: FULL SAMPLE:

I begin my analysis of the relationship between financial resources and the progression of functional limitation in the older population (not stratified by sex or birth cohort) using only income. I choose to analyze the relationship between wealth and functional limitation progression in a separate model as income and wealth are correlated. The reference outcome category for analyses of functional limitation progression is remaining with the same level of functional limitation. For the full sample, the first panel of **Table 13** in the appendix shows the probit regression coefficients for improvement of functional limitation, the second panel shows the probit regression coefficients for having an increase in functional limitation while the third panel shows the probit regression coefficients for dying between survey waves. Please note that only the panel for worsening functional limitation is shown in the text while the panels for other transitions are only shown in the appendix table.

In Model 1, I include income as well as basic demographic control variables (age, sex, rural/urban, and marital status) and exclude other socioeconomic variables and health covariates. Before adjusting for education, higher income is associated with a lower probability of worsening functional limitation. However, after adding education in Model 2, the probability of worsening functional limitation does not differ by income level. Lower educational attainment was a significant predictor of worsening functional limitation. In terms of predicted probabilities, compared to respondents with beyond elementary education (probability of worsening functional limitation=0.09), having no education, incomplete elementary education, or complete elementary education increased the probability of increasing functional limitation by 0.07, 0.05, and 0.05 respectively.

Table 13 (Short): Multinomial Probit Model of Worsening Functional Limitation and Income among Older Mexicans in the Mexican Health and Aging Study (n=8,148 Transitions among 6,072 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years			0.50 (0.09)	***	0.48 (0.10)	***
1-5 Years			0.35 (0.08)	***	0.35 (0.10)	***
6 Years			0.36 (0.09)	***	0.36 (0.10)	***
Income Decile	-0.02 (0.01)	*	-0.01 (0.01)		-0.01 (0.01)	

Note: Reference outcome is remaining at same level of functional limitation, mortality and improvement are included as additional outcomes. Model 1 accounts for age, rural/urban, interwave period and marital and ADL status, Model 2 adds education, Model 3 adds marital status, occupation, smoking and binge drinking, chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

In the full model, Model 3, all covariates are added (occupation, health behaviors, chronic conditions, self-rated health, and health insurance). Lower education remained a significant predictor of worsening functional limitation. In terms of predicted probabilities, compared to respondents with beyond elementary education (probability of worsening functional limitation=0.09), having no education, incomplete elementary education, or complete elementary education increased the probability of increasing functional limitation by 0.07, 0.06, and 0.05 respectively. Higher age, being a current versus never smoker, reporting more chronic conditions, and lower self-rated health were associated with a higher probability of worsening functional limitation between waves in the full model.

In addition to experiencing increases in functional limitation, respondents were also able to have improvements in physical functioning or die between survey waves. Focusing on the first panel of **Table 13** respondents who were younger and male were more likely to improve in physical functioning while respondents who reported more chronic conditions or lower self-rated health were less likely to improve. Two counter-intuitive results are seen: respondents who were current smokers or uninsured were more likely to improve. However, these results do not suggest that one should take up smoking or withdraw from health insurance. Respondents who are current smokers may be those who are healthy enough to smoke while those who obtain healthcare coverage may do so as a result of a medical problem. Results for mortality are shown in the third panel of **Table 13**. In the full model, Model 3, respondents with no education compared to those with beyond an elementary education are more likely die between waves. Higher age, being male, not being married, being a current smoker, reporting more chronic

conditions, lower self-rated health, and lower income are associated with a higher probability of mortality between waves. Once again, it should be noted that mortality estimates do not take into account the timing of death between survey waves.

REGRESSION RESULTS FOR WEALTH AND FUNCTIONAL LIMITATION PROGRESSION: FULL SAMPLE:

I then shift my attention to wealth. Similar to the analysis of income and functional limitation progression, the first panel of **Table 14** shows the probit regression coefficients for improvement of functional limitation, the second panel shows the probit regression coefficients for having an increase in functional limitation while the third panel shows the probit regression coefficients for dying between survey waves. In Model 1, being in a higher wealth decile was associated with a better trajectory of deterioration between waves. However, after adjusting for educational attainment in Model 2, the wealth parameter was no longer statistically significant. Once again, lower educational attainment was associated with steeper functional deterioration. In the full wealth model, the statistically significant parameters in the model for functional deterioration, functional improvement, and death were similar to those in analyses of income and functional limitation progression.

INCOME, WEALTH AND FUNCTIONAL LIMITATION PROGRESSION: SEX STRATIFICATION:

I begin my analyses of the association between financial resources and functional limitation progression by predicting functional limitation progression with only income or wealth and basic demographic control variables (age, sex, rural/urban, and marital status) (results not shown). Before adjusting for education, lower income but not wealth was associated with worsening functional limitation among men. For females, lower wealth but not income was associated with worsening functional limitation. After

adjusting for education, neither income nor wealth were significant in predicting worsening functional limitation for males or females.

Table 14 (Short): Multinomial Probit Model of Worsening Functional Limitation and Wealth among Older Mexicans in the Mexican Health and Aging Study (n=8,148 Transitions among 6,072 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years			0.48 (0.09)	***	0.46 (0.10)	***
1-5 Years			0.34 (0.08)	***	0.34 (0.10)	***
6 Years			0.36 (0.09)	***	0.36 (0.10)	***
Wealth Decile	-0.03 (0.01)	*	-0.02 (0.01)		-0.01 (0.01)	

Note: Reference outcome is remaining at same level of functional limitation, mortality and improvement are included as additional outcomes. Model 1 accounts for age, rural/urban, interwave period and marital and ADL status, Model 2 adds education, Model 3 adds marital status, occupation, smoking and binge drinking, chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

Regression results for males are shown in **Table 15**. As financial resources were not significant predictors of worsening functional limitation after adjusting for education and education seemed to play an important role in functional limitation progression, I then model functional limitation progression using educational attainment, age, and rural/urban location for an early life model among men (Model 1). In Model 1, those with lower educational attainment were more likely to experience functional deterioration between waves. In Model 2, I add the midlife covariates including marital status, occupation, and health behaviors. After including these covariates, the educational attainment-functional deterioration associations were attenuated and having zero years of formal education compared to having beyond an elementary education lost significance

while the other educational attainment categories remained significant. This suggests that education may partly impact the progression of functional limitation through health behaviors. In the late life model (Model 3), educational attainment was no longer significant in predicting worsening functional limitation. Being a current smoker, and having poor self-rated health at the start of the interwave period (compared to good) were associated with worsening functional limitation among men. Predictors of mortality by the end of the interwave period in the full model included higher age, being a widower, being a current smoker, having more chronic conditions, reporting poor self-rated health, and having lower levels of income and wealth.

Table 15 (Short): Multinomial Probit Model of Worsening Functional Limitation among Older Mexican Males in the Mexican Health and Aging Study (n=2,860 Transitions among 2,227 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.33 (0.15)	*	0.31 (0.17)		0.19 (0.17)	
1-5 Years	0.34 (0.14)	*	0.32 (0.16)	*	0.24 (0.16)	
6 Years	0.35 (0.16)	*	0.33 (0.17)	*	0.24 (0.17)	
Income Decile					-0.03 (0.02)	
Wealth Decile					-0.02 (0.02)	

Note: Reference outcome is remaining at same level of functional limitation, mortality and improvement are included as additional outcomes. Model 1 accounts for age, rural/urban, interwave period, and ADL status, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

Regression results for females are shown in **Table 16**.The results for women were quite different from the results for men. In the early life model, women with lower educational attainment were more likely to experience a decline in functionality between

waves. However, after adding the midlife covariates in Model 2, the educational attainment parameters remain statistically significant. Even after accounting for the late life covariates in Model 3, having zero years of formal education, having incomplete elementary education, and having complete elementary education compared to those with beyond elementary education remained statistically significant predictors of worsening functional limitation. In the full model, women with lower educational attainment, who were older, reported more chronic conditions, or reported poor self-rated health were more likely to deteriorate between waves. Significant predictors of death in the full model included having no education, being older, being divorced or separated, being a current smoker, and reporting more chronic conditions. Respondents who were younger, reported fewer chronic conditions, or better self-rated health at the beginning of each interwave period were more likely to experience an improvement in physical functioning between study waves.

Again, to facilitate interpretation of parameters, a summary table of results for education and the probability of functional deterioration in the full sample and by sex is provided below in **Table 17**. Estimates are shown in terms of predicted probabilities of functional deterioration (in fully adjusted models) and also by interwave period. Again, given the longer follow-up time in the second interwave period (2003-2012), the predicted probabilities of functional deterioration are larger in this period. Importantly, education-functional deterioration associations are similar whether observing the 2001-2003 transitions or the 2003-2012 transitions.

Table 16 (Short): Multinomial Probit Model of Worsening Functional Limitation among Older Mexican Females in the Mexican Health and Aging Study (n=5,288 Transitions among 3,845 Respondents)

	Model 1		Model 2		Model 3	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.59 (0.11)	***	0.67 (0.13)	***	0.61 (0.13)	***
1-5 Years	0.38 (0.10)	***	0.45 (0.12)	***	0.42 (0.13)	**
6 Years	0.37 (0.11)	**	0.44 (0.13)	**	0.42 (0.13)	**
Income Decile					-0.01 (0.02)	
Wealth Decile					-0.01 (0.02)	

Note: Reference outcome is remaining at same level of functional limitation, mortality and improvement are included as additional outcomes. Model 1 accounts for age, rural/urban, interwave period, and ADL status, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

Table 17: Summary Table of Education and Functional Limitation Progression Results by Sex and Interwave Period. Results Presented as Adjusted Predicted Probabilities.

	All		Males		Females	
Years of Education	2001-2003	2003-2012	2001-2003	2003-2012	2001-2003	2003-2012
7+ Years	6.22%	13.06%	5.42%	12.37%	6.79%	13.49%
6 Years	9.21%	19.45%	9.18%	14.40%	9.17%	23.17%
1-5 Years	11.41%	19.41%	10.95%	14.55%	11.63%	21.94%
0 Years	12.35%	21.23%	9.40%	15.14%	13.64%	24.31%

Note: Source: Author's own calculation using the Mexican Health and Aging Study using multinomial probit models (reference outcome is remaining same level of functional limitation, mortality, and functional limitation improvement are included as an additional outcome, n=7,405). Model also adjusts for age, sex, rural/urban, marital status, occupation, smoking, binge drinking, ADL status, chronic condition count, self-rated health, income, wealth and health insurance.

Chapter 5: Cohort Stratification and Sensitivity Analyses Results

EDUCATION AND THE ONSET OF FUNCTIONAL LIMITATION: THE YOUNGER COHORT:

To examine whether the associations between socioeconomic variables and functional limitation differed by subsequent birth cohort, I stratify the sample by birth cohort. Significant education-functional limitation onset interactions by birth cohort were observed. I begin by focusing on the younger cohort (aged 50-59 at baseline). Results for this later birth cohort are shown in **Table 18**. In Model 1, respondents with lower education had a higher probability of developing a functional limitation between waves even after accounting for age, sex, and whether the respondent lived in a rural area. In the midlife model (Model 2), I add marital status, occupation, and health behaviors (smoking and binge drinking). The parameter estimates for educational attainment remain significant and relatively unaffected by the inclusion of these variables. Self-rated health, economic variables, and insurance status are added to the full model (Model 3). Respondents with zero years of formal education or incomplete elementary education compared to those with beyond an elementary education are more likely to develop a functional limitation between waves. Additional predictors of functional limitation onset included higher age, being female, reporting a greater number of chronic conditions and lower self-rated health ratings.

Educational attainment was not clearly associated with mortality. In Model 1, respondents with zero years of formal education or incomplete elementary education compared to respondents with greater than an elementary education were more likely to die between waves. However, the parameter estimates are reversed in the final model accounting for self-rated health, financial resources, and health insurance. This is similar

to the results reported in previous studies (Herd et al. 2007) and is likely the result of surprisingly similar survival given an unfavorable self-rating of health among the lower educated.

Table 18 (Short): Multinomial Probit Model of Functional Limitation Onset among Older Mexicans in the Mexican Health and Aging Study (n=6,353 Transitions among 4,326 Respondents) The Younger Cohort

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.45 (0.06)	***	0.46 (0.09)	***	0.31 (0.07)	***
1-5 Years	0.33 (0.05)	***	0.33 (0.08)	***	0.18 (0.06)	**
6 Years	0.22 (0.06)	***	0.21 (0.08)	**	0.09 (0.07)	
Income Decile					-0.01 (0.01)	
Wealth Decile					0.00 (0.01)	

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

EDUCATION AND THE ONSET OF FUNCTIONAL LIMITATION: THE OLDER COHORT:

Overall, the older cohort (aged 60+ at baseline) exhibits weaker educational gradients for the onset of functional limitation. Regression results for the earlier birth cohort are shown in **Table 19**. In Model 1, respondents who report zero years of formal education compared to those with beyond an elementary education were significantly more likely to report the onset of a functional limitation between survey waves. Marital status, occupation, and health behaviors are then added to Model 2. After including these variables, the parameter estimates for having no education remained statistically

significant and the estimate for incomplete elementary education became statistically significant. In the full model, Model 3, educational attainment parameters were attenuated to statistical non-significance with the inclusion of chronic conditions and self-rated health variables.

Table 19 (Short): Multinomial Probit Model of Functional Limitation Onset among Older Mexicans in the Mexican Health and Aging Study (n=4,214 Transitions among 3,079 Respondents) The Older Cohort

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.28 (0.10)	**	0.36 (0.12)	**	0.22 (0.12)	
1-5 Years	0.14 (0.09)		0.22 (0.11)	*	0.10 (0.11)	
6 Years	0.04 (0.10)		0.12 (0.12)		0.03 (0.12)	
Income Decile					-0.01 (0.01)	
Wealth Decile					-0.00 (0.01)	

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

Two counter-intuitive results emerge in Model 3. Respondents who were divorced/separated/other compared to married respondents were less likely to develop a functional limitation between waves. Additionally, respondents who were missing for occupation compared to respondents who primarily worked a white collar job throughout the life-course were less likely to experience functional limitation onset. These results may be explained by selective survival. Respondents must survive to age 60+ to be analyzed in the older cohort. It may be that respondents who were divorced or separated

or who were missing on occupation may have had higher likelihood of mortality prior to the study, thus leaving only the healthiest of their groups to participate in the study and resulting in a biased estimate.

FINANCIAL RESOURCES AND THE PROGRESSION OF FUNCTIONAL LIMITATION: THE YOUNGER COHORT:

While there were not statistically significant interactions between educational attainment and birth cohort in the case of functional limitation progression, a significant interaction between wealth and birth cohort was found. For this reason, I decide to stratify my analyses by birth cohort. To begin, I examined, among the younger cohort, educational adjusted parameters for income and wealth individually and found that neither measure of financial resources were associated with the probability of functional deterioration after accounting for education. For this reason, financial resource parameters are included together and I structure my models into stages of the life-course. The results for the younger sample are shown in **Table 20.**

As a whole, the results from the younger cohort appear to reflect those obtained from the full sample. Throughout each model, lower educational attainment was associated with a higher probability experiencing functional decline between waves. Interestingly the addition of mid-life (in Model 2) or late-life (in Model 3) covariates did not seem to weaken the parameter estimates for educational attainment significantly. Neither income nor wealth were associated with functional limitation progression. However, self-reported health predicted the likelihood of functional improvement and deterioration in the expected directions.

Table 20 (Short): Multinomial Probit Model of Worsening Functional Limitation among Older Mexicans in the Mexican Health and Aging Study (The Younger Cohort n=3,385 Transitions among 2,583 Respondents)

	Model 1		Model 2		Model 3	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.55 (0.13)	***	0.67 (0.15)	***	0.59 (0.16)	***
1-5 Years	0.37 (0.12)	**	0.49 (0.14)	***	0.45 (0.14)	**
6 Years	0.34 (0.13)	**	0.43 (0.14)	**	0.38 (0.14)	**
Income Decile					0.01 (0.02)	
Wealth Decile					0.00 (0.02)	

Note: Reference outcome is remaining at same level of functional limitation, mortality and improvement are included as additional outcomes. Model 1 accounts for age, rural/urban, interwave period, and ADL status, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

FINANCIAL RESOURCES AND THE PROGRESSION OF FUNCTIONAL LIMITATION: THE OLDER COHORT:

Regression results for the older cohort are shown in **Table 21.** To begin my analyses for the older cohort, I examined educational attainment adjusted parameters for financial resources and found being in a higher decile of wealth but not income to be associated with a lower probability of experiencing a worsening functional limitation between waves. For this reason, I included the parameter for wealth in every model to determine if other variables throughout the models weaken the association between wealth and functional limitation progression. Among the older cohort, lower educational attainment seemed to play an important role in predicting the probability of deteriorating between survey waves. Chronic conditions and self-rated health were associated with improvements and declines in functionality in the expected directions. Interestingly,

being in a higher decile of wealth was associated with less functional deterioration between waves in the older birth cohort. This effect remained statistically significant even in fully adjusted models. However, lower educational attainment seemed to be a more important indicator of functional deterioration over follow up.

Table 21 (Short): Multinomial Probit Model of Worsening Functional Limitation among Older Mexicans in the Mexican Health and Aging Study (The Older Cohort n=4,763 Transitions among 3,489 Respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.44 (0.12)	***	0.41 (0.14)	**	0.38 (0.15)	**
1-5 Years	0.32 (0.12)	**	0.29 (0.14)	*	0.27 (0.14)	*
6 Years	0.38 (0.12)	**	0.36 (0.15)	*	0.34 (0.15)	*
Wealth Decile	-0.03 (0.01)	*	-0.03 (0.01)	*	-0.02 (0.01)	*

Note: Reference outcome is remaining at same level of functional limitation, mortality and improvement are included as additional outcomes. Model 1 accounts for age, rural/urban, interwave period, and ADL status, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

SENSITIVITY ANALYSES: RETURNS TO EDUCATION AND FINANCIAL RESOURCES BY RURAL AND URBAN AREAS:

Previous research has suggested that socioeconomic position may be associated with health in different ways in rural versus urban areas in Mexico (Smith and Goldman 2007). In particular, socioeconomic health gradients may be weaker in rural areas. This may be for a variety of reasons. For example, resources in rural areas including healthcare and employment may be more scarce. With restricted availability of employment and healthcare options, older adults with higher education may not be able to generate health returns to education due to an insufficient supply of health producing

resources. That is, health promoting resources may be insufficient for everyone, regardless of socioeconomic position (Smith and Goldman 2007). For this reason, I decide to stratify my results by rural/urban location to test whether my results are consistent across context or are sensitive to these model specifications.

Table 22: Multinomial Probit Model of Functional Limitation Onset among Older Mexicans in Urban Areas in the Mexican Health and Aging Study (n=6,917 transitions among 4,832 respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**β (SE)**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.54 (0.08)	***	0.52 (0.08)	***	0.39 (0.09)	***
1-5 Years	0.41 (0.06)	***	0.38 (0.07)	***	0.26 (0.07)	**
6 Years	0.26 (0.06)	***	0.23 (0.07)	**	0.13 (0.07)	
Income Decile					-0.02 (0.01)	+
Wealth Decile					0.01 (0.01)	

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

To examine differences in socioeconomic gradients by rural/urban locations, I repeat analyses separately for rural and urban areas. This is shown above in **Table 22** in which I consider the case of functional limitation onset in the urban dwelling sample. In Model 1, lower educational attainment is associated with a higher probability of developing a functional limitation between waves when adjusting for only age and sex. The association between lower educational attainment and functional limitation onset remained significant even after accounting for mid-life covariates in Model 2 including

marital status, occupation, and health behaviors (smoking and binge drinking). In the full model, Model 3, I add late-life covariates including self-rated health, chronic condition count, income, wealth, and health insurance. Increasing deciles of income are marginally significantly associated with lower probability of functional limitation onset between waves. While the association between lower educational attainment and functional limitation is somewhat attenuated, having no education or incomplete elementary education compared to having beyond an elementary education remain associated with a higher probability of developing a functional limitation. The results for the urban sample somewhat echo those observed in the full sample.

Table 23: Multinomial Probit Model of Functional Limitation Onset among Older Mexicans in Rural Areas in the Mexican Health and Aging Study (n=3,650 transitions among 2,573 respondents)

	Model 1		**Model 2**		**Model 3**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years	0.10 (0.13)		0.05 (0.15)		-0.04 (0.15)	
1-5 Years	-0.02 (0.12)		-0.07 (0.15)		-0.15 (0.15)	
6 Years	-0.07 (0.14)		-0.11 (0.16)		-0.15 (0.16)	
Income Decile					-0.00 (0.01)	
Wealth Decile					-0.02 (0.01)	+

Note: Reference outcome is remaining without functional limitation, mortality is included as an additional outcome. Model 1 accounts for age, rural/urban and interwave period, Model 2 adds marital status, occupation, smoking and binge drinking, Model 3 adds chronic condition count, self-rated health, income, wealth, and health insurance. All variables are time-varying.

I then focus my attention to the rural sample above in **Table 23.** Age-sex adjusted probabilities of functional limitation onset did not differ by level of education in rural

areas in Model 1. The inclusion of mid-life covariates in Model 2 does not substantially impact the parameter estimates for educational attainment. In the final Model, Model 3, educational attainment was not associated with the onset of a functional limitation. Interestingly, while being in a higher decile of income was marginally significantly associated with lower odds of functional limitation in the urban sample, being in a higher decile of *wealth* was marginally significantly associated with lower odds of functional limitation onset in the rural sample.

Table 24: Multinomial Probit Model of Functional Limitation Progression among Older Mexicans in Rural Areas in the Mexican Health and Aging Study (n=2,836 transitions among 2,117 respondents)

	Model 1		**Model 2**		**Model 3**		**Model 4**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years			0.50 (0.21)	*			0.47 (0.20)	*
1-5 Years			0.30 (0.20)				0.28 (0.21)	
6 Years			0.35 (0.22)				0.35 (0.22)	
Income Decile	-0.01 (0.02)		-0.01 (0.02)					
Wealth Decile					-0.04 (0.02)	*	-0.03 (.02)	*

Note: Reference outcome is remaining without same level of functional limitation, mortality and improvement in functional limitation are included as additional outcomes. Models 1 and 3 adjust for age, sex, and interwave period. Models 2 and 4 add educational attainment. All variables are time-varying.

I then consider the case of functional limitation progression. Indeed, the resources available to counteract functional limitation including rehabilitation are likely to differ

across rural and urban contexts. I employ an approach similar to the sensitivity analyses for functional limitation onset by stratifying my analyses by rural/urban context. I present the results above in **Table 24.** Models 1-4 represent the sample residing in rural areas. Models 1-2 demonstrate the association between income and having a worsening functional limitation (adjusting for age and sex) with and without adjustment for education. Increasing income decile was not associated with declines in functionality between waves in Model 1, this association remains non-significant when adjusted for educational attainment in Model 2. Compared to the full sample, educational attainment seems to have a weaker association with the probability of having a worsening functional limitation between waves. In rural areas, only respondents with the very lowest levels of education (zero years of formal education) show significantly elevated probability of having a worsening functional limitation. Models 3-4 demonstrate the association between wealth and having a worsening functional limitation between waves (adjusting for age and sex) with and without adjustment for educational attainment. In Model 3, higher levels of wealth are associated with a lower probability of experiencing functional deterioration. This association remains statistically significant even after adjusting for educational attainment in Model 4 but loses significance after including all covariates (results not shown).

I then repeat the analyses for respondents residing in urban areas and obtained results that were similar to those from the full cohort. In urban areas, respondents with lower education were significantly more likely to experience the worsening of a functional limitation between waves. Neither income nor wealth were associated with

further disablement after accounting for educational attainment. Results for urban areas are shown below in **Table 25.**

Table 25: Multinomial Probit Model of Functional Limitation Progression among Older Mexicans in Urban Areas in the Mexican Health and Aging Study (n=5,312 transitions among 3,955 respondents)

	Model 1		**Model 2**		**Model 3**		**Model 4**	
Education (Ref=7+ Years)	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**	**β (SE)**	**p**
0 Years			0.47 (0.10)	***			0.47 (0.10)	***
1-5 Years			0.36 (0.10)	***			0.36 (0.09)	***
6 Years			0.34 (0.11)	**			0.34 (0.10)	**
Income Decile	-0.02 (0.01)	*	-0.01 (0.01)					
Wealth Decile					-0.02 (0.01)	*	-0.01 (0.01)	

Note: Reference outcome is remaining without same level of functional limitation, mortality and improvement in functional limitation are included as additional outcomes. Models 1 and 3 adjust for age, sex, and interwave period. Models 2 and 4 add educational attainment. All variables are time-varying.

FURTHER SENSITIVITY ANALYSES: SOCIOECONOMIC INTERACTIONS:

As socioeconomic variables throughout the life-course are often correlated, it is sometimes difficult to interpret the parameter of one socioeconomic measure when controlling for others. Throughout the analyses, educational attainment often appears to play a larger role in predicting functional limitation onset and progression between waves. To address the issue of the correlation of socioeconomic measures I address two interactions; 1) education and income and 2) education and wealth. In doing so, I reduce

the variation in each measure of financial resources and examine the effect of educational attainment at each level of the income and wealth distributions (here, stratified by tertiles). If education matters beyond its correlation with income and wealth we would expect educational gradients at all levels of the income and wealth spectrums (i.e. Are those with high education still *advantaged* even when they have low income/wealth? Are those with low education still *disadvantaged* even when they have high income/wealth?) Each interaction was not significant suggesting that educational attainment impacts functional limitation onset and progression at all levels of the income and wealth distributions. The results are presented in terms of predicted probabilities in fully adjusted models. First, I present the predicted probabilities of functional limitation onset by educational attainment and income level in **Figure 4** while I present the predicted probabilities of functional deterioration by educational attainment and income level in **Figure 5**. As the results throughout the analysis have been in terms of probit regression coefficients which have little interpretation beyond direction and statistical significance, the results here are reported in terms of probabilities to facilitate interpretation. I only present the stratification by income as stratifications by wealth revealed similar results.

Figure 4: Predicted Probabilities of Functional Limitation Onset

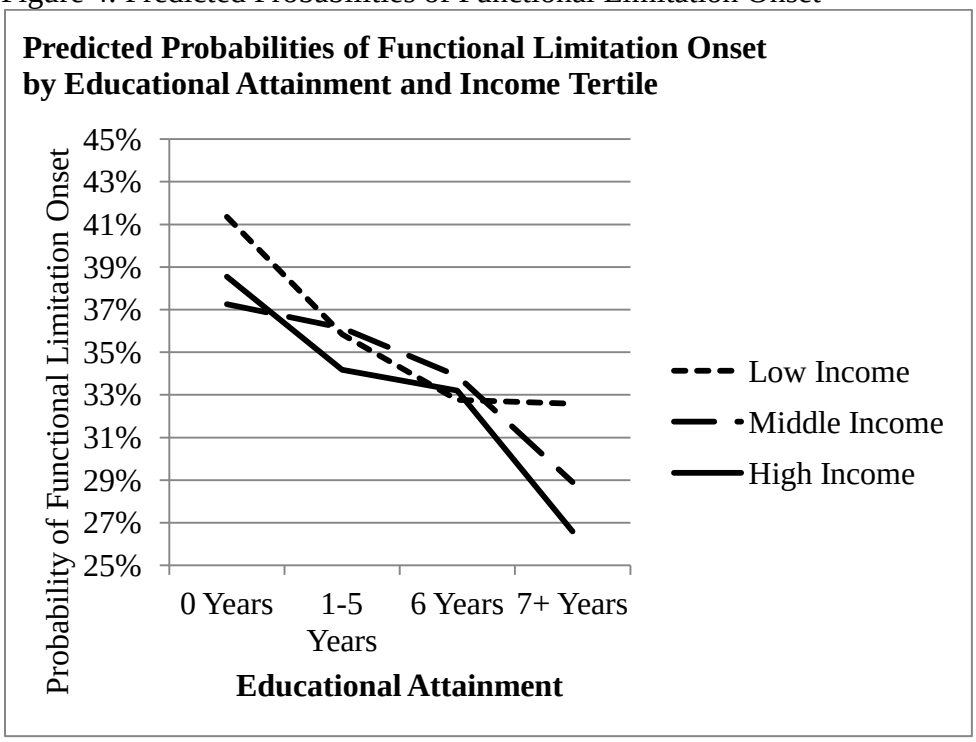
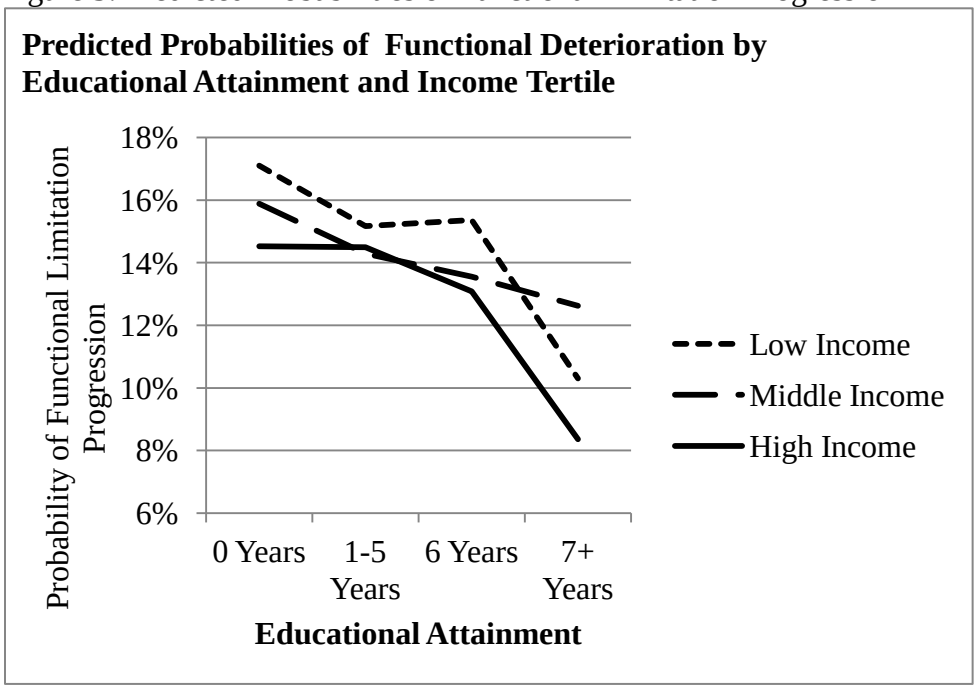


Figure 5: Predicted Probabilities of Functional Limitation Progression



Chapter 6: Functional Limitation Onset Conclusions

EDUCATION AND THE ONSET OF FUNCTIONAL LIMITATION:

In reference to my first aim, I hypothesized that the lower educated would have a higher likelihood of experiencing the onset of a functional limitation over the course of the 11-year follow up. The results suggested support for this hypothesis as respondents with lower education were considerably more likely to develop functional limitations over follow-up. The results echo previous work in developed countries that has suggested educational gradients in the onset of functional limitation (Grundy and Glaser 2000; Herd et al. 2007; Taylor 2010; Zimmer and House 2003). However, the current study extended this framework to the context of an aging population in a developing country and found comparability. From a theoretical standpoint, it seems that the risk of functional limitation begins early in life in a developing country such as Mexico. As suggested by previous research, education is determined early in the life-course and shapes exposures to disability promoting conditions throughout life (Herd et al. 2007; Zimmer and House 2003). Further, the association between low education and functional limitation onset was present across sex as well as birth cohorts but seemed to be restricted to urban areas.

While I hypothesized that occupation, health behaviors and chronic conditions, would be important in connecting educational attainment to functional limitation, only partial support was found. The inclusion of occupation, health behaviors, and chronic conditions resulted in a weakening of the educational attainment-functional limitation associations. However, this association remained significant across sex even after including all proposed mediators. These results are not surprising. Through a fundamental cause theory perspective, too much focus is given to proposed mediators

connecting socioeconomic conditions to health. The classic example of fundamental cause theory describes how, in the early 1900s, the association between lower socioeconomic standing and ill-health seemed to be explained by unfavorable living conditions and poor sanitation among the poor. It then seemed reasonable to assume that population wide improvements in sanitation and vaccination efforts would eliminate the association between lower socioeconomic standing and ill-health. However, socioeconomic gradients remain for many forms of ill-health. The reason for the persistent association between lower socioeconomic position and ill-health is that SES is flexible and represents access to a broad array of resources which may be used to produce health allowing the risk factors for ill-health to change over time from sanitation to lifestyle factors such as smoking, physical activity, and diet (Link and Phelan 1995). For the current analysis, the manner in which education influences functional limitation onset may be far too complex to be captured by occupation, health behaviors, and chronic conditions as education represents access to such a broad array of resources.

The relative unimportance of occupational history for the onset of functional limitation in old age may be the result of limitations of the measure. Analyzing the main occupation the respondent worked throughout the life-course may not capture the full range of work in which the study participants were engaged in the formal and informal labor sectors. Participants may have worked many jobs for varying lengths of time. For this reason, measuring occupation for older adults is often difficult and uncertain in old age (Grundy and Holt 2001). Further, the classification of occupations into blue and white collar jobs may not fully capture the disabling aspects of certain occupation as considerable heterogeneity may exist within occupation categories.

INCOME, WEALTH AND THE ONSET OF FUNCTIONAL LIMITATION:

While the lower educated seem to have a higher likelihood of developing functional limitation in late-life in Mexico, this socioeconomic risk did not seem to extend to income and wealth disadvantage. While previous work has found higher levels of income to have a significant impact on the likelihood of developing functional limitations (Taylor 2010) in the United States, income was not associated with the onset of functional limitation in Mexico after adjusting for educational attainment. Previous research in developing countries has suggested that individuals may not realize the same health returns to financial resources in developing countries. Especially in early stages of economic development, socioeconomic gradients may be weaker or even reversed in developing countries. In the case of obesity, greater financial resources may reflect an individual's ability to afford a sedentary lifestyle, calorie rich processed foods and harmful health behaviors such as smoking (Sobal and Stunkard 1989). In this way, the association between income and functional limitation may be weakened by health returns to income that may have been reversed in earlier stages of economic development.

Income may also impact the onset of functional limitation through healthcare access in developed countries. However, this may not necessarily be the case in the context of Mexico. In earlier stages of economic development and especially in rural areas of Mexico, healthcare supply and quality may be poor for everyone. In this case, higher income or greater financial resources may not provide the same returns to health as one would expect in urban areas or developed countries. That is, income and wealth gradients in Mexico may be have been weakened by a lack of healthcare options across

the socioeconomic spectrum in earlier stages of development and especially in rural areas.

Further, the relative unimportance of financial resources in the onset of functional limitation in Mexico may be explained through *Seguro Popular*. Mexico enacted a voluntary public health insurance program, *Seguro Popular*, in 2003 which provides free healthcare services to the bottom four income deciles if not otherwise insured (Bosch et al. 2012). Much of the functional limitation onset occurred between the 2003 and 2012 waves of the study when low income respondents may have enrolled in healthcare through *Seguro Popular.* Promising results have been observed in evaluations of *Seguro Popular*. Among diabetics, those with *Seguro Popular* are more likely to have their blood glucose levels under control than uninsured diabetics (Sosa-Rubí, Galárraga, and López-Ridaura 2009). A similar study was conducted examining hypertension treatment and control which found hypertensive adults who were enrolled in *Seguro Popular* to be more likely to be taking medication for their hypertension and to have blood pressure under control than uninsured hypertensive adults (Bleich et al. 2007). While financial resources did not predict functional limitation onset in the context of Mexico, lower income is associated with functional limitation onset in the United States (Taylor 2010). These conflicting results may be because the United States did not enact public healthcare until more recently. It may be that, in the context of Mexico, *Seguro Popular* has acted to reduce the income-functional limitation onset associations.

In my analyses, I was unable to directly test whether *Seguro Popular* reduced the probability of functional limitation onset because I could not determine whether reported enrollment in *Seguro Popular* preceded the onset of a functional limitation. Neither the

time of enrollment in *Seguro Popular* nor the time of functional limitation onset were ascertained in the MHAS. However, if *Seguro Popular* reduced the association between financial resources and functional limitation onset one would expect the parameter estimates for financial resources to be weaker between the last two survey waves (2003-2012) than the first two survey waves (2001-2003) given that *Seguro Popular* was only active after 2003. However, the parameter estimates for socioeconomic variables did not differ significantly between the two interwave periods although this was not a direct evaluation of *Seguro Popular* and may be confounded by age and other period effects.

Further, the lack of a statistically significant association between income and functional limitation onset is somewhat less surprising given the age of the MHAS sample. In old age, income is often very low and may not convey the same health benefits as the value of accumulated assets which may better represent the financial resources available to older adults (Robert and House 1996; Wong and Espinoza 2014). However, wealth did not seem to play an important role in the development of functional limitations over follow up except in the case of rural areas where wealth was marginally significant in predicting functional limitation onset. The relative unimportance of income and wealth may be explained in part by the measures used. Many older adults in Mexico live in multigenerational household and receive economic support from their children and family outside of the household of residence. This has been documented in Mexico and other developing countries (Gomes 2007). In some cases, older adults may have been unable to afford certain treatments and healthcare through their own means but may have gained access through their children's or extended family's income and wealth to treat disabling pathologies preventing or delaying the onset of functional limitation.

FACETS OF SOCIOECONOMIC POSITION AND THE ONSET OF FUNCTIONAL LIMITATION BY COHORT:

Older adults in Mexico are a heterogeneous population that have aged in unique social, demographic, and political contexts. I stratified the MHAS sample into two birth cohorts, one of which was aged 50-59 at baseline and one of which was aged 60+ at baseline to determine whether the relationships between individual facets of socioeconomic position and disablement differed by birth cohort. The results of the cohort stratification were consistent in demonstrating a stronger relationship between education and functional limitation onset in the younger cohort than the older cohort. This is consistent with previous research demonstrating a mortality disadvantage for those with lower educational attainment among more recent birth cohorts of older Mexican adults (born after 1940) but not among those born before 1940 (Saenz and Wong 2015). In the case of functional limitation onset, however, respondents with lower educational attainment were disadvantaged in both birth cohorts. In the United States, previous research has found those with lower income to be most disadvantaged in terms of health related quality of life around ages 45-54 while income was not associated with health-related quality of life at very old ages (75-89) (Robert et al. 2009).

The steeper educational advantage in the younger cohort may be explained in various ways. First, I cannot declare with certainty that the weaker effect of education in the older cohort is the result of a cohort difference because what I observe is truly an effect of both age and cohort. It may be that in more advanced ages (60+), education may not be as important as it was in younger ages (Robert et al. 2009) and this may be explained by selective survival. As education is determined early in the life-course and rarely changes in old age, the lower educated may have been more likely to experience

mortality before the study began to a larger extent than the highly educated and may be less likely to make it to age 60 and be included in the older cohort. This selective survival would result in only the healthiest of the lower educated surviving to be included in the study, thus, diluting the education-functional limitation relationship in the older old. Alternatively, through the age-as-leveler hypothesis, the consequences of biological deterioration in very advanced ages may so large that the disadvantages of lower socioeconomic position are not as evident (House, Lantz, and Herd 2005).

Second, the steeper educational advantage in the younger cohort may be a true cohort difference. A large population shift from rural to urban areas has occurred in Mexico which may have influenced the education-functional limitation association. Rural areas in Mexico, especially in the first half of the 20th century, had very few educational opportunities (Lacy 1994). The state of education and community development in rural Latin America were key reasons for the creation of the *Centro Regional de Educacion Fundamental para America Latina* (CREFAL) (Regional Center of Education for Latin America) in 1950 (Hughes 1963). Given the history of urbanization in Mexico, if the older birth cohort (born before 1940) was more likely to have been born and attained their education in rural areas then the schooling options may have been inadequate across the socioeconomic spectrum. Returns to educational attainment may also have differed by birth cohort as a result of the process of urbanization and its relationship to employment in Mexico. The younger cohort may have been more likely to have lived longer periods of their life in urban areas with a wider variety of employment opportunities. For this reason, the younger cohort may have been better able to take advantage of their education in terms of employment and the associated financial compensation. Further,

improvements have been seen in the previous century not only in the quantity of education (more schools have been built and more people are being educated), but also the overall quality of education has improved (Lacy 1994).

The limited educational, occupational, and healthcare opportunities in rural areas may also explain why the benefits of higher educational attainment were limited to urban areas in the full sample. The diminished occupational options in rural areas may imply that those who achieved higher levels of education may ultimately be restricted to the same occupations as those with limited education, possibly forcing the higher educated to be exposed to similar job control, stress, and physical labor as their lower educated counterparts leading to similar levels of functional limitation onset. Further, although the higher educated in rural areas may have benefited from greater health knowledge, healthcare options to treat disabling pathologies before the development of functional limitations may have been limited for both the higher and lower educated.

FUTURE DIRECTIONS:

Given the important role of educational attainment in the development of functional limitation, efforts to reduce the burden of functional limitation on caregivers and healthcare systems should focus more attention on early life. The current study demonstrates the elevated risk of functional limitation onset among the lower educated, however, this risk may truly emerge prior to the integration of individuals into the educational system. Educational attainment may be determined to a considerable extent by childhood conditions and parental characteristics preceding the entrance of children into the educational system. For example, it has been shown that the educational attainment of children is influenced by the educational attainment of parents as well as

the socioeconomic conditions of the household in the United States (Davis-Kean 2005) and Mexico (Levison, Moe, and Marie Knaul 2001). Future studies of educational attainment and the onset of functional limitation should examine the role of these factors preceding educational attainment in shaping disability risk. What is clear, however, is that it is insufficient to study functional limitation in late-life without acknowledging one's process through the life-course.

While this study provides insight into the life-course processes leading to functional limitation onset and progression in old age in developing countries, future studies should examine other developing countries as well as Mexican-Americans in the United States. Globally, developing countries will contribute a sizeable share of population growth in the elderly. Latin America, in particular, is experiencing a rapid expansion in the older population (Wong and Palloni 2009) which will likely be accompanied with substantial increases in functional limitation. While Mexico certainly shares common characteristics with other developing countries in Latin America, cross-national research may elucidate the importance of cultural and political differences across countries and life-course disablement processes to suggest health policies and interventions that are tailored to individual nations and population groups.

Comparative studies between Mexico and Mexican-Americans in the United States may also highlight important distinctions between these groups. Mexican-Americans in the United States present with surprisingly better health than African-Americans to whom they share similar socioeconomic profiles and show health profiles similar to and sometimes better than non-Hispanic whites (Hummer et al. 2007; Markides and Coreil 1986). While Mexican-Americans seem to live longer, this health advantage

does not seem to extend to disability. While Hispanics seem to live longer, they also seem to experience a larger disability burden (Hayward et al. 2013). It would be interesting to see how socioeconomic conditions throughout the life-course impact the onset of functional limitation among older Mexican-Americans given their unique migration history, paradoxically better health profiles coupled with a high disability burden, and weaker socioeconomic gradients.

Chapter 7: Functional Limitation Progression Conclusions

FACETS OF SOCIOECONOMIC POSITION AND THE PROGRESSION OF FUNCTIONAL LIMITATION:

In reference to my second aim, to examine the relationship between financial resources in old age (income and wealth) and the progression of functional limitation in Mexico, insufficient support is seen for the hypothesis that older adults with limited financial resources would have a faster deterioration in functionality. Except in the earlier birth cohort and in rural areas, income and wealth were not significant predictors of functional decline after adjusting for education. Rather, educational attainment seemed to be crucial to maintaining functionality after the onset of a functional limitation. However, the latter of these results varied by sex as well as rural/urban context. Interestingly, only among females was lower educational attainment predictive of deterioration in fully adjusted models. It also appeared that the beneficial effects of educational attainment were restricted only to urban areas and did not extend to rural areas. Finally, stratifications by birth cohort revealed small but interesting differences. While financial resources were not associated with functional limitation progression in the younger birth cohort, wealth seemed to play a small but significant role in the older birth cohort. The effects of lower educational attainment appeared slightly stronger in the younger birth cohort (although the interaction was not significant). However, the association between educational attainment and functional decline was significant in fully adjusted models in both birth cohorts.

FINANCIAL RESOURCES AND THE PROGRESSION OF FUNCTIONAL LIMITATION:

Together, these results conflict with the conclusions of studies from developed countries including the United States where those who were disadvantaged in terms of

financial resources suffered a faster decline in functionality (Herd et al. 2007; Taylor 2010; Zimmer and House 2003). The contrasting results, however, are not entirely surprising. First, scholars have noted the weak (Riosmena and Dennis 2012) and even reverse associations (Sobal and Stunkard 1989) between financial resources and health using samples from nations in earlier stages of economic development. In the case of functional limitation onset the relative irrelevance of financial resources in the context of Mexico could be explained by greater financial resources reflecting an individual's ability to afford a sedentary lifestyle, calorie rich processed foods, and harmful health behaviors such as smoking (Sobal and Stunkard 1989). In the case of functional limitation progression, however, this argument must be reconsidered.

As my conceptual framework suggested the importance of access to healthcare, treatment for chronic conditions, and rehabilitation as mediating variables connecting lower income and wealth to functional limitation progression, I consider these constructs in the unique case of Mexico. Previous literature suggests that financial resources may not be associated with healthcare access and availability of services in the same way in developing countries (Smith and Goldman 2007). In early stages of economic development, the healthcare, treatment, and rehabilitation options may be absent or lacking for everyone regardless of financial resources. Hence, if rehabilitation is not available, having greater income will not improve access (except in the case of improved access to transportation). It remains to be seen whether, with health and economic development, successive Mexican birth cohorts will exhibit associations between financial resources and functional limitation progression that are similar to those observed in the United States.

Second, previous studies of socioeconomic status and health in old age have demonstrated the limitations of income in capturing financial status in late life. Income in late life is often quite low as older Mexican adults exit the labor force as they age (Wong and Palloni 2009). As mentioned above, among older Mexican adults, income may not fully capture the economic resources available to older adults (Wong and Espinoza 2014). Additionally, issues of reverse causation may occur if older adults receive financial benefits as a result of health problems and disability such as pensions. Income may also be extraordinarily difficult to capture in old age as the older population may be receiving economic support from a variety of sources (Grundy and Holt 2001). Especially in the case of Mexico, where intergenerational support and multigenerational dwelling is common (Mónica Espinoza and Rebeca Wong 2004), simply measuring the income of spouses may not fully capture the extent of the support provided by children, extended family, and friends. It should be noted that the Mexican Health and Aging Study does capture support from children as part of the income measure. However, if children or extended family provide access to healthcare by paying directly to healthcare service providers or enrolling respondents on their health insurance plans, these transfers are not captured in my income measure. Such transfers, while important, are beyond the scope of this analysis and should be the target of future research on the health benefits of financial resources in Mexico.

Third, the age of the MHAS sample is older relative to previous studies which have contrasted the unique roles that measures of socioeconomic position play in disablement. While the analyses of Zimmer & House (2003) and Herd, Goesling, & House (2007) using the Americans Changing Lives (ACL) study were based on a

population age 25 and over (with an over-sample of those above age 60), the MHAS sampled only households with a member age 50 and over and the current analyses were restricted only to individuals age 50+ at baseline (2001). Given the diminished relevance of income for health in old age, the older age of the MHAS sample may be part of the reason for the relative unimportance of income in the current study compared to previous works. Even among the older Mexican population, however, increased income through a cash transfer program was associated with favorable health across a variety of indicators (Behrman and Parker 2013). It would be quite interesting to see whether the results obtained from younger samples are consistent with those from the current analysis (age 50+) and this should be the subject of future work.

Again, the relative unimportance of income and wealth in the progression of functional limitation in Mexico may be explained through the enactment of *Seguro Popular*. As mentioned above, *Seguro Popular* is a voluntary public health insurance program which was enacted in 2003, provides free healthcare services to the bottom four income deciles (Bosch et al. 2012), and research has shown promising impacts on health (Bleich et al. 2007; Sosa-Rubí et al. 2009). It may be that *Seguro Popular* has reduced the association between financial resources and health by providing medical care to the most economically disadvantaged segments of the population. Indeed, *Seguro Popular* has improved control of diabetes (Sosa-Rubí et al. 2009) which is an important disabling pathology among older Mexican adults (Andrade 2009) and at a global level (Wong et al. 2013). *Seguro Popular* enrollees additionally enjoy access to rehabilitation services through their insurance (Comision Nacional de Proteccion Social en Sauld, Seguro

Popular 2014) and rehabilitation services have increased in Mexico substantially since 2003 (Guzman and Salazar 2014).

As mentioned above, I was unable to test whether *Seguro Popular* influenced functional limitation progression directly as I could not determine the timing of enrollment in *Seguro Popular*. Also, I stratified models by interwave period to determine whether income and wealth gradients in functional limitation progression were steeper in the first interwave period (2001-2003) than the second (2003-2012) as the latter would have been influenced by *Seguro Popular* but the gradients were not significantly different. Future research should attempt to address the question of whether *Seguro Popular* has reshaped socioeconomic gradients more directly using advanced econometric techniques.

EDUCATIONAL ATTAINMENT AND THE PROGRESSION OF FUNCTIONAL LIMITATION:

An additional result worth further elaboration was the association between lower educational attainment and functional limitation progression which emerged in the analyses. While not hypothesized as part of my conceptual framework, higher educational attainment may be predictive of a more favorable progression of functional limitation through health knowledge. Along these lines, those with greater educational attainment may be more aware of the actions one may take (including treatment of disabling pathologies and rehabilitation) to prevent further complications and disablement once a functional limitation manifests. Further, educational attainment may suggest better treatment compliance. For example, in the United States, the higher educated may have better compliance with treatments for diabetes (Goldman and Smith 2002) and may be in a favorable position to control illness (Goldman and Lakdawalla

2001). For these reasons, the lower educated may be disadvantaged in two complementary ways as they may be, first, less aware of the available options to counteract disabling pathologies; and second, may have a lower likelihood of benefiting fully from treatments due to lower treatment compliance.

The disadvantaged position of the lower educated in terms of functional limitation progression should also not come as a surprise through the fundamental cause theory of health (Link and Phelan 1995; Phelan et al. 2004). These factors (knowledge of interventions and treatment compliance) are consistent with the theoretical framework. If educational attainment is a fundamental cause, it then represents access to a broad array of health promoting resources including health knowledge and human capital (as the procedural knowledge and know-how of navigating the healthcare system). Additionally, as interventions to address disabling pathologies and improve functionality are developed, the higher educated will be in a favorable position to be aware of, access, and use these interventions effectively (Link and Phelan 1995).

The strong benefits of educational attainment for women in reducing the probability of increasing functional limitation are expected given previous work suggesting that educational returns may be greater for females and especially in countries in earlier stages of economic development (Psacharopoulos 1985). Improved access to education is an important step towards economic and social development in developing countries, however, women still report lower literacy rates and educational attainment in developing countries despite clear economic benefits of increasing education for women (King and Hill 1997). This is crucial as females may receive larger economic, health, and

psychosocial benefits to education for certain outcomes in developed (Cutler and Lleras-Muney 2010) and developing countries (King and Hill 1997; Psacharopoulos 1994).

HEALTHCARE AND THE PROGRESSION OF FUNCTIONAL LIMITATION:

Finally, while healthcare was hypothesized to be an important factor in preventing the progression of functional limitation, this hypothesis did not find support in the results. A key issue is that enrollment in health insurance is endogenously determined. Respondents with health problems may perceive great utility from health insurance as it can be used to treat health problems. However, respondents with no health problems may see little utility in health insurance and not enroll. If one's research question is whether health insurance reduces functional limitation progression, one could exploit the exogenous geographic variation in healthcare availability to yield results. Alternatively, my research question concerns the role of healthcare access in mediating the relationship between financial resources and functional limitation progression. Focusing on exogenous variation would then obfuscate the endogenous mediation I aim to detect. Future research should further examine the role which healthcare coverage in developing countries plays in preventing disablement.

FACETS OF SOCIOECONOMIC POSITION AND THE PROGRESSION OF FUNCTIONAL LIMITATION BY COHORT:

While the lower educated in both cohorts exhibited a higher probability of functional deterioration, the results for wealth appeared to differ by birth cohort and somewhat by rural/urban. Higher wealth was associated with a lower probability of experiencing a worsening functional limitation between waves only among the older birth cohort. However, this difference is likely an effect of age rather than birth cohort. This is consistent with previous research suggesting that wealth more accurately captures the

resources older adults have available (Wong and Espinoza 2014) and previous work has found stronger wealth-health gradients in older age groups (Robert and House 1996; Wenzlow et al. 2004). In the literature, there are several explanations for the enduring relationship between wealth and health in advanced ages. First, higher wealth may produce better health by granting access to health promoting resources including healthcare and rehabilitation (Pollack et al. 2007). Second, health status throughout life influences one's ability to produce financial resources and wealth. Similarly, those in better health are likely to spend less on healthcare without health conditions to treat (Grossman 1972). Last, the correlation between wealth and health may be explained by the correlation between parents and offspring's in terms of both health and socioeconomic position (Lindeboom, Portrait, and Van den Berg 2004).

The framework through which my analyses were structured were based on the first explanation by arguing that individuals with higher levels of wealth would be able to mobilize these assets to access resources which may prevent further physical deterioration (including healthcare, treatment for disabling pathologies, and rehabilitation). In the context of these mechanisms, the significance of wealth only in the older age group is not surprising. Respondents who are older are less likely to be working and are more likely to have much lower levels of income than the younger birth cohort (this was observed in the data) leading to a stronger reliance on wealth and financial assets in older age groups. Future studies should address other possible explanations for the wealth-health association by accounting for health conditions, wealth. and health expenditures throughout the life-course as well as health and economic profiles of parents.

It should be noted that, although lower wealth was not significantly associated with functional deterioration in fully adjusted models, lower wealth was associated with functional deterioration even after accounting for educational attainment in rural areas. This may due to two factors. First, those living in rural areas were more likely to be in the older birth cohort (this was observed in the data) and may have shown a stronger effect of lower wealth on functional deterioration due to their older age for the reasons outlined above. Unfortunately, limited sample size prevented further stratification of the data into cohort-rural/urban groups and should be the focus of future work. Second, in rural areas where houses may be less expensive and may contribute a smaller share to one's wealth, higher wealth may be indicative of owning transportation such as cars. In the context or rural areas where healthcare options may be scarce, having access to a car may provide access to greater healthcare services outside of the community to achieve a better trajectory of functional limitation. However, transportation availability was beyond the scope of my analyses and should be a target for future research.

FUTURE DIRECTIONS:

As mentioned above, future research on the socioeconomic predictors of functional limitation progression should test the role of income and wealth in shaping functional limitation trajectories using younger samples. While I have focused on the older population of Mexico, younger samples and birth cohorts may produce markedly different results. Analyzing the impact of *Seguro Popular* and the expanding availability of rehabilitation services in Mexico may also provide meaningful insight into the ability and effectiveness of public health insurance to improve physical functioning among the elderly and reduce the burden of physical limitations on care givers. Future research

should also examine the role of financial resources in shaping functional limitation trajectories using samples from other developing countries in Latin America and world-wide.

Importantly, as intergenerational dwelling and support is common in Mexico, future research should seek to understand the essential role which intergenerational transfers may play in providing access to healthcare, rehabilitation, and treatment for chronic disease. The continuing reduction in fertility and intergenerational dwelling may also lead to a highly economically vulnerable population of older Mexican adults as institutional support for the elderly in Mexico remains incomplete. Finally, while previous studies have focused on how individual facets of socioeconomic position are associated with the onset and progression of functional limitation in the United States (Herd et al. 2007; Taylor 2010; Zimmer and House 2003), these studies have not focused on the rapidly growing population of older Mexican-Americans. Understanding the socioeconomic risk factors, pathways, and disablement processes of this unique group may have vital implications for United States healthcare systems.

LIMITATIONS & STRENGTHS:

There are several limitations worth mentioning. First, as timing of disability onset was not captured, I was unable to determine the ordering of events in the case of enrollment in *Seguro Popular* and had to rely on indirect program impact measures. Second, the length of follow-up in the first interwave period (2 years) was much shorter than the second interwave period (9 years). While I account for interwave period in my models and tested the interactions between socioeconomic variables and interwave period to determine whether results differed by interwave period, future studies should use equal

length periods to circumvent these problems. Third, as mentioned above, the measure of occupation I use may be ineffective because the main job a respondent worked throughout the life-course does not take into account the length of employment or the additional jobs that respondent may have worked. Future studies should analyze a more complete employment history.

Fourth, using other measures of education and financial resources may further illuminate the multifaceted ways in which socioeconomic position influences health. For education, it would be an interesting alternative to investigate the role of health literacy specifically when predicting the onset and progression of functional limitation. Health literacy may be of particular importance among the large population with no formal education. For financial resources, other measures exist including self-assessed financial standing, household level consumer durables, and financial strain. These alternative specifications may be informative especially in the context of low income in old age. Further, these may also somewhat capture financial support from children and extended family more effectively than income and wealth. Fifth, the older birth cohort (age 60+) may be quite heterogeneous given the substantial age range. However, small cell sizes prevented the investigation of smaller birth cohorts. This is especially important because economic opportunities to reap returns to education are driven by external macroeconomic processes. For example, great economic opportunities were present during the Mexican oil boom (roughly 1977-1985) while other periods may have offered limited economic opportunities.

Notwithstanding these limitations, the present study comes with several strengths. The MHAS is a powerful resource to address my research questions for many reasons.

The MHAS has a very large sample size with a considerably long length of follow up. While I focus on the first 11 years, the study is still active. Further, the MHAS contains a rich supply of information including health, demographics, economic information, healthcare services, functionality, employment, housing, family and support, and cognition. The variety of domains available in the MHAS as well as the presence of items on early life allow users to conduct nuanced analyses of the multifaceted ways through which early life and education impact late life health.

CONCLUSIONS & IMPLICATIONS:

Throughout these analyses I have found that educational attainment plays a key role in both the onset and the progression of disablement in Mexico. Except in a few circumstances (for example, higher wealth seemed to improve functional trajectories in the older old and somewhat in rural areas), neither income nor the value of financial assets were associated with the onset or progression of disability after accounting for educational attainment. Clear implications can be drawn from these results. First, in order to improve the physical functionality of the elderly in Mexico it is vital to focus on improving access to education. These efforts must not only aim to increase the quantity and quality of educational opportunities for children, but also to understand the social and economic reasons why children do not complete or attend school.

Although policy efforts including Prospera/Progresa/Oportunidades along with educational initiatives are already in practice that may improve the educational opportunities and functionality of future older cohorts of the Mexican population, the question remains of what can be done to protect those who are already un- or under-educated. The importance of educational attainment and the relative unimportance of

income and wealth throughout my results suggest that, in many cases, the insalubrious consequences of under-education cannot be "bought away" through income and wealth.

Through a fundamental cause perspective, this suggests that education influences access to health promoting resources such as health knowledge, effective healthcare utilization, and treatment compliance. The uneducated are likely to be disadvantaged at every stage disablement. The lower educated may be more likely to develop disabling pathologies, to not have regular access to healthcare and tests for chronic conditions, to not be aware of the treatment options for disabling pathologies, to be less able to use treatments effectively, and to forego interventions which may prevent the onset or improve the trajectory of functional limitations. In this context of disadvantage, healthcare must make a special effort to address the needs of the undereducated. This must not only involve the healthcare coverage of the undereducated (*Seguro Popular* has already focused on this and the mere status of health insurance does not inherently convey benefits), but also focus on the continued use of preventive care, health advising, and screening for disabling pathologies. Further, more efforts should be made to educate the public of rehabilitative services and how to use medications and healthcare more effectively. However, although improved access to and use of healthcare among the undereducated may be beneficial in promoting health, insufficient healthcare is a proximal cause of disablement. That is, addressing the distal causes of educational inequality and reducing income and wealth disparities may be more fruitful in terms of health equity.

Appendix Tables:

Table 5 (Long): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2001 and 2003 (n=5,430).

	Remain		Onset		Death		Total
	n	**%**	**n**	**%**	**n**	**%**	**n**
Education							
None	714	62.6%	396	34.7%	31	2.7%	1,141
1-5 Years	1,268	69.7%	516	28.4%	36	2.0%	1,820
6 Years	795	73.0%	280	25.7%	14	1.3%	1,089
7+	1,107	80.2%	249	18.0%	24	1.7%	1,380
Sex							
Male	2,186	76.0%	622	21.6%	70	2.4%	2,878
Female	1,698	66.5%	819	32.1%	35	1.4%	2,552
Rural/Urban							
More Rural	1,275	67.3%	583	30.8%	37	2.0%	1,895
More Urban	2,609	73.8%	858	24.3%	68	1.9%	3,535
Marital Status							
Married	2,924	72.9%	1,021	25.5%	65	1.6%	4,010
Widowed	467	62.7%	252	33.8%	26	3.5%	745
Other	493	73.0%	168	24.9%	14	2.1%	675
Occupation							
White	726	80.7%	165	18.3%	9	1.0%	900
Blue Collar	2,008	71.8%	726	26.0%	61	2.2%	2,795
Agriculture/Fishing	625	69.3%	253	28.1%	24	2.7%	902
Missing	525	63.0%	297	35.7%	11	1.3%	833
Smoking							
Current Smoker	771	74.6%	228	22.1%	35	3.4%	1,034
Former Smoker	1,047	73.3%	355	24.8%	27	1.9%	1,429
Never Smoker	3,065	69.7%	856	28.9%	43	1.5%	2,964
Drinking							
No Binge Drinking	3,486	71.1%	1,331	27.2%	86	1.8%	4,903
Binge Drinking	398	75.5%	110	20.9%	19	3.6%	527
Self Rated Health							
Good	2,088	79.4%	505	19.2%	38	1.4%	2,631
Fair	1,544	65.4%	771	32.7%	45	1.9%	2,360
Poor	252	57.4%	165	37.6%	22	5.0%	439
Health Insurance							
Not Insured	1,466	70.7%	555	26.8%	52	2.5%	2,073
Insured	2,418	72.0%	886	26.4%	53	1.6%	3,357
Income							
Low	1,117	66.0%	530	31.3%	46	2.7%	1,693

	Medium	1,351	71.4%	510	26.9%	32	1.7%	1,893
	High	1,416	76.8%	401	21.8%	27	1.5%	1,844
Wealth								
	Low	1,101	67.7%	486	29.9%	40	2.5%	1,627
	Medium	1,363	72.3%	479	25.4%	43	2.3%	1,885
	High	1,420	74.0%	476	24.8%	22	1.2%	1,918

Note: Source: author's own calculation using the Mexican Health and Aging Study, all respondents begin the study period with no functional limitation. Respondents are classified as "onset" if they develop a functional limitation between study waves and "death" if the respondent dies between study waves.

Table 6 (Long): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2003 and 2012 (n=5,137).

	Remain		Onset		Death		Total
	n	**%**	**n**	**%**	**n**	**%**	**n**
Education							
None	340	30.6%	535	48.2%	235	21.2%	1,110
1-5 Years	660	36.2%	796	43.7%	367	20.1%	1,823
6 Years	461	45.2%	409	40.1%	151	14.8%	1,021
7+	589	49.8%	420	35.5%	174	14.7%	1,183
Sex							
Male	1,226	45.4%	901	33.4%	573	21.2%	2,700
Female	824	33.8%	1,259	51.7%	354	14.5%	2,437
Rural/Urban							
More Rural	666	38.0%	764	43.5%	325	18.5%	1,755
More Urban	1,384	40.9%	1,396	41.3%	602	17.8%	3,382
Marital Status							
Married	1,576	42.4%	1,548	41.6%	595	16.0%	3,719
Widowed	208	26.4%	362	46.0%	217	27.6%	787
Other	266	42.2%	250	39.6%	115	18.2%	631
Occupation							
White	377	47.7%	298	37.7%	115	14.6%	790
Blue Collar	1,059	39.8%	1,113	41.8%	492	18.5%	2,664
Agriculture/Fishing	353	39.8%	340	38.3%	195	22.0%	888
Missing	261	32.8%	409	51.5%	125	15.7%	795
Smoking							
Current Smoker	458	43.6%	373	35.5%	220	20.9%	1,051
Former Smoker	496	39.1%	506	39.8%	268	21.1%	1,270
Never Smoker	1,096	38.9%	1,281	45.5%	439	15.6%	2,816
Drinking							
No Binge Drinking	1,771	38.8%	1,972	43.2%	826	18.1%	4,569
Binge Drinking	263	49.8%	173	32.8%	92	17.5%	528
Self Rated Health							
Good	1,051	48.2%	806	40.0%	324	14.9%	2,181
Fair	874	35.2%	1,138	45.9%	469	18.9%	2,481
Poor	125	26.3%	216	45.5%	124	28.2%	475
Health Insurance							
Not Insured	822	40.5%	847	41.8%	359	17.7%	2,028
Insured	1,224	39.5%	1,307	42.2%	567	18.3%	3,098
Income							
Low	614	37.1%	703	42.5%	339	20.5%	1,656
Medium	683	38.8%	757	43.0%	319	18.1%	1,759
High	742	43.6%	692	40.7%	268	15.8%	1,702
Wealth							
Low	556	36.8%	633	41.8%	324	21.4%	1,513
Medium	727	39.6%	781	42.5%	330	18.0%	1,838
High	761	42.9%	743	41.8%	272	15.3%	1,776

Note: Source: author's own calculation using the Mexican Health and Aging Study, all respondents begin the study period with no functional limitation. Respondents are classified as "onset" if they develop a functional limitation between study waves and "death" if the respondent dies between study waves.

Table 7 (Long): Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference Outcome) to Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=10,567 Transitions among 7,405 Respondents).

	No functional limitation to functional limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.45	(0.06)***	0.42	(0.07)***	0.31	(0.07)***
1-5 Years	0.33	(0.05)***	0.29	(0.06)***	0.18	(0.06)**
6 Years	0.22	(0.06)***	0.19	(0.07)**	0.09	(0.07)
Demographics						
Age	0.03	(0.00)***	0.03	(0.00)***	0.03	(0.00)***
Female	0.56	(0.04)***	0.57	(0.05)***	0.52	(0.05)***
More Urban	-0.07	(0.04)	-0.09	(0.05)	-0.07	(0.05)
Marital Status (Ref: Married)						
Widowed			0.01	(0.06)	0.03	(0.06)
Other			-0.13	(0.06)*	-0.11	(0.06)
Occupation (Ref: White Collar)						
Blue Collar			0.06	(0.07)	0.02	(0.07)
Agriculture/Fishing			0.00	(0.09)	-0.01	(0.09)
Missing			0.06	(0.08)	0.03	(0.08)
Health Covariates						
Former Smoker (Ref: Never)			0.06	(0.05)	0.03	(0.05)
Current Smoker (Ref: Never)			0.00	(0.05)	0.02	(0.05)
Binge Drinking			0.05	(0.07)	0.07	(0.07)
Chronic Conditions					0.24	(0.03)***
Self Rated Health (Ref: Good)						
Fair					0.36	(0.04)***
Poor					0.43	(0.07)***
Financial Resources						
Income					-0.01	(0.01)
Wealth					0.00	(0.01)
Health Insurance						
Insured					0.02	(0.04)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 7 (Long) Continued: Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference Outcome) to Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=10,567 Transitions among 7,405 Respondents).

	No functional limitation to death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.19	(0.09)*	0.09	(0.10)	-0.14	(0.10)
1-5 Years	0.20	(0.08)**	0.11	(0.09)	-0.08	(0.09)
6 Years	0.03	(0.09)	-0.06	(0.10)	-0.21	(0.10)*
Demographics						
Age	0.08	(0.00)***	0.08	(0.00)***	0.08	(0.00)***
Female	0.02	(0.05)	0.04	(0.07)	-0.04	(0.07)
More Urban	0.03	(0.06)	-0.01	(0.06)	0.02	(0.07)
Marital Status (Ref: Married)						
Widowed			0.23	(0.07)**	0.29	(0.08)***
Other			0.11	(0.09)	0.15	(0.09)
Occupation (Ref: White Collar)						
Blue Collar			0.21	(0.10)*	0.12	(0.10)
Agriculture/Fishing			0.09	(0.12)	0.03	(0.13)
Missing			0.22	(0.12)	0.16	(0.13)
Health Covariates						
Former Smoker (Ref: Never)			0.09	(0.07)	0.07	(0.07)
Current Smoker (Ref: Never)			0.26	(0.07)***	0.33	(0.07)***
Binge Drinking			0.13	(0.09)	0.16	(0.09)
Chronic Conditions					0.44	(0.04)***
Self Rated Health (Ref: Good)						
Fair					0.30	(0.06)***
Poor					0.62	(0.10)***
Financial Resources						
Income					-0.03	(0.01)**
Wealth					-0.03	(0.01)**
Health Insurance						
Insured					-0.07	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes

$p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 8 (Long): Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference Outcome) to Functional Limitation or Death among Older Mexican Males in the Mexican Health and Aging Study (MHAS) (n=5,578 Transitions among 3,789 Respondents).

	No functional limitation to functional limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.46	(0.09)***	0.46	(0.10)***	0.37	(0.10)***
1-5 Years	0.28	(0.07)***	0.28	(0.09)**	0.20	(0.09)*
6 Years	0.23	(0.08)**	0.23	(0.09)*	0.15	(0.09)
Demographics						
Age	0.04	(0.00)***	0.04	(0.00)***	0.04	(0.00)***
More Urban	-0.05	(0.06)	-0.07	(0.07)	-0.06	(0.07)
Marital Status (Ref: Married)						
Widowed			-0.12	(0.10)	-0.10	(0.10)
Other			-0.10	(0.10)	-0.07	(0.10)
Occupation (Ref: White Collar)						
Blue Collar			0.00	(0.09)	-0.04	(0.09)
Agriculture/Fishing			-0.03	(0.11)	-0.07	(0.11)
Missing			0.43	(0.38)	0.43	(0.37)
Health Covariates						
Former Smoker (Ref: Never)			0.04	(0.06)	0.00	(0.06)
Current Smoker (Ref: Never)			0.01	(0.07)	0.03	(0.07)
Binge Drinking			0.04	(0.07)	0.06	(0.07)
Chronic Conditions					0.24	(0.04)***
Self Rated Health (Ref: Good)						
Fair					0.35	(0.06)***
Poor					0.39	(0.11)***
Financial Resources						
Income					-0.01	(0.01)
Wealth					0.00	(0.01)
Health Insurance						
Insured					-0.01	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 8 (Long) Continued: Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference Outcome) to Functional Limitation or Death among Older Mexican Males in the Mexican Health and Aging Study (MHAS) (n=5,578 Transitions among 3,789 Respondents).

	No functional limitation to death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.00	(0.11)	-0.13	(0.13)	-0.31	(0.13)*
1-5 Years	0.07	(0.10)	-0.05	(0.11)	-0.20	(0.12)
6 Years	-0.08	(0.11)	-0.19	(0.12)	-0.31	(0.12)*
Demographics						
Age	0.09	(0.00)***	0.09	(0.00)***	0.09	(0.00)***
More Urban	0.14	(0.08)	0.09	(0.09)	0.13	(0.09)
Marital Status (Ref: Married)						
Widowed			0.27	(0.11)*	0.33	(0.12)**
Other			0.22	(0.13)	0.27	(0.13)*
Occupation (Ref: White Collar)						
Blue Collar			0.22	(0.12)	0.15	(0.12)
Agriculture/Fishing			0.13	(0.15)	0.04	(0.15)
Missing			0.08	(0.47)	0.07	(0.45)
Health Covariates						
Former Smoker (Ref: Never)			0.10	(0.09)	0.07	(0.09)
Current Smoker (Ref: Never)			0.39	(0.09)***	0.45	(0.09)***
Binge Drinking			0.13	(0.10)	0.17	(0.10)
Chronic Conditions					0.39	(0.05)***
Self Rated Health (Ref: Good)						
Fair					0.30	(0.08)***
Poor					0.78	(0.13)***
Financial Resources						
Income					-0.02	(0.01)
Wealth					-0.03	(0.01)
Health Insurance						
Insured					-0.06	(0.08)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 9 (Long): Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference Outcome) to Functional Limitation or Death among Older Mexican Females in the Mexican Health and Aging Study (MHAS) (n=5,989 Transitions among 3,616 Respondents).

	No functional limitation to functional limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.46	(0.08)***	0.37	(0.10)***	0.23	(0.10)*
1-5 Years	0.38	(0.08)***	0.29	(0.09)**	0.15	(0.10)
6 Years	0.22	(0.08)*	0.14	(0.10)	0.02	(0.10)
Demographics						
Age	0.03	(0.00)***	0.03	(0.00)***	0.03	(0.00)***
More Urban	-0.10	(0.06)	-0.10	(0.06)	-0.09	(0.06)
Marital Status (Ref: Married)						
Widowed			0.07	(0.07)	0.09	(0.07)
Other			-0.15	(0.08)	-0.13	(0.08)
Occupation (Ref: White Collar)						
Blue Collar			0.13	(0.10)	0.10	(0.10)
Agriculture/Fishing			0.06	(0.15)	0.06	(0.15)
Missing			0.11	(0.10)	0.09	(0.10)
Health Covariates						
Former Smoker (Ref: Never)			0.10	(0.08)	0.10	(0.08)
Current Smoker (Ref: Never)			-0.05	(0.09)	-0.02	(0.09)
Binge Drinking			0.16	(0.20)	0.15	(0.20)
Chronic Conditions					0.25	(0.04)***
Self Rated Health (Ref: Good)						
Fair					0.38	(0.06)***
Poor					0.44	(0.10)***
Financial Resources						
Income					-0.01	(0.01)
Wealth					0.00	(0.01)
Health Insurance						
Insured					0.05	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 9 (Long) Continued: Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference Outcome) to Functional Limitation or Death among Older Mexican Females in the Mexican Health and Aging Study (MHAS) (n=5,989 Transitions among 3,616 Respondents).

	No functional limitation to death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.45	(0.13)**	0.39	(0.17)*	0.09	(0.18)
1-5 Years	0.41	(0.12)**	0.36	(0.16)*	0.11	(0.16)
6 Years	0.22	(0.14)	0.18	(0.17)	-0.02	(0.17)
Demographics						
Age	0.08	(0.01)***	0.08	(0.01)***	0.07	(0.01)***
More Urban	-0.12	(0.09)	-0.12	(0.09)	-0.09	(0.10)
Marital Status (Ref: Married)						
Widowed			0.22	(0.10)*	0.27	(0.10)**
Other			0.06	(0.12)	0.08	(0.12)
Occupation (Ref: White Collar)						
Blue Collar			0.08	(0.18)	-0.01	(0.18)
Agriculture/Fishing			0.22	(0.25)	0.20	(0.26)
Missing			0.09	(0.18)	0.03	(0.18)
Health Covariates						
Former Smoker (Ref: Never)			0.15	(0.12)	0.17	(0.12)
Current Smoker (Ref: Never)			-0.09	(0.15)	-0.01	(0.15)
Binge Drinking			-0.09	(0.37)	-0.08	(0.38)
Chronic Conditions					0.51	(0.06)***
Self Rated Health (Ref: Good)						
Fair					0.29	(0.09)**
Poor					0.39	(0.15)**
Financial Resources						
Income					-0.04	(0.02)*
Wealth					-0.03	(0.02)*
Health Insurance						
Insured					-0.06	(0.10)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 11 (Long): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2001 and 2003 (n=4,518).

	Improve		Remain		Progress		Death		Total
	n	%	n	%	n	%	n	%	n
Education									
None	590	44.7%	440	33.4%	174	13.2%	115	8.7%	1,319
1-5 Years	829	47.9%	605	35.0%	197	11.4%	100	5.8%	1,731
6 Years	411	53.8%	248	32.5%	63	8.4%	41	5.4%	764
7+	369	52.4%	267	37.9%	42	6.0%	26	3.7%	704
Sex									
Male	835	53.2%	457	29.1%	146	9.3%	131	8.4%	1,569
Female	1,364	46.3%	1,103	37.4%	331	11.2%	151	5.1%	2,949
Rural/Urban									
More Rural	692	47.3%	504	34.5%	178	12.2%	89	6.1%	1,463
More Urban	1,507	49.3%	1,056	34.6%	299	9.8%	193	6.3%	3,055
Marital Status									
Married	1,500	51.6%	975	33.6%	285	9.8%	146	5.0%	2,906
Widowed	432	41.2%	383	36.6%	128	12.2%	105	10.0%	1,048
Other	267	47.3%	202	35.8%	64	11.4%	31	5.5%	564
Occupation									
White	258	49.5%	193	37.0%	42	8.1%	28	5.4%	521
Blue Collar	1,166	49.4%	793	33.6%	250	10.6%	150	6.4%	2,359
Agriculture/Fishing	338	48.6%	229	32.9%	72	10.3%	57	8.2%	696
Missing	437	46.4%	345	36.6%	113	12.0%	47	5.0%	942
Smoking									
Current Smoker	374	57.7%	185	28.6%	50	7.7%	39	6.0%	648
Former Smoker	617	47.0%	469	35.7%	132	10.1%	96	7.3%	1,314
Never Smoker	1,206	47.2%	905	35.5%	295	11.6%	147	5.8%	2,553
Drinking									
No Binge Drinking	2,058	48.2%	1,476	34.6%	461	10.8%	271	6.4%	4,266
Binge Drinking	141	56.0%	84	33.3%	16	6.4%	11	4.4%	252
Self Rated Health									
Good	513	58.3%	275	31.3%	55	6.3%	37	4.2%	880
Fair	1,185	49.6%	854	35.7%	230	9.6%	122	5.1%	2,391
Poor	501	40.2%	431	34.6%	192	15.4%	123	9.9%	1,247
Health Insurance									
Not Insured	829	51.1%	515	31.8%	174	10.7%	103	6.4%	1,621
Insured	1,370	47.3%	1,045	36.1%	303	10.5%	179	6.2%	2,897
Income									
Low	817	46.2%	598	33.8%	216	12.2%	136	7.7%	1,767
Medium	758	49.1%	534	34.6%	161	10.4%	92	6.0%	1,545
High	624	51.7%	428	35.5%	100	8.3%	54	4.5%	1,206
Wealth									
Low	754	45.4%	569	34.3%	205	12.3%	133	8.0%	1,661
Medium	791	51.4%	505	32.8%	159	10.3%	84	5.5%	1,539
High	654	49.6%	486	36.9%	113	8.6%	65	4.9%	1,318

Note: Source: author's own calculation using the Mexican Health and Aging Study, all respondents begin the study period with some functional limitation. Respondents are classified as "improve" if they experience an improvement in functional limitation between study waves, "remain" if they remain at the same level of functional limitation between study waves, "progress" if they experience a worsening functional limitation between waves, and "death" if the respondent dies between study waves.

Table 12 (Long): Descriptive Characteristics of Older Adults in the Mexican Health and Aging Study by Functional Limitation Transitions between 2003 and 2012 (n=3,630).

	Improve		Remain		Progress		Death		Total
	n	%	n	%	n	%	n	%	n
Education									
None	157	14.3%	239	21.8%	224	20.4%	477	43.4%	1,097
1-5 Years	270	19.1%	405	28.7%	270	19.1%	467	33.1%	1,412
6 Years	116	19.2%	176	29.2%	125	20.7%	186	30.9%	603
7+	125	24.1%	173	33.4%	72	13.9%	148	28.6%	518
Sex									
Male	255	19.8%	281	21.8%	188	14.6%	567	43.9%	1,291
Female	413	17.7%	712	30.4%	503	21.5%	711	30.4%	2,339
Rural/Urban									
More Rural	251	18.3%	363	26.4%	269	19.6%	490	35.7%	1,373
More Urban	417	18.5%	630	27.9%	422	18.7%	788	34.9%	2,257
Marital Status									
Married	466	20.6%	670	29.5%	434	19.1%	698	30.8%	2,268
Widowed	124	13.2%	217	23.2%	173	18.5%	423	45.1%	937
Other	78	18.4%	106	24.9%	84	19.8%	157	36.9%	425
Occupation									
White	83	21.8%	124	32.6%	59	15.5%	114	30.0%	380
Blue Collar	341	18.6%	525	28.6%	346	18.9%	622	33.9%	1,834
Agriculture/Fishing	115	18.6%	124	20.0%	124	20.0%	257	41.5%	620
Missing	129	16.2%	220	27.6%	162	20.4%	285	35.8%	796
Smoking									
Current Smoker	106	20.5%	117	22.6%	104	20.1%	190	36.8%	517
Former Smoker	163	17.1%	206	21.6%	177	18.5%	410	42.9%	956
Never Smoker	399	18.5%	670	31.1%	410	19.0%	678	31.4%	2157
Drinking									
No Binge Drinking	610	17.9%	934	27.4%	655	19.2%	1212	35.5%	3,411
Binge Drinking	58	26.5%	59	26.9%	36	16.4%	66	30.1%	219
Self Rated Health									
Good	129	22.7%	189	33.3%	79	13.9%	171	30.1%	568
Fair	385	20.2%	557	29.3%	386	20.3%	576	30.3%	1,904
Poor	154	13.3%	247	21.3%	226	19.5%	531	45.9%	1,158
Health Insurance									
Not Insured	231	18.9%	319	26.1%	246	20.1%	426	34.9%	1,222
Insured	437	18.2%	674	28.0%	445	18.5%	852	35.4%	2,408
Income									
Low	218	15.3%	347	24.3%	284	19.9%	578	40.5%	1,427
Medium	253	20.6%	330	26.8%	238	19.4%	409	33.3%	1,230
High	191	20.1%	309	32.6%	165	17.4%	284	29.9%	949
Wealth									
Low	233	17.2%	312	23.1%	231	17.1%	577	42.6%	1,353
Medium	237	20.0%	325	27.4%	246	20.7%	380	32.0%	1,188
High	195	18.1%	354	32.8%	212	19.7%	318	29.5%	1,079

Note: Source: author's own calculation using the Mexican Health and Aging Study, all respondents begin the study period with some functional limitation. Respondents are classified as "improve" if they experience an improvement in functional limitation between study waves, "remain" if they remain at the same level of functional limitation between study waves, "progress" if they experience a worsening functional limitation between waves, and "death" if the respondent dies between study waves.

Table 13 (Long): Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=8,148 Transitions among 6,072 Respondents).

	Functional Limitation Improvement					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None			-0.04	(0.08)	-0.04	(0.09)
1-5 Years			-0.06	(0.07)	-0.06	(0.09)
6 Years			0.02	(0.08)	0.03	(0.09)
Demographics						
Age	-0.02	(0.00)***	-0.02	(0.00)***	-0.02	(0.00)***
Female	-0.37	(0.05)***	-0.37	(0.05)***	-0.32	(0.06)***
More Urban	0.02	(0.05)	0.01	(0.05)	0.05	(0.06)
Marital Status (Ref: Married)						
Widowed	-0.01	(0.06)	-0.01	(0.06)	-0.02	(0.06)
Other	0.03	(0.07)	0.02	(0.07)	0.01	(0.07)
Occupation (Ref: White Collar)						
Blue Collar					0.05	(0.09)
Agriculture/Fishing					0.08	(0.12)
Missing					0.12	(0.10)
Health Covariates						
Former Smoker (Ref: Never)					0.00	(0.06)
Current Smoker (Ref: Never)					0.22	(0.07)**
Binge Drinking					-0.08	(0.10)
Chronic Conditions					-0.14	(0.03)***
Self Rated Health (Ref: Good)						
Fair					-0.19	(0.06)**
Poor					-0.47	(0.07)***
Financial Resources						
Income	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
Health Insurance						
Insured					-0.16	(0.05)**

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 13 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=8,148 Transitions among 6,072 Respondents).

	Worsening Functional Limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None			0.50	(0.09)***	0.48	(0.10)***
1-5 Years			0.35	(0.08)***	0.35	(0.10)***
6 Years			0.36	(0.09)***	0.36	(0.10)***
Demographics						
Age	0.01	(0.00)***	0.01	(0.00)***	0.01	(0.00)***
Female	-0.01	(0.06)	-0.02	(0.06)	-0.01	(0.07)
More Urban	-0.08	(0.05)	-0.02	(0.05)	0.01	(0.06)
Marital Status (Ref: Married)						
Widowed	0.02	(0.07)	0.01	(0.07)	0.02	(0.07)
Other	0.08	(0.08)	0.11	(0.08)	0.11	(0.08)
Occupation (Ref: White Collar)						
Blue Collar					-0.10	(0.10)
Agriculture/Fishing					-0.05	(0.13)
Missing					-0.07	(0.11)
Health Covariates						
Former Smoker (Ref: Never)					0.04	(0.06)
Current Smoker (Ref: Never)					0.19	(0.08)*
Binge Drinking					-0.12	(0.12)
Chronic Conditions					0.10	(0.03)**
Self Rated Health (Ref: Good)						
Fair					0.20	(0.08)*
Poor					0.39	(0.09)***
Financial Resources						
Income	-0.02	(0.01)*	-0.01	(0.01)	-0.01	(0.01)
Health Insurance						
Insured					-0.04	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 13 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=8,148 Transitions among 6,072 Respondents).

	Death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None			0.26	(0.09)**	0.20	(0.11)
1-5 Years			0.05	(0.09)	-0.01	(0.10)
6 Years			0.21	(0.10)*	0.15	(0.11)
Demographics						
Age	0.06	(0.00)***	0.06	(0.00)***	0.07	(0.00)***
Female	-0.52	(0.06)***	-0.53	(0.06)***	-0.57	(0.07)***
More Urban	0.10	(0.06)	0.12	(0.06)*	0.09	(0.06)
Marital Status (Ref: Married)						
Widowed	0.13	(0.07)	0.13	(0.07)	0.14	(0.07)*
Other	0.24	(0.09)**	0.25	(0.09)**	0.27	(0.09)**
Occupation (Ref: White Collar)						
Blue Collar					0.03	(0.11)
Agriculture/Fishing					-0.07	(0.14)
Missing					0.15	(0.13)
Health Covariates						
Former Smoker (Ref: Never)					0.06	(0.07)
Current Smoker (Ref: Never)					0.38	(0.08)***
Binge Drinking					-0.05	(0.12)
Chronic Conditions					0.26	(0.03)***
Self Rated Health (Ref: Good)						
Fair					0.01	(0.08)
Poor					0.27	(0.09)**
Financial Resources						
Income	-0.02	(0.01)*	-0.02	(0.01)	-0.02	(0.01)
Health Insurance						
Insured					-0.02	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 14 (Long): Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=8,148 Transitions among 6,072 Respondents).

	Functional Limitation Improvement					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None			-0.03	(0.08)	-0.00	(0.09)
1-5 Years			-0.06	(0.07)	-0.10	(0.09)
6 Years			0.02	(0.08)	0.03	(0.09)
Demographics						
Age	-0.02	(0.00)***	-0.02	(0.00)***	-0.00	(0.00)***
Female	-0.37	(0.05)***	-0.37	(0.05)***	-0.30	(0.06)***
More Urban	0.02	(0.05)	0.01	(0.05)	0.05	(0.06)
Marital Status (Ref: Married)						
Widowed	-0.00	(0.06)	0.00	(0.06)	-0.00	(0.06)
Other	0.04	(0.07)	0.03	(0.07)	0.02	(0.07)
Occupation (Ref: White Collar)						
Blue Collar					0.06	(0.09)
Agriculture/Fishing					0.08	(0.12)
Missing					0.12	(0.10)
Health Covariates						
Former Smoker (Ref: Never)					0.00	(0.06)
Current Smoker (Ref: Never)					0.22	(0.07)**
Binge Drinking					-0.10	(0.10)
Chronic Conditions					-0.10	(0.03)***
Self Rated Health (Ref: Good)						
Fair					-0.20	(0.06)**
Poor					-0.50	(0.07)***
Financial Resources						
Wealth	0.01	(0.01)	0.01	(0.01)	0.01	(0.01)
Health Insurance						
Insured					-0.20	(0.05)**

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type

1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 14 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=8,148 Transitions among 6,072 Respondents).

	Worsening Functional Limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None			0.48	(0.09)***	0.46	(0.10)***
1-5 Years			0.34	(0.08)***	0.34	(0.10)***
6 Years			0.36	(0.09)***	0.36	(0.10)**
Demographics						
Age	0.02	(0.00)***	0.01	(0.00)***	0.01	(0.00)***
Female	-0.01	(0.06)	-0.02	(0.06)	-0.02	(0.07)
More Urban	-0.07	(0.05)	-0.02	(0.05)	0.01	(0.06)
Marital Status (Ref: Married)						
Widowed	-0.00	(0.07)	0.00	(0.07)	0.00	(0.07)
Other	0.06	(0.08)	0.09	(0.08)	0.09	(0.08)
Occupation (Ref: White Collar)						
Blue Collar					-0.10	(0.10)
Agriculture/Fishing					-0.05	(0.13)
Missing					-0.07	(0.11)
Health Covariates						
Former Smoker (Ref: Never)					0.04	(0.06)
Current Smoker (Ref: Never)					0.19	(0.08)*
Binge Drinking					-0.13	(0.12)
Chronic Conditions					0.10	(0.03)**
Self Rated Health (Ref: Good)						
Fair					0.20	(0.08)*
Poor					0.38	(0.09)***
Financial Resources						
Wealth	-0.03	(0.01)**	-0.02	(0.01)	-0.02	(0.01)
Health Insurance						
Insured					-0.04	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type

1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 14 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (MHAS) (n=8,148 Transitions among 6,072 Respondents).

	Death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None			0.25	(0.09)**	0.19	(0.11)
1-5 Years			0.04	(0.09)	-0.02	(0.10)
6 Years			0.21	(0.10)*	0.15	(0.11)
Demographics						
Age	0.06	(0.00)***	0.06	(0.00)***	0.07	(0.00)***
Female	-0.52	(0.06)***	-0.53	(0.06)***	-0.58	(0.07)***
More Urban	0.10	(0.06)	0.13	(0.06)*	0.10	(0.06)
Marital Status (Ref: Married)						
Widowed	0.10	(0.07)	0.10	(0.07)	0.11	(0.07)
Other	0.20	(0.09)*	0.22	(0.09)*	0.24	(0.09)**
Occupation (Ref: White Collar)						
Blue Collar					0.03	(0.11)
Agriculture/Fishing					-0.07	(0.14)
Missing					0.16	(0.13)
Health Covariates						
Former Smoker (Ref: Never)					0.05	(0.07)
Current Smoker (Ref: Never)					0.38	(0.08)***
Binge Drinking					-0.06	(0.12)
Chronic Conditions					0.26	(0.03)***
Self Rated Health (Ref: Good)						
Fair					0.01	(0.08)
Poor					0.27	(0.09)**
Financial Resources						
Wealth	-0.03	(0.01)**	-0.03	(0.01)**	-0.03	(0.01)**
Health Insurance						
Insured					-0.02	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type

1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 15 (Long): Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Males in the Mexican Health and Aging Study (MHAS) (n=2,860 Transitions among 2,227 Respondents).

	Functional Limitation Improvement					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	-0.05	(0.13)	-0.08	(0.15)	-0.07	(0.15)
1-5 Years	0.06	(0.12)	0.04	(0.13)	0.06	(0.14)
6 Years	0.06	(0.13)	0.03	(0.14)	0.10	(0.15)
Demographics						
Age	-0.03	(0.00)***	-0.02	(0.00)***	-0.02	(0.00)***
More Urban	0.02	(0.08)	0.05	(0.10)	0.09	(0.10)
Marital Status (Ref: Married)						
Widowed			-0.07	(0.14)	-0.12	(0.14)
Other			-0.22	(0.16)	-0.28	(0.16)
Occupation (Ref: White Collar)						
Blue Collar			0.04	(0.14)	0.03	(0.15)
Agriculture/Fishing			0.10	(0.17)	0.05	(0.17)
Missing			-0.23	(0.47)	-0.25	(0.46)
Health Covariates						
Former Smoker (Ref: Never)			0.01	(0.09)	0.06	(0.09)
Current Smoker (Ref: Never)			0.31	(0.11)**	0.28	(0.11)*
Binge Drinking			-0.01	(0.11)	-0.07	(0.11)
Chronic Conditions					-0.19	(0.05)***
Self Rated Health (Ref: Good)						
Fair					-0.14	(0.10)
Poor					-0.35	(0.12)**
Financial Resources						
Income					0.01	(0.02)
Wealth					0.00	(0.02)
Insurance						
Insured					-0.21	(0.09)*

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 15 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Males in the Mexican Health and Aging Study (MHAS) (n=2,860 Transitions among 2,227 Respondents).

	Worsening Functional Limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.33	(0.15)*	0.31	(0.17)	0.19	(0.17)
1-5 Years	0.34	(0.14)*	0.32	(0.16)*	0.24	(0.16)
6 Years	0.35	(0.16)*	0.33	(0.17)*	0.24	(0.17)
Demographics						
Age	0.01	(0.00)*	0.01	(0.01)	0.01	(0.01)
More Urban	-0.10	(0.09)	-0.09	(0.11)	-0.07	(0.11)
Marital Status (Ref: Married)						
Widowed			-0.01	(0.15)	-0.02	(0.15)
Other			-0.07	(0.17)	-0.11	(0.18)
Occupation (Ref: White Collar)						
Blue Collar			0.00	(0.17)	-0.07	(0.17)
Agriculture/Fishing			0.03	(0.19)	-0.07	(0.20)
Missing			-0.06	(0.54)	-0.18	(0.54)
Health Covariates						
Former Smoker (Ref: Never)			0.14	(0.11)	0.12	(0.11)
Current Smoker (Ref: Never)			0.26	(0.13)*	0.25	(0.13)*
Binge Drinking			-0.33	(0.14)*	-0.29	(0.14)*
Chronic Conditions					0.06	(0.05)
Self Rated Health (Ref: Good)						
Fair					0.23	(0.13)
Poor					0.40	(0.15)**
Financial Resources						
Income					-0.03	(0.02)
Wealth					-0.02	(0.02)
Insurance						
Insured					-0.05	(0.10)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 15 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Males in the Mexican Health and Aging Study (MHAS) (n=2,860 Transitions among 2,227 Respondents).

	Death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.08	(0.14)	0.02	(0.17)	-0.14	(0.17)
1-5 Years	-0.07	(0.13)	-0.13	(0.16)	-0.26	(0.16)
6 Years	0.17	(0.15)	0.11	(0.17)	-0.01	(0.17)
Demographics						
Age	0.06	(0.00)***	0.06	(0.00)***	0.06	(0.00)***
More Urban	0.15	(0.09)	0.10	(0.10)	0.09	(0.11)
Marital Status (Ref: Married)						
Widowed			0.30	(0.13)*	0.31	(0.13)*
Other			0.19	(0.17)	0.15	(0.17)
Occupation (Ref: White Collar)						
Blue Collar			0.12	(0.17)	0.07	(0.18)
Agriculture/Fishing			0.03	(0.20)	-0.06	(0.20)
Missing			0.16	(0.45)	0.02	(0.44)
Health Covariates						
Former Smoker (Ref: Never)			0.15	(0.10)	0.11	(0.10)
Current Smoker (Ref: Never)			0.38	(0.12)**	0.37	(0.13)**
Binge Drinking			-0.20	(0.14)	-0.12	(0.14)
Chronic Conditions					0.22	(0.05)***
Self Rated Health (Ref: Good)						
Fair					0.00	(0.12)
Poor					0.34	(0.14)*
Financial Resources						
Income					-0.04	(0.02)*
Wealth					-0.04	(0.02)*
Insurance						
Insured					-0.03	(0.10)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 16 (Long): Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Females in the Mexican Health and Aging Study (MHAS) (n=5,288 Transitions among 3,845 Respondents).

	Functional Limitation Improvement					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
No Education	-0.05	(0.09)	-0.09	(0.11)	-0.04	(0.12)
1-5 Years Education	-0.14	(0.08)	-0.18	(0.11)	-0.13	(0.11)
6 Years Education	-0.01	(0.10)	-0.05	(0.11)	-0.03	(0.12)
Demographics						
Age	-0.02	(0.00)***	-0.02	(0.00)***	-0.03	(0.00)***
More Urban	0.00	(0.06)	0.01	(0.06)	0.03	(0.07)
Marital Status (Ref: Married)						
Widowed			0.02	(0.07)	0.03	(0.07)
Other			0.11	(0.08)	0.10	(0.08)
Occupation (Ref: White Collar)						
Blue Collar			0.06	(0.12)	0.09	(0.12)
Agriculture/Fishing			0.11	(0.16)	0.12	(0.17)
Missing			0.15	(0.12)	0.16	(0.13)
Health Covariates						
Former Smoker (Ref: Never)			-0.04	(0.07)	-0.02	(0.07)
Current Smoker (Ref: Never)			0.20	(0.10)*	0.19	(0.10)
Binge Drinking			-0.16	(0.23)	-0.21	(0.24)
Chronic Conditions					-0.10	(0.03)***
Self Rated Health (Ref: Good)						
Fair					-0.23	(0.08)**
Poor					-0.54	(0.09)***
Financial Resources						
Income					0.00	(0.01)
Wealth					0.01	(0.01)
Insurance						
Insured					-0.10	(0.06)*

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 16 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Females in the Mexican Health and Aging Study (MHAS) (n=5,288 Transitions among 3,845 Respondents).

	Worsening Functional Limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
No Education	0.59	(0.11)***	0.67	(0.13)***	0.61	(0.13)***
1-5 Years Education	0.38	(0.1)***	0.45	(0.12)***	0.42	(0.13)**
6 Years Education	0.37	(0.11)**	0.44	(0.13)**	0.42	(0.13)**
Demographics						
Age	0.02	(0.00)***	0.02	(0.00)***	0.02	(0.00)***
More Urban	0.02	(0.07)	0.02	(0.07)	0.04	(0.07)
Marital Status (Ref: Married)						
Widowed			0.02	(0.08)	0.01	(0.08)
Other			0.17	(0.09)	0.15	(0.09)
Occupation (Ref: White Collar)						
Blue Collar			-0.12	(0.13)	-0.15	(0.13)
Agriculture/Fishing			-0.02	(0.17)	-0.05	(0.17)
Missing			-0.07	(0.14)	-0.10	(0.14)
Health Covariates						
Former Smoker (Ref: Never)			0.01	(0.08)	0.00	(0.08)
Current Smoker (Ref: Never)			0.14	(0.11)	0.16	(0.11)
Binge Drinking			0.25	(0.24)	0.30	(0.24)
Chronic Conditions					0.11	(0.04)**
Self Rated Health (Ref: Good)						
Fair					0.18	(0.10)
Poor					0.38	(0.11)***
Financial Resources						
Income					0.01	(0.01)
Wealth					-0.01	(0.01)
Insurance						
Insured					-0.00	(0.07)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 16 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexican Females in the Mexican Health and Aging Study (MHAS) (n=5,288 Transitions among 3,845 Respondents).

	Death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
No Education	0.43	(0.11)***	0.48	(0.14)**	0.43	(0.15)**
1-5 Years Education	0.19	(0.11)	0.24	(0.14)	0.20	(0.14)
6 Years Education	0.26	(0.13)*	0.30	(0.15)*	0.29	(0.15)
Demographics						
Age	0.07	(0.00)***	0.07	(0.00)***	0.07	(0.00)***
More Urban	0.10	(0.07)	0.10	(0.08)	0.11	(0.08)
Marital Status (Ref: Married)						
Widowed			0.05	(0.08)	0.04	(0.08)
Other			0.29	(0.1)**	0.26	(0.11)*
Occupation (Ref: White Collar)						
Blue Collar			-0.07	(0.15)	-0.08	(0.15)
Agriculture/Fishing			-0.06	(0.19)	-0.08	(0.19)
Missing			0.07	(0.15)	0.05	(0.15)
Health Covariates						
Former Smoker (Ref: Never)			0.05	(0.09)	0.03	(0.09)
Current Smoker (Ref: Never)			0.33	(0.12)**	0.41	(0.12)**
Binge Drinking			0.02	(0.28)	0.10	(0.28)
Chronic Conditions					0.29	(0.04)***
Self Rated Health (Ref: Good)						
Fair					0.01	(0.11)
Poor					0.23	(0.12)
Financial Resources						
Income					0.00	(0.01)
Wealth					-0.02	(0.01)
Insurance						
Insured					0.01	(0.08)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value

(probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 18 (Long): Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference) to Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (Younger Cohort, n=6,353 Transitions among 4,326 Respondents).

	No functional limitation to functional limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.45	(0.06)***	0.46	(0.09)***	0.31	(0.07)***
1-5 Years	0.33	(0.05)***	0.33	(0.08)***	0.18	(0.06)**
6 Years	0.22	(0.06)***	0.21	(0.08)**	0.09	(0.07)
Demographics						
Age	0.03	(0.00)***	0.03	(0.01)***	0.03	(0.00)***
Female	0.56	(0.04)***	0.54	(0.06)***	0.51	(0.05)***
More Urban	-0.07	(0.04)	-0.04	(0.06)	-0.08	(0.05)
Marital Status (Ref: Married)						
Widowed			0.01	(0.09)	0.03	(0.06)
Other			-0.08	(0.07)	-0.10	(0.06)
Occupation (Ref: White Collar)						
Blue Collar			0.17	(0.08)*	0.02	(0.07)
Agriculture/Fishing			0.07	(0.11)	-0.02	(0.09)
Missing			0.23	(0.10)*	0.03	(0.08)
Health Covariates						
Former Smoker (Ref: Never)			0.08	(0.06)	0.03	(0.05)
Current Smoker (Ref: Never)			-0.07	(0.07)	0.02	(0.05)
Binge Drinking			0.04	(0.08)	0.07	(0.07)
Chronic Conditions					0.24	(0.03)***
Self Rated Health (Ref: Good)						
Fair					0.36	(0.04)***
Poor					0.43	(0.07)***
Financial Resources						
Income					-0.01	(0.01)
Wealth					0.00	(0.01)
Health Insurance						
Insured					0.02	(0.04)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 18 (Long) Continued: Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference) to Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (Younger Cohort, n=6,353 Transitions among 4,326 Respondents).

	No functional limitation to death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.19	(0.09)*	0.11	(0.14)	-0.13	(0.10)
1-5 Years	0.20	(0.08)**	0.16	(0.11)	-0.08	(0.09)
6 Years	0.03	(0.09)	0.04	(0.12)	-0.21	(0.10)*
Demographics						
Age	0.08	(0.00)***	0.07	(0.01)***	0.08	(0.00)***
Female	0.02	(0.05)	0.05	(0.10)	-0.08	(0.07)
More Urban	0.03	(0.06)	0.08	(0.09)	0.01	(0.07)
Marital Status (Ref: Married)						
Widowed			0.24	(0.13)	0.27	(0.08)***
Other			0.24	(0.11)*	0.13	(0.09)
Occupation (Ref: White Collar)						
Blue Collar			0.27	(0.13)*	0.12	(0.10)
Agriculture/Fishing			0.14	(0.18)	0.02	(0.13)
Missing			0.43	(0.16)**	0.15	(0.13)
Health Covariates						
Former Smoker (Ref: Never)			0.08	(0.10)	0.07	(0.07)
Current Smoker (Ref: Never)			0.18	(0.10)	0.33	(0.07)***
Binge Drinking			0.14	(0.11)	0.16	(0.09)
Chronic Conditions					0.44	(0.04)***
Self Rated Health (Ref: Good)						
Fair					0.30	(0.06)***
Poor					0.63	(0.10)***
Financial Resources						
Income					-0.03	(0.01)**
Wealth					-0.03	(0.01)**
Health Insurance						
Insured					-0.07	(0.06)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 19 (Long): Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference) to Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (Older Cohort, n=4,214 Transitions among 3,079 Respondents).

	No functional limitation to functional limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.28	(0.10)**	0.36	(0.12)**	0.22	(0.12)
1-5 Years	0.14	(0.09)	0.22	(0.11)*	0.10	(0.11)
6 Years	0.04	(0.10)	0.12	(0.12)	0.03	(0.12)
Demographics						
Age	0.04	(0.01)***	0.04	(0.01)***	0.04	(0.01)***
Female	0.56	(0.06)***	0.66	(0.08)***	0.61	(0.08)***
More Urban	-0.16	(0.07)*	-0.17	(0.07)*	-0.15	(0.07)*
Marital Status (Ref: Married)						
Widowed			0.02	(0.08)	0.03	(0.08)
Other			-0.24	(0.10)*	-0.20	(0.10)*
Occupation (Ref: White Collar)						
Blue Collar			-0.18	(0.11)	-0.20	(0.11)
Agriculture/Fishing			-0.18	(0.14)	-0.20	(0.14)
Missing			-0.28	(0.14)*	-0.30	(0.14)*
Health Covariates						
Former Smoker (Ref: Never)			0.06	(0.07)	0.04	(0.07)
Current Smoker (Ref: Never)			0.13	(0.09)	0.18	(0.09)*
Binge Drinking			0.06	(0.12)	0.08	(0.12)
Chronic Conditions					0.26	(0.05)***
Self Rated Health (Ref: Good)						
Fair					0.30	(0.06)***
Poor					0.27	(0.11)*
Financial Resources						
Income					-0.01	(0.01)
Wealth					-0.00	(0.01)
Health Insurance						
Insured					-0.10	(0.07)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 19 (Long) Continued: Multinomial Probit Model Predicting Transitions from No Functional Limitation (Reference) to Functional Limitation or Death among Older Mexican Adults in the Mexican Health and Aging Study (Older Cohort, n=4,214 Transitions among 3,079 Respondents).

	No functional limitation to death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.28	(0.10)**	0.02	(0.16)	-0.20	(0.17)
1-5 Years	0.14	(0.09)	0.03	(0.15)	-0.15	(0.16)
6 Years	0.04	(0.10)	-0.20	(0.16)	-0.37	(0.16)*
Demographics						
Age	0.04	(0.01)***	0.11	(0.01)***	0.11	(0.01)***
Female	0.56	(0.06)***	0.07	(0.11)	-0.03	(0.11)
More Urban	-0.16	(0.07)*	-0.13	(0.09)	-0.14	(0.10)
Marital Status (Ref: Married)						
Widowed			0.22	(0.10)*	0.26	(0.10)*
Other			-0.11	(0.13)	-0.10	(0.14)
Occupation (Ref: White Collar)						
Blue Collar			0.06	(0.16)	0.03	(0.16)
Agriculture/Fishing			-0.05	(0.18)	-0.06	(0.18)
Missing			-0.09	(0.19)	-0.10	(0.19)
Health Covariates						
Former Smoker (Ref: Never)			0.12	(0.10)	0.09	(0.10)
Current Smoker (Ref: Never)			0.40	(0.11)***	0.50	(0.11)***
Binge Drinking			0.15	(0.16)	0.17	(0.17)
Chronic Conditions					0.48	(0.06)***
Self Rated Health (Ref: Good)						
Fair					0.34	(0.09)***
Poor					0.63	(0.14)***
Financial Resources						
Income					-0.02	(0.02)
Wealth					-0.04	(0.02)*
Health Insurance						
Insured					0.05	(0.09)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents and accounts for clustering of observations within individuals. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes p≤0.05, ** denotes p≤0.01, *** denotes p≤0.001.

Table 20 (Long): Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexicans in the Mexican Health and Aging Study (MHAS) (n=3,385 Transitions among 2,583 Respondents). The Younger Cohort.

	Functional Limitation Improvement					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
No Education	-0.09	(0.11)	-0.04	(0.13)	-0.05	(0.13)
1-5 Years Education	-0.13	(0.09)	-0.08	(0.11)	-0.06	(0.12)
6 Years Education	0.00	(0.1)	0.05	(0.12)	0.08	(0.12)
Demographics						
Age	-0.00	(0.01)*	-0.02	(0.01)	-0.00	(0.01)
Female	-0.39	(0.08)***	-0.35	(0.09)***	-0.30	(0.09)**
More Urban	0.07	(0.07)	0.08	(0.08)	0.15	(0.08)
Marital Status (Ref: Married)						
Widowed			-0.13	(0.11)	-0.14	(0.11)
Other			0.01	(0.10)	-0.10	(0.10)
Occupation (Ref: White Collar)						
Blue Collar			-0.09	(0.12)	-0.11	(0.13)
Agriculture/Fishing			-0.05	(0.17)	-0.10	(0.17)
Missing			-0.04	(0.14)	-0.10	(0.15)
Health Covariates						
Former Smoker (Ref: Never)			0.05	(0.09)	0.08	(0.09)
Current Smoker (Ref: Never)			0.24	(0.10)*	0.22	(0.10)*
Binge Drinking			-0.11	(0.13)	-0.20	(0.14)
Chronic Conditions					-0.20	(0.04)***
Self Rated Health (Ref: Good)						
Fair					-0.20	(0.09)*
Poor					-0.44	(0.11)***
Financial Resources						
Income					-0.01	(0.01)
Wealth					0.00	(0.01)
Health Insurance						
Insured					-0.30	(0.08)**

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates

probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 20 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexicans in the Mexican Health and Aging Study (MHAS) (n=3,385 Transitions among 2,583 Respondents). The Younger Cohort.

	Worsening Functional Limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
No Education	0.55	(0.13)***	0.67	(0.15)***	0.59	(0.16)***
1-5 Years Education	0.37	(0.12)**	0.49	(0.14)***	0.45	(0.14)**
6 Years Education	0.34	(0.13)**	0.43	(0.14)**	0.38	(0.14)**
Demographics						
Age	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)
Female	-0.09	(0.09)	-0.13	(0.11)	-0.20	(0.11)
More Urban	0.08	(0.08)	0.05	(0.09)	0.08	(0.09)
Marital Status (Ref: Married)						
Widowed			-0.03	(0.13)	-0.04	(0.13)
Other			0.11	(0.12)	0.12	(0.12)
Occupation (Ref: White Collar)						
Blue Collar			-0.21	(0.15)	-0.26	(0.15)
Agriculture/Fishing			-0.28	(0.20)	-0.30	(0.20)
Missing			-0.06	(0.16)	-0.10	(0.17)
Health Covariates						
Former Smoker (Ref: Never)			0.10	(0.10)	0.09	(0.10)
Current Smoker (Ref: Never)			0.22	(0.11)	0.22	(0.11)
Binge Drinking			-0.18	(0.17)	-0.20	(0.17)
Chronic Conditions					0.05	(0.05)
Self Rated Health (Ref: Good)						
Fair					0.35	(0.13)**
Poor					0.58	(0.14)***
Financial Resources						
Income					0.01	(0.02)
Wealth					0.00	(0.02)
Health Insurance						
Insured					-0.10	(0.09)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates

probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 20 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexicans in the Mexican Health and Aging Study (MHAS) (n=3,385 Transitions among 2,583 Respondents). The Younger Cohort.

	Death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
No Education	0.39	(0.15)**	0.42	(0.17)*	0.30	(0.18)
1-5 Years Education	0.11	(0.13)	0.14	(0.16)	0.06	(0.16)
6 Years Education	0.29	(0.14)*	0.31	(0.17)	0.22	(0.17)
Demographics						
Age	0.04	(0.02)*	0.04	(0.02)*	0.03	(0.02)
Female	-0.53	(0.10)***	-0.70	(0.12)***	-0.80	(0.13)***
More Urban	0.21	(0.10)*	0.13	(0.11)	0.11	(0.11)
Marital Status (Ref: Married)						
Widowed			0.22	(0.14)	0.23	(0.15)
Other			0.34	(0.14)*	0.29	(0.15)*
Occupation (Ref: White Collar)						
Blue Collar			-0.02	(0.19)	-0.01	(0.19)
Agriculture/Fishing			-0.32	(0.25)	-0.30	(0.25)
Missing			0.25	(0.21)	0.25	(0.21)
Health Covariates						
Former Smoker (Ref: Never)			0.14	(0.12)	0.09	(0.13)
Current Smoker (Ref: Never)			0.36	(0.13)**	0.41	(0.13)**
Binge Drinking			-0.37	(0.19)	-0.40	(0.20)
Chronic Conditions					0.35	(0.06)***
Self Rated Health (Ref: Good)						
Fair					-0.20	(0.14)
Poor					0.18	(0.16)
Financial Resources						
Income					0.00	(0.02)
Wealth					-0.04	(0.02)
Health Insurance						
Insured					0.06	(0.11)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates

probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type 1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 21 (Long): Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexicans in the Mexican Health and Aging Study (MHAS) (n=4,763 Transitions among 3,489 Respondents). The Older Cohort.

	Functional Limitation Improvement					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.04	(0.11)	-0.10	(0.13)	-0.07	(0.13)
1-5 Years	0.02	(0.10)	-0.10	(0.13)	-0.08	(0.13)
6 Years	0.04	(0.12)	-0.08	(0.14)	-0.06	(0.14)
Demographics						
Age	-0.03	(0.00)***	-0.03	(0.00)***	-0.03	(0.00)***
Female	-0.40	(0.06)***	-0.39	(0.08)***	-0.36	(0.09)***
More Urban	-0.04	(0.07)	-0.02	(0.07)	-0.02	(0.08)
Marital Status (Ref: Married)						
Widowed			0.06	(0.08)	0.05	(0.08)
Other			0.09	(0.11)	0.08	(0.11)
Occupation (Ref: White Collar)						
Blue Collar			0.23	(0.13)	0.25	(0.14)
Agriculture/Fishing			0.27	(0.16)	0.28	(0.16)
Missing			0.33	(0.15)*	0.33	(0.15)*
Health Covariates						
Former Smoker (Ref: Never)			-0.10	(0.08)	-0.06	(0.08)
Current Smoker (Ref: Never)			0.26	(0.10)*	0.24	(0.10)*
Binge Drinking			0.09	(0.15)	0.01	(0.15)
Chronic Conditions					-0.10	(0.04)**
Self Rated Health (Ref: Good)						
Fair					-0.20	(0.08)*
Poor					-0.49	(0.10)***
Financial Resources						
Wealth	0.01	(0.01)	0.02	(0.01)	0.01	(0.01)
Health Insurance						
Insured					-0.08	(0.07)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type

1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 21 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexicans in the Mexican Health and Aging Study (MHAS) (n=4,763 Transitions among 3,489 Respondents). The Older Cohort.

	Worsening Functional Limitation					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.44	(0.12)***	0.41	(0.14)**	0.38	(0.15)**
1-5 Years	0.32	(0.12)**	0.29	(0.14)*	0.27	(0.14)*
6 Years	0.38	(0.13)**	0.36	(0.15)*	0.34	(0.15)*
Demographics						
Age	0.01	(0.00)	0.01	(0.00)	0.01	(0.01)*
Female	0.03	(0.07)	0.09	(0.09)	0.07	(0.09)
More Urban	-0.08	(0.07)	-0.06	(0.07)	-0.06	(0.08)
Marital Status (Ref: Married)						
Widowed			0.00	(0.08)	0.01	(0.08)
Other			0.08	(0.11)	0.08	(0.11)
Occupation (Ref: White Collar)						
Blue Collar			0.06	(0.14)	0.04	(0.14)
Agriculture/Fishing			0.17	(0.16)	0.15	(0.17)
Missing			-0.01	(0.16)	-0.00	(0.16)
Health Covariates						
Former Smoker (Ref: Never)			0.02	(0.08)	0.00	(0.08)
Current Smoker (Ref: Never)			0.10	(0.11)	0.13	(0.11)
Binge Drinking			-0.18	(0.17)	-0.14	(0.18)
Chronic Conditions					0.12	(0.04)**
Self Rated Health (Ref: Good)						
Fair					0.11	(0.10)
Poor					0.28	(0.11)*
Financial Resources						
Wealth	-0.03	(0.01)*	-0.03	(0.01)*	-0.02	(0.01)*
Health Insurance						
Insured					0.01	(0.07)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type

1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

Table 21 (Long) Continued: Multinomial Probit Model Predicting Transitions from Functional Limitation (Reference Outcome: Stable Functional Limitation) to Worsening or Improving Functional Limitation or Death among Older Mexicans in the Mexican Health and Aging Study (MHAS) (n=4,763 Transitions among 3,489 Respondents). The Older Cohort.

	Death					
	Model 1		Model 2		Model 3	
	β	(SE)p	β	(SE)p	β	(SE)p
Education (Ref: 7+ Years)						
None	0.20	(0.11)	0.17	(0.14)	0.13	(0.14)
1-5 Years	0.02	(0.11)	-0.03	(0.14)	-0.06	(0.14)
6 Years	0.15	(0.13)	0.10	(0.15)	0.08	(0.15)
Demographics						
Age	0.07	(0.00)***	0.07	(0.00)***	0.07	(0.00)***
Female	-0.50	(0.07)***	-0.47	(0.09)***	-0.50	(0.09)***
More Urban	0.08	(0.07)	0.07	(0.08)	0.06	(0.08)
Marital Status (Ref: Married)						
Widowed			0.08	(0.08)	0.08	(0.08)
Other			0.20	(0.11)	0.21	(0.12)
Occupation (Ref: White Collar)						
Blue Collar			0.11	(0.14)	0.10	(0.14)
Agriculture/Fishing			0.07	(0.16)	0.05	(0.17)
Missing			0.16	(0.16)	0.16	(0.16)
Health Covariates						
Former Smoker (Ref: Never)			0.05	(0.08)	0.03	(0.08)
Current Smoker (Ref: Never)			0.29	(0.11)**	0.34	(0.11)**
Binge Drinking			0.04	(0.16)	0.11	(0.16)
Chronic Conditions					0.24	(0.04)***
Self Rated Health (Ref: Good)						
Fair					0.10	(0.10)
Poor					0.29	(0.11)**
Financial Resources						
Wealth	-0.03	(0.01)*	-0.02	(0.01)	-0.02	(0.01)
Health Insurance						
Insured					-0.01	(0.08)

Note, Source: author's own calculation using the MHAS data. All models include a variable indicating which interwave period the observation represents, account for clustering of observations within individuals, and control for baseline level of functional limitation. β indicates probit regression coefficient, SE refers to Standard Error, p indicates p-value (probability of type

1 error) * denotes $p \leq 0.05$, ** denotes $p \leq 0.01$, *** denotes $p \leq 0.001$.

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Vita

Joseph Linneman Sáenz was born on May 15, 1989 in Bryan, Texas to his father Rogelio Sáenz and mother Judith Linneman. Joseph completed his primary education through the College Station Independent School District and conducted his undergraduate studies at Texas Agricultural and Mechanical (A&M) University in College Station, Texas earning a Bacherlor's of Science (Cum Laude) in Psychology with a minor in Sociology. With this dissertation, Joseph will complete the final requirement to obtain his Ph.D. from the University of Texas Medical Branch (2011 to 2016). Joseph has several publications including the following:

- **Sáenz, J.L.**, & Wong, R. "Educational Gradients & Pathways of Disability Onset among Older Mexicans." *Research on Aging*. Forthcoming.
- Díaz-Venegas, C., **Sáenz, J.** & Wong, R. "Family Size and Old-Age Wellbeing, Effects of the Fertility Transition in Mexico." *Ageing & Society*. Forthcoming.
- **Sáenz, J. L.**, & Wong, R. (2015). A Life Course Approach to Mortality in Mexico. *Salud Publica de Mexico*, *57*, s46-s53.
- Siordia, C., & **Sáenz, J.** (2013). On the Relationship between Neighborhood Perception, Length of Residence and Co-Ethnic Concentration. *Applied Spatial Analysis and Policy*, *6*(4), 267-284.
- Siordia, C., & **Sáenz, J.** (2013). What is a Neighborhood? Definition in Studies about Depressive Symptoms in Older Persons." *The Journal of frailty & aging*, *2*(3), 153-164.
- Siordia, C., **Sáenz, J.**, & Tom, S. E. (2012). An Introduction to Macro-Level Spatial Nonstationarity: a Geographically Weighted Regression Analysis of Diabetes and Poverty. *Human Geographies*, *6*(2), 5.
- Siordia, C., & **Sáenz, J.** (2012). Neighborhood Perception and Obesity in Aged Mexican Americans. *The Journal of Frailty & Aging*, *1*(4), 152.

Joseph Saenz has served as a teaching assistant for courses in epidemiology and focuses his research on socioeconomic disparities in disability, mortality, and cognition among the Mexican and Mexican-American population. Joseph's areas of expertise

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