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Border Epidemiological Study of Aging: The Role of Psychosocial Factors on Mortality of Mexican Americans in South Texas

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BORDER EPIDEMIOLOGICAL STUDY OF AGING: THE ROLE OF PSYCHOSOCIAL FACTORS ON MORTALITY OF MEXICAN AMERICANS IN SOUTH TEXAS

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Raed Jannadi

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To: Dean Tomás R. Guilarte
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This dissertation, written by Raed Jannadi, and entitled Border Epidemiological Study of Aging: The Role of Psychosocial Factors on Mortality of Mexican Americans in South Texas, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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ABSTRACT OF THE DISSERTATION

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Despite Mexican Americans experiencing many chronic illnesses, e.g., diabetes and obesity, they exhibit higher life expectancy than other population groups in the United States. This is known as the Hispanic Paradox. This dissertation aimed to further contribute to the literature on the “paradox” by investigating the association between psychosocial factors rarely investigated in this population, such as social support, self-rated health, and stressful life events, with incident diabetes and all-cause mortality.

Data for this dissertation are from the Border Epidemiological Study of Aging, known as BESA, a population based longitudinal study consisting of four waves conducted in South Texas from 1994 to 2006/07. Additional 12 years of mortality data were requested from the National Death Index (NDI-CDC) database resulting in a total of 24 years of survival follow-up (1995-2019). The initial probability sample yielded 1089 Mexican American participants, 45 years or older. When weighed the sample was statistically representative of 300,000 border residents.

Findings indicate that low social support, loss of a father between 5 – 30 years old, and loss of a child at any time are independent risk factors for developing type 2 diabetes. Additionally, findings from the Cox Hazard Model indicate that losing a father between the ages of 5 – 17 increased the mortality risk decades later after adjusting for demographics, education, self-rated heath, and physical health. The median survival age for those losing a father between the ages of 5 – 17 years was 83 years old compared to 86 for those who did not experience this loss. Moreover, a better self-rating of health in late midlife increased over all life expectancy, even after adjusting for demographics, education, physical and mental health at the time of first health assessment.

It is suggested that results presented in this dissertation have the potential to advance gerontological policy by providing insights on older adults at risk for diabetes and lower survival through the assessment of psychosocial stress. Policy enhancing social support interventions at the population level are recommended cost-effective strategies for promoting health. Finally, research investigating efficacy of culturally tailored interventions aimed to support social environments is recommended.

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ABBREVIATIONS AND ACRONYMS

BESA	Border Epidemiological Study of Aging
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
CVD	Cardiovascular Diseases
DSHS	Department of State Health Services
HR	Hazard Ratio
HRS	Health and Retirement Study
IADL	Instrumental Activities of Daily Living
IRB	Institutional Review Board
MRFIT	Multiple Risk Factor Intervention Trial
NDI	National Death Index
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
OR	Odds Ratio
RGV	Rio Grande Valley
SD	Standard Deviation
SSN	Social Security Number
SPSS	Statistical Package for the Social Sciences
SES	Socioeconomic Status
SLE	Stressful Life Events

SRH	Self-Rated Health
T2DM	Type 2 Diabetes Mellitus
U.S.	United States
WHI	Women Health Initiative
WHO	World Health Organization

CHAPTER I: INTRODUCTION

This dissertation follows the three-manuscript option, hence this introductory chapter presents a comprehensive discussion that includes the regional background of the study and the broad theoretical and literature review that underlie and provide the rationale for the research questions and hypotheses separately presented in each of the three manuscripts. The study was approved by Florida International University, Human Subjects Review Board, IRB-19-0139 on April 25, 2019 (Appendix A).

Specific Aims and Hypotheses

We propose three manuscripts and respective hypotheses to achieve the dissertation goal of conducting a longitudinal analysis on predictors of diabetes, all-cause mortality, and self-assessment of health in a probability sample of 1089 middle aged and older Mexican Americans in the Lower Rio Grande Valley of Texas.

Manuscript 1:

AIM1: Assess the impact of self-rated health on diabetes risk among non-diabetic older Mexican American adults in South Texas after 12 years of follow-up.

Hypothesis 1: Non-diabetic participants with poorer self-rated health at wave 1 will have higher incident diabetes at wave 4 when compared to individuals with excellent self-rated health. AIM2: Investigate the effect of social support and exposure to stressful life events on diabetes risk among non-diabetic older Mexican Americans in South Texas after a 12-year follow-up.

Hypothesis 2: Non-diabetic participants with low social support or experienced stressful life events reported at wave 1 will have higher diabetes risk at wave 4 when compared to those with high social support or experienced less stressful life events.

Manuscript 2:

AIM1: Examine the association between early parental death and all-cause mortality among older Mexican American adults in South Texas across 24 years of follow-up.

Hypothesis 1: Participants who experienced early parental death will have lower life expectancy when compared to those who did not experience early parental death.

AIM2: Assess the moderating effect of sex in the relationship between early parental death and all-cause mortality.

Hypothesis 2: The association between exposure to early parental death and all-cause mortality will be moderated by sex.

Manuscript 3:

AIM1: Assess the predictors of self-health rating among older adult Mexican Americans living in South Texas.

Hypothesis 1: Participants who reported a physical or mental health diagnosis will rate their health lower than those who did not.

AIM2: Investigate the relationship between self-rated health and all-cause mortality among older Mexican Americans in South Texas during a 24-year follow-up.

Hypothesis 2: Respondents with excellent self-rated health at baseline will have lower mortality risk when compared to those with poorer self-rated health at baseline.

AIM3: Examine the moderating effect of sex in the relationship between self-rated health and all-cause mortality.

Hypothesis 3: The association between self-rated health and all-cause mortality will be modified by sex.

Methods

Below we provide a brief review of the parent study that generated the data for the research conducted in this dissertation.

The Border Epidemiological Study of Aging (BESA)

Study Design and Sample

Data are from the Border Epidemiological Study of Aging, known as BESA, a longitudinal design study consisting of four waves conducted in South Texas from 1994 to 2006/07. In 2008, the sample was reviewed for mortality by requesting death certificates from the Texas Department of State Health Services (DSHS) for all participants who had been lost to follow up during the 2006/2007 Wave 4 data collection. This first death certificate review yielded 127 deaths. Additional 12 years of survival follow up data were requested and received from the National Death Index (NDI) resulting in a total of 24 years of follow-up mortality and survival (1995-2019).

The sampling frame for the BESA was drawn using tract data from the 1990 US Census on the 40+ population of Mexican origin for all tracts in Hidalgo County, TX, and tracts within surrounding three counties (Cameron, Willacy and Starr). Besides the age stratum of 45+ and Mexican American origin, census tracts were used as the strata to generate recruitment quotas to meet the requirements of the sampling frame. Hidalgo County is ranked 7th among Texas counties, with a population of slightly over a million. Surrounding counties are much smaller and only the bordering counties were used as stratum to generate the final sample. Sample recruitment for all census tracts were stratified by age and proportionally represented in the final sample.

It is noted that the sampling frame was proportionally representative of the total number of census tract residents, 40 years or older in 1990, of Mexican origin, residing in those tracts, who at the initiation of the study five years later, would have reached the minimum age of 45 for sample selection. The sampling unit consisted of all households in the tract that included a 40-year-old and older Mexican American in 1990; as reported in the decennial 1990 census. All households in the tract indicating at least one 40-year old Mexican American dweller met the sampling frame specifications. For all urban tracts, streets were randomized and within streets, city blocks were further randomized. The total sample size for the tract was proportionally stratified, given the number of the 40-year old who resided in the tract in 1990; thus, sample sizes by tracts vary according to the total size of the population, stratified by age and ethnicity.

Finally, it is noted that counties along the Texas-Mexico border area densely populated by Mexican Americans, with Hidalgo County, at the center of the study, with a population that is 90% Mexican American in origin. Starr County is 99% Mexican American and Willacy and Cameron are about 87% Mexican American. Hence, the study took advantage of the density of the population which afforded a probability sample selection, since otherwise the tracts would not have yielded large numbers. A number table was used to select randomly the last digit of house numbers or apartment buildings that would be targeted for recruitment. At this level, sampling was with replacement, two additional digits were randomly drawn for replacement, these additional replacement numbers were used to either replace a number that did not exist on the block or for a refusal to participate in the study. This was necessary because street numbers vary by blocks. Two houses were selected for recruitment within each randomized block. For each tract, the number of households targeted was established according to the estimated number of 40-year old living on the tract in 1990. The sampling frame was finalized in July 1994, with sample recruitment beginning in fall 1994. The total sample consisted of 1089 households with at least one resident aged 45, or turning 45 years of age in 1995. No further randomization was implemented at the household level. Households with more than one member eligible to participate could decide on which household member would participate in the study. An effort was made early on to randomize all eligible members of the household, but householders met this effort with resistance. Consequently, the decision was made to allow all eligible participants to decide on who would volunteer. Thus, randomization stopped at the household level. Hence, participants represent a probability sample of households. However, when weighed the data is representative of 300,000 border residents (Bastida et al., 2008).

Study Measures

Data collection began in 1995. Three consecutive waves were conducted between 1998 and the end of the last wave in 2006/07. Participants consented to respond to an in-home face-to-face interview in either Spanish or English. A two-hour IRB approved survey questionnaire by a panel of community residents and researchers were administered in each wave to collect the data. A medical doctor who reviewed the data with reference to prescription medications, family physician and laboratory work whenever included further verified all health reported data.

Data Wave 1 (1995 – 1996)

Usual demographic and socioeconomic status (SES) questions were asked, e.g. age, date of birth, place of birth, time of immigration for those who born outside the U.S., marital status, type of work/occupation done most of their lives, employment status, years of education, annual personal and household income, and literacy. Additionally, Wave 1 queried participants on living arrangements, physical and mental health conditions, prior hospitalizations, medications, instrumental and physical daily activities, alcohol consumption, social support, life events, and religious attendance. Moreover, interviewer measured the height and weight of the participants and assessed their mental capacity and physical functioning. Participants were asked about their willingness to be contacted for a second interview at a later time, which included their names, address, telephone number, and a second telephone number of a contact person who would know about them.

Data Wave 2 (1998 – 1999)

Repeated questions of the first wave and added new questions on sleep with no additional new information requested. Similarly to wave 1, participants were queried on their willingness to be interviewed at a later time, which included the name, address, and telephone number of a contact person.

Data Wave 3 (2002 – 2003)

Repeated second wave measurements and added new questions on physical activities, managing stress, and smoking. Again, willingness to be interviewed at a later time was recorded with corresponding contact person information.

Data Wave 4 (2006 – 2007)

Repeated third wave measurements and included additional questions on lifestyle (changes in physical activities and eating) and neighborhood assessments. As in previous waves, questions about willingness to continue with the study and contact person were included.

Mortality Data (1995 – 2019)

Survival follow-up was assessed through three different methods. In 2008, death data were obtained from the death certificates requested from the Texas Department of State Health Services (DSHS). In 2020, mortality data of the entire BESA sample were requested from the CDC through the records of the National Death Index. For participants with incorrect or missing Social Security Numbers (SSN), obituaries news and/or phone calls were used to obtain date of death and assess their vital status. Survival time was measured in years starting with the date of baseline data collection and ending with the death of the participant or end of follow up on December 31, 2019.

Regional Background

Mexican Americans in the Rio Grande Valley (RGV) living on the Texas–Mexico border reside in one of the most disadvantaged regions of the country (Ryabov & Merino, 2017). Four southernmost Texas counties – Cameron, Willacy, Starr, and Hidalgo – constitute the Rio Grande Valley. During the period between 1990 and 2009, the area was recognized for substantial population growth knowing that the U.S. population increased by only 24% while the Valley had a 75% growth rate (Ryabov & Merino, 2017). Nowadays, more than 1.3 million (4.7%) of the total Texas population are living in the Valley (U.S. Census Bureau, 2020). Moreover, the majority of the RGV residents are Mexican Americans, reaching up to 95.3% in Starr County (U.S. Census Bureau, 2020).

Notwithstanding the area's population growth, residents of the Valley exhibit low education, low income, and limited access to healthcare. Based on the 2019 Census data, the proportion of the adult population in the four-county area without a high-school school degree ranges from 32.1% in Cameron County to 46.7% in Starr County while the national average is 12% (U.S. Census Bureau, 2020). In Hidalgo, the most populated county in the Valley, the poverty rate is about 30%, which is more than twice that of Texas (13.6%) (U.S. Census Bureau, 2020). Furthermore, latest census data revealed that approximately 30% of Hidalgo County population living without health insurance compared to 8.8% nationally (U.S. Census Bureau, 2020). Moreover, the county is only served by one primary care physician for every 2,220 individuals (County Health Rankings, 2020).

Currently, this region has been swept by the COVID 19 pandemic and frequently has made it to the national news in terms of COVID 19 incidence, death, and the absence of hospital beds to manage the rising number of daily cases. The latter unfolding within a context of high rates of obesity and diabetes which have plagued the region for decades (Bastida & Pagán, 2002; Fisher-Hoch et al., 2010). The culture of the region is one of the most dynamic in the country, where limited English proficiency is common, and where it is said the predominant culture is family-centered, with women fulfilling essential social roles, particularly related to caregiving (Perkins et al., 2001).

In sum, the Valley region with one of the fastest population growth in Texas and recently popularized by the media as one of three US Mexico border crossings where the recent major immigration crises occurred provides a challenging context for the study of population health. In this vein, below I present and discuss the broad research literature that supported the research conducted and presented here.

Significance

Hispanic Paradox and Psychosocial Factors

Despite their socioeconomic disadvantage, Hispanics in the U.S. have better life expectancy and better outcomes on some health measures compared to non-Hispanic whites (Markides & Eschbach, 2005). Recent data from the division of vital statistics indicated that the overall life expectancy at birth for the Hispanic population in the United States is 81.8 years compared to 78.5 years for the non-Hispanic white population (Arias & Xu, 2019). However, evidence suggested that Mexican Americans, the largest Hispanic subgroup in the country, have higher rates of other morbidities such as disability and diabetes (CDC, 2020; Hayward et al., 2014). The logical inconsistencies that these factors indicate are frequently referred to as the Hispanic Paradox.

Evidence indicated that US-Mexico border counties in spite of their low socio economic level show higher life expectancy when compared to other similar regions. For example, a study conducted among older Mexican Americans living across the border revealed that participants resided in a border county had lower mortality risk compared to non-border residents (Salinas et al., 2013). Moreover, the Valley counties exhibited good life expectancy when compared to international life expectancy (Kulkarni et al., 2011). The relatively health advantages Hispanics encounter are frequently explained by cultural attributes, neighborhoods environments, and immigrant health selection (Eschbach et al., 2004; Markides & Eschbach, 2005; Palloni & Arias, 2004).

Some research supports the Paradox and reveals that Mexican Americans who live in high ethnically concentrated neighborhoods have lower risk of mortality (Eschbach et al., 2004). Moreover, evidence suggested that sociocultural factors may serve a protective function when it comes to the overall health of border residents where social and cultural resources are more accessible, such as tradition and customs and family and friends' support, which may associated with positive health behaviors and benefit longevity (Markides & Eschbach, 2005; Palloni & Arias, 2004). Furthermore, evidence indicates other explanatory factors that may elucidate the observed survival advantage. For example, health services utilization in Mexico may be linked to better health outcomes for older Mexican Americans who live across the border (Bastida et al., 2008).

Aside from the benefits that the region's close proximity to Mexico provides its residents, it also manifests a high disease burden; hence, examining the region's health may explain, at least some elements, of the Hispanic Paradox. Previous studies on the Hispanic Paradox have helped to narrow the focus of the current study to assess the association between certain psychosocial factors, such as social support, self-rated health, and adverse life events with the incidence of diabetes and mortality among Mexican Americans living along the border in our attempt to provide additional insights in the investigation of the Hispanic Paradox.

Psychosocial Factors and Diabetes Risk

Type 2 diabetes mellitus (T2DM) has become increasingly prevalent globally (Kaiser et al., 2018). Diabetes was diagnosed in about 13% of the U.S. adults, aged 18 years or older and 14.7% of Hispanic adults, which makes them the second-highest U.S. ethnic population burdened with the disease, second only to Native Americans (CDC, 2020). Recent data showed that Mexicans Americans had the highest age-adjusted prevalence of diabetes (14.4%) when compared to other Hispanic populations (CDC, 2020). Furthermore, diabetes incidence was higher among those aged 45 to 64 years and those aged 65 years or older when compared to other younger age populations (CDC, 2020). Several studies indicate that exposure to chronic stress increases the risk for developing T2DM (Bergmann et al., 2014). However, most of this literature have focused on the casual association between work related stress and T2DM (Brunner & Kivimäki, 2013; Heraclides et al., 2009; Norberg et al., 2007).

Recently, researchers have begun to consider low self-rated health (SRH) as a predictor for consequent T2DM relying on the evidence connecting low SRH to other known diabetes predictors, such as obesity (Cullinan & Gillespie, 2016), stress (Halford et al., 2003), and inflammatory markers (Christian et al., 2011). The significant correlational association between T2DM and low SRH has been indicated by various cross-sectional studies (Ramkumar et al., 2009; Manor et al., 2001). However, very few longitudinal studies have investigated poor SRH as a predictor for T2DM. To our knowledge, only four prospective studies have assessed this association, which showed that low SRH increases the risk of incident T2DM (Latham & Peek, 2013; Noh et al., 2019; Tapp et al., 2010; Wennberg et al., 2013). Investigating the relationship between low SRH and incident T2DM among Mexican Americans may hold important empirical implications given the higher burden of diabetes among this population and poorer self-rating of health when compared to other ethnic groups (CDC, 2020; Mier et al., 2008).

Evidence shows that low levels of received social support may be linked to the development of diabetes among those without a prior diagnosis of the disease (Altevers et al., 2016; Hilding et al., 2015; Lukaschek et al., 2017; Norberg et al., 2007). For example, a study conducted in Germany suggested that low structural social support has been linked to the development of diabetes among middle-aged men only (Altevers et al., 2016). Similarly, middle-aged women highly integrated into a social network were less likely to have glucose dysregulation after about 8 years of follow-up (Hilding et al., 2015). Although several studies have suggested that various forms of stress may predict incident T2DM (Bergmann et al., 2014), studies examining the effect of major stressful life events (SLE) on risk for T2DM are few. For example, a recent prospective study analyzed data from the Women Health Initiative (WHI) showed that exposure to SLE increases the risk of T2DM among postmenopausal women after controlling for demographic and lifestyle factors (Hendryx et al., 2020). Examining the role of psychosocial factors on the development of T2DM among older adult Mexican Americans may yield valuable findings for diabetes prevention programs, giving that diabetes disproportionally affects this disadvantaged population.

Early Parental Death and Mortality

Stressful life events (SLE) may be defined as major life changes that may result in adverse health effects on the exposed individuals, such as the death of loved ones, the loss of a job, or divorce (Cohen et al., 2019). Research showed that exposure to SLE may have adverse outcomes on mental and physical health (Cohen et al., 1993; Kraaij et al., 2002; Rosengren et al., 2004; Ritchie et al., 2011). Moreover, research examining the relationship between exposure to SLE and mortality has shown inconsistent findings (Aldwin et al., 2014; Hollis et al., 1990; Rosengren et al., 1993). Some studies have revealed an increased mortality risk among participants who experienced adverse life events (Aldwin et al., 2014; Rosengren et al., 1993), while others showed inverse association (Hollis et al., 1990). Recently, the life course perspective has received greater attention in better understanding health disparities between various social groups (Pearlin et al., 2005). The life course approach illustrates the significance of duration and timing of exposures within an individual lifespan when investigating consequent health outcomes (Ben-Shlomo & Kuh, 2002; Kuh et al., 2003).

Age related social and cultural norms may provide a timeline for the occurrence of life events and these guide personal expectancies about when major life events are supposed to occur in their lives, hence, disruptions of these anticipations may lead to adverse health outcomes (Cohen et al., 2019). However, exposure to unfavorable life events at any time during the life course may lead to adverse health consequences several years later (Pearlin et al., 2005). Research suggests that the occurrence of stressful events, particularly in childhood, seems to increase the risk of morbidity in later life (Miller et al., 2011; Wegman & Stetler, 2009).

Furthermore, Cohen et al. (2019) suggests that exposure to stressful life events is seldom a random occurrence, but is patterned by psychological and ecological conditions. Research reveals that individuals with low socioeconomic status tend to be more consistently exposed to various chronic stressors, and experienced more adverse life events than those with higher socioeconomic status (Lantz et al., 2005). Several studies have suggested that individuals who were exposed to early parental death had higher risk of morbidity later in life (Krause, 1998; Phillips & Carver, 2015; Simbi et al., 2020). For example, Phillips and Carver (2015) indicated that death of a parent during childhood, predicted self-rating of health among older adults aged 65 – 74 years. Furthermore, research has revealed that death of a parent in childhood increases the risk of all-cause mortality for the bereaved offspring (Li et al., 2014; Rostila & Saarela, 2011; Smith et al., 2014). However, most of the existing studies examining the effects of early parental death on a bereaved child focus on mortality risks in early or midlife, hence conclusions about the long-term effects of early parental death on mortality cannot be established from this literature. Assessing the relationship between early parental death during childhood or adolescence and later life mortality is novel and has not been well investigated.

Self-Rated Health and Mortality

To evaluate health status, researchers typically ask participants to rate their health generally by indicating one of the following categories: excellent, good, fair, or poor. During the last four decades, numerous population-based studies have assessed the association between self-rated health (SRH) and all-cause mortality (DeSalvo et al., 2006; Idler & Benyamini, 1997; Kaplan & Camacho, 1983; Shen et al., 2014). This literature reveals that SRH seems to have its own mortality risks, even after adjusting for demographic, socioeconomic, behavioral, mental, and physical risk factors. Kaplan and Camacho (1983) indicated that poor self-rating of health is a collective feature that may connect different adverse psychosocial factors, such as SLE, social isolation, and depression, thus suggesting that self-assessment of health is a key factor for explaining the effects of various psychosocial factors on health (Idler & Benyamini, 1997).

Therefore, self-assessment of health criterion may offer a simple, quick, and comprehensive tool for assessing the three dimensions of health (physical, mental, and social) (Idler & Benyamini, 1997). Previous studies indicated that the effect of self-rating of health on mortality may be related to sex, cultural factors, educational level, and socioeconomic differences (Burström & Fredlund, 2001; Hays et al., 1996; Huisman et al., 2007). For example, a Swedish study revealed that the association between SRH and mortality was stronger among respondents with better socioeconomic status (SES) than those with lower SES (Burström & Fredlund, 2001). Moreover, studies examining the effect of SRH on mortality prediction by sex reveal stronger association among men (Hays et al., 1996; Idler & Benyamini, 1997).

Previous research suggesting that foreign-born Hispanics have a significantly better health outcomes than US-born Hispanics (Abraido-Lanza et al., 1999; Bostean, 2013), however, they seem to rate their health as lower than their more acculturated equivalents (Lommel et al., 2019; Shetterly et al., 1996). It has been noted that Hispanics may perceive their health differently than other ethnic populations (Benjamins et al., 2012). Lommel et al. (2019) indicated that greater psychosocial stressors may predict poorer SRH among Mexican Americans. However, data from the National Health Interview Survey have shown that Hispanics who perceive their health as fair or poor are more likely to have a higher burden of chronic diseases, such as hypertension and diabetes, than non-Hispanics (Borrell & Dallo, 2008).

Very little research has investigated the factors predicting SRH among Mexican Americans in the United States. Additionally, there is a dearth of literature examining the association between SRH and mortality among Hispanics in general and among Mexican Americans specifically. For example, a study conducted among older Mexican Americans revealed that respondents who rated their health as poor had lower life expectancy compared to those with excellent SRH, despite the inclusion of potential confounders, such as BMI and physical disability (Cesari et al., 2009). Since evidence indicates that SRH is impacted by a socioeconomic and cultural context that may underlie its effect on subsequent mortality, we aim to assess the predictors of SRH among an economically disadvantaged and culturally unique population, residing in the Lower Rio Grande Valley of South Texas.

Role of Psychosocial Factors on Diabetes and Mortality Risk

Little is known about the role of psychosocial factors on diabetes and mortality risk among older adult Mexican Americans living in the border region. Previous studies on the Hispanic Paradox have narrowed our focus by assessing the association between certain psychosocial factors, such as social support, SRH, and exposure to stressful life events with the incidence of diabetes and mortality among Mexican Americans. We followed a population residing along the US Mexico border to provide insight into the Hispanic Paradox. Findings from this investigation hold important policy implications, especially in the investigation of the buffering effects that positive social environments exercise on populations that experience low socioeconomic conditions and opportunities.

Further, the association between SRH and all-cause mortality will be examined, and the interactions of SRH with sex in predicting mortality will be investigated. Additionally, the impact of social support and exposure to stressful life events on diabetes risk among non-diabetic older Mexican American adults in South Texas after a 12-year follow-up will be investigated. In concluding, it is important to inform the reader that two components of this chapter, large segments of the literature review and presentation and discussion on the BESA study and sample, will overlap with introductions and reviews of the literature included in each of the subsequent three manuscripts. The somewhat repetitiveness of these two components in each of the manuscripts is necessary because the format of the dissertation requires each of the manuscripts to stand independently of the dissertation and ready to be submitted to a journal for review and publication. Hence, each manuscript provides identical descriptions of the BESA study and sample, as may be expected. Likewise, given the comprehensive review of the literature presented in this introductory chapter, topics and references discussed here will selectively reappear in each of the three articles, based on their applicability to the aims and particular segments of data presented in each manuscript.

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CHAPTER II: FIRST MANUSCRIPT

Psychosocial Factors and Diabetes Risk

2.1. Introduction

Type 2 diabetes mellitus (T2DM) has become a major health problem worldwide with grave consequences in terms of human and economic costs. A recent global assessment documented that close to 500 million people suffer from T2DM (Kaiser et al., 2018). In the United States, 34.1 million adults, or 13% of adults aged 18 years or older, live with diabetes (CDC, 2020). Furthermore, 14.7% of Hispanic adults have diabetes, which makes them the second-highest U.S. ethnic population diagnosed with the disease after Native Americans (CDC, 2020). Data from the 2017-2018 National Health Interview Survey revealed that Mexican Americans had the highest age-adjusted prevalence of diagnosed diabetes (14.4%) compared to other Hispanic adults. Moreover, the rise of T2DM was greater among those aged 45 to 64 years and those aged 65 years or older when compared to other younger age groups (CDC, 2020).

Several studies have indicated that family history of diabetes, body mass index (BMI), and lifestyle may contribute to the development of T2DM (Korat et al., 2014). However, the etiology of T2DM remains generally unexplained. There is evidence demonstrating that exposure to chronic stress increases the risk of developing T2DM. For example, a systematic review of sixteen longitudinal studies showed that perceived stress and emotional distress are associated with the diagnosis of T2DM but only among men (Bergmann et al., 2014). However, half of these studies and most of the literature on the subject have mainly examined the casual association between work-related stress and T2DM (Brunner & Kivimäki, 2013; Heraclides et al., 2009; Norberg et al., 2007).

Hispanic immigrants may experience higher levels of various economic and ecological stressors e.g. neighborhood stressors, acculturation stress, and low socioeconomic status (Ornelas & Perreira, 2011). In this manuscript, we assessed the relationship between psychosocial stress indicators, such as low self-rated health (SRH), stressful life events (SLE), and lack of social support with the onset of diabetes among Mexican Americans living along U.S.-Mexico border. Recent investigations have explored the potential of SRH reports in predicting consequent T2DM based on existing evidence connecting SRH to other known diabetes risk factors, such as obesity (Cullinan & Gillespie, 2016), inflammatory markers (Christian et al., 2011), and stress (Halford et al., 2003). The positive correlation between T2DM and low SRH has been assessed by various cross-sectional studies (Ramkumar et al., 2009; Manor et al., 2001). However, very few prospective studies have considered individuals' choice of response when self-rating their health as a possible indicator of their risk for T2DM.

To our knowledge, only four longitudinal analyses have examined this relationship, which revealed that low SRH is associated with incident T2DM (Latham & Peek, 2013; Noh et al., 2019; Tapp et al., 2010; Wennberg et al., 2013). For example, Latham and Peek (2013) indicated that among late midlife US adults aged 51 – 61 years, low SRH is a significant risk factor for five main chronic illnesses, including diabetes, but excluding cancer. Furthermore, a recent prospective study conducted among a large-scale cohort of Korean men and women concluded that lower self-rating of health is an independent predictor of T2DM (Noh et al., 2019). Exploring the longitudinal association between SRH and development of T2DM among Mexican Americans has empirical implications given the high prevalence of diabetes among this group and lower self-rating of health compared to other populations (CDC, 2020; Mier et al., 2008). Research shows that low social support may contribute to the development of diabetes among individuals without a prior diagnosis of diabetes (Altevers et al., 2016; Hilding et al., 2015; Lukaschek et al., 2017; Norberg et al., 2007). Nevertheless, results from these studies have been inconsistent, specifically when controlled by sex. For example, a population-based study conducted in Germany revealed that low structural social support was related to the development of diabetes only among middle-aged men (Altevers et al., 2016). Furthermore, evidence indicated that married men or men living with a partner had a lower risk of developing diabetes (Hilding et al., 2015), while men with low social network satisfaction had an elevated risk of developing the disease (Lukaschek et al., 2017).

Other studies have revealed that women who reported low emotional support and work stress were at higher risk for the subsequent development of diabetes (Norberg et al., 2007). Moreover, a recent analysis conducted in the U.S. on postmenopausal women who participated in the Women Health Initiative (WHI) study showed that women with high social support had a lower risk of developing T2DM even after controlling for demographic, lifestyle factors, and depressive symptoms (Hendryx et al., 2020). Likewise, middle-aged Swedish women highly integrated into a social network were less likely to have glucose dysregulation after a follow-up of approximately 8 years (Hilding et al., 2015). Previous studies have indicated that various forms of stress may be associated with incident T2DM (Bergmann et al., 2014). However, studies evaluating the effect of major stressful life events, as a form of psychosocial stress, on T2DM risk are few. A recent longitudinal study analyzed data from the Women Health Initiative (WHI) and revealed that SLE increase T2DM risk among postmenopausal women, even after adjusting for demographic and lifestyle factors (Hendryx et al., 2020). Another recent prospective U.S. study that analyzed data from the Health and Retirement Study (HRS) concluded that middle-aged adults who experienced SLE were at higher risk of developing T2DM than those who did not (Smith et al., 2020). Moreover, a large-scale study conducted in the U.S. among non-diabetic Hispanic adults showed that previous exposure to chronic stress was associated with glucose dysregulation (McCurley et al., 2015). Investigating the role of psychosocial factors on the development of T2DM among middle to old-aged Mexican American adults may yield valuable findings to assist in diabetes prevention efforts, since diabetes disproportionally affects this disadvantaged group.

2.2. Methods

2.2.1. Study Design and Sampling

Data are from the Border Epidemiological Study of Aging, known as (BESA), a longitudinal study consisting of four waves conducted in South Texas from 1994 to 2006/07. The first and last waves will be used in this analysis by linking the factors measured at the baseline wave with incident T2DM reported in the last wave. A two-stage stratified random sampling was utilized in recruiting participants to the study. The initial sample yielded 1089 participants, 45 years or older, selected using tract data from the 1990 US Census to estimate the number of qualifying Hispanic adults 45 years and older in four counties along the Texas Mexico border (Hidalgo, Cameron, Willacy, and Starr). Sample recruitment for all census tracts were stratified by age and proportionally represented in the final sample. For analytic purposes, 705 participants were excluded from the initial sample resulting in an analytic sample of 384 participants. Exclusion criteria was as follows: (1) diagnosed with diabetes at baseline (n= 257) or (2) loss of follow up in the last wave (n= 304) or (3) missing data (n= 144).

2.2.2. Study Variables

Data collection began in 1995 followed by three consecutive waves conducted between 1998 and the end of the last wave in 2006/07. Respondents consented to join an in-home face-to-face interview in either Spanish or English. In every wave, participants were administered a 2-hr general health questionnaire approved by a panel of community residents and researchers. All health reported data were further verified by a medical doctor who reviewed the data with reference to prescription medications, family physician, and laboratory work whenever included.

2.2.2.1. Independent Variables

Self-Rated Health (SRH)

Self-rated health was measured at baseline using a Likert scale question that asked participants to self-rate their health in one of four categories ranging from=excellent, good, fair, and poor. The “excellent” category was used as a reference group in the regression analysis.

Social Support

Social support was assessed at baseline using a single-item measure that asked participants to report the frequency of support they received from the person closest to them. Responses were coded as follows: receiving daily support and not receiving daily support. The group that received daily support was set as a reference group in the regression analysis.

Stressful Life Events (SLE)

Participants were asked at baseline if they experienced any of the following events: father death, mother death, and child death and, if yes, at what age it happened. Father and mother death were separately coded into two categories: respondent experienced father or mother death between 5 – 30 years of age, and the other category for those who did not. Those who did not report a father or mother death between 5 – 30 years were used in each variable as a reference group in multivariate analysis. Child death was coded as a dichotomous variable whether the participant ever lost a child or not. Those who did not report the death of a child were used as a reference group.

2.2.2.2. Dependent Variable

Type 2 Diabetes Mellitus

Self-reported medical diagnosis of T2DM was assessed at wave 4 (2006/07) and was coded as a dichotomous variable whether the respondent has the disease or not. All respondents who reported a medical diagnosis of diabetes had a fasting glucose test done by a local laboratory, and all were confirmed. Additionally, a medical doctor verified all the prescribed medications the participant brought to the interview and confirmed whether participants' medications were for glucose control.

2.2.2.3. Covariates

Age, sex, marital status, and country of birth

Age at baseline was treated as a continuous variable in the logistic regression analysis. In the univariate analysis, we categorized the age of participants into three groups (45 – 59, 60 – 69, and 70+). Sex was coded as male or female. Marital status was coded as married or not married. Country of birth was self-reported and coded as U.S. or Mexico.

Income

Annual participant income was self-reported at baseline in 1995 and coded as less than $7000 and $7000 or higher.

Education

Participants were asked about years of formal education. Responses were coded as having some college education (13 years or more) or not having a college education (less than 13 years).

Years in the United States

Years of residence in the United States were coded as follows: being a U.S. resident for less than 20 years and 20 years or more of residency in the U.S.

Cardiovascular Diseases (CVD)

Cardiovascular diseases were measured as a three-item index. Participants were asked if they were medically diagnosed with high blood pressure, heart disease, or stroke. An index was created by coding responses as being diagnosed with at least one of these diseases or none. A clinical interviewer recorded all cardiovascular diseases, which were further validated by a medical review of all prescribed medications that respondents were taking at the time of the interview and their correspondence to their responses on whether or not they had been diagnosed with the disease.

Comorbidities

Comorbidities were measured as a four-item index. Participants were asked if they were medically diagnosed with any of the following diseases: thyroid diseases, cancer, gastrointestinal diseases, such as ulcer, or neuromuscular disorders. Accordingly, the response was coded dichotomously as whether the participant was diagnosed with at least one of these diseases or none. All comorbidities were recorded by a clinical interviewer and further validated by a medical doctor who reviewed all prescribed medications participants were taking at the time of the interview and their self-report of a chronic disease.

Instrumental Activities of Daily Living (IADL)

Self-reported instrumental activities of daily living (IADL) were measured at baseline using the Older Americans Resources and Services scale (Duke University CSAHD, 1978). This scale contains two subscales that assess functional skills essential for independent living. The IADL scale assesses broader activities such as participants assistance needs, e.g. to use the telephone or do housework. Response to the IADL items was coded as a binary variable: no required assistance and at least one required assistance with an instrumental daily activity.

Body Mass Index (BMI)

Height and weight were measured for all participants by trained staff in all waves. BMI at baseline was calculated and categorized into four groups: underweight (below 18.5 kg/m^2), normal "healthy weight" (18.5–24.99 kg/m^2), overweight (25–29.99 kg/m^2), and obese (30 kg/m^2 and above) using the Centers for Disease Control and Prevention (CDC) BMI guidelines (CDC, 2021). Having a "healthy weight" was used as a reference group in multivariate analysis.

Mental Health

A binary question asked participants at baseline if they were medically diagnosed with any mental health disorder, such as depression or anxiety. Responses were coded whether the participant was diagnosed with at least one mental health disorder or none. A clinical interviewer recorded all mental health disorders, which were further validated by a medical review of all prescribed medications that respondents were taking at the time, and the medical doctor who prescribed the medication.

2.2.3. Statistical Analysis

In univariate analysis, Chi-square test was used to examine the relationship between selected study variables and incident diabetes. For multivariable analysis, a binary logistic regression model was applied to assess the association between independent variables and incident diabetes adjusting for study covariates. The final regression model was adjusted for baseline sex, age, years in the US, education, income, mental disorders, Instrumental Activities of Daily Living (IADL), Body Mass Index (BMI), Cardiovascular Diseases (CVD), comorbidities, and all independent variables. Associations were considered significant at alpha level of 0.05. IBM SPSS software version 26 was used to analyze the data (IBM Corporation).

2.3. Results

Table 2.1 describes the overall distribution of the baseline measures for study participants. Of the 384 subjects included in the analysis, about one-third (33.9%) were male and two-thirds (66.1%) were female with an overall average age of 62 years (mean $\pm$ SD = 62.1 $\pm$ 10.2). Almost half were born in Mexico (45.3%) and the other half were born in the U.S. (54.2%) with 2 participants excluded who reported other countries as a place of birth. One in tenth of the participants (10.2%) reported relatively recent immigration to the U.S. with a duration less than or equal to 20 years while the remaining (89.8%) had been in the U.S. for more than 20 years. Moreover, 16.1% of the study subjects reported over 12 years of formal education compared to (83.9%) who had 12 years or less of formal education.

Moreover, 16.9% of study participants who were non-diabetic at the baseline wave, started in 1994, reported a diagnosis of T2DM at wave 4 (2006/2007). When looking at the socioeconomic and demographic characteristics among diabetic and non-diabetics, the incidence of diabetes was higher among the low annual income group compared to those who had >$7,000 annual income (21.5% vs. 10.9%; $p=0.006$). Age, sex, marital status, education, country of birth, and duration in the U.S. were not significantly different between diabetics and non-diabetics. Obese subjects had a higher incidence of diabetes (21.1%) compared to overweight (16%) and normal weight (12.2%), however, this trend was not statistically significant ($p=0.22$). Furthermore, subjects who reported a prior diagnosis of cardiovascular diseases ($p=0.008$), mental disorders ($p<0.001$), and other comorbidities ($p<0.001$) at baseline were more likely to develop diabetes during follow up (Table 2.1). The univariate association between baseline (wave 1) self-rated health (SRH) and incident diabetes at wave 4 was marginally significant. Participants with a better rating of their health at baseline had a lower risk of developing diabetes at the end of the study ($p=0.055$) (Table 2.1). However, this relationship was not statistically significant when assessed using multivariable regression analysis (Table 2.2).

Furthermore, 28.6% of the subjects who did not have daily support at baseline developed diabetes during the study period compared to 14.9% of the subjects with daily support who reported diabetes diagnosis during the same time ($p=0.01$) (Table 2.1). In the logistic regression analysis, the odds of not receiving daily support at baseline is twice as likely among those with diabetes than those without diabetes at wave 4 (OR=2.36; 95%CI=1.07 - 5.21; p=0.03) (Table 2.2). Moreover, 26.2% of the individuals who experienced a father's death between 5 – 30 years of age developed diabetes during follow-up when compared to 14.3% of the individuals who did not report a father loss at the same stage of life (p=0.01) (Table 2.1). Multivariable analysis revealed that those who reported diabetes diagnosis at wave 4 had twice the odds of losing their fathers between 5 – 30 years old (OR=2.22; 95%CI=1.13 – 4.36; p=0.02) when compared to those who did not report diabetes diagnosis (Table 2.2).

On the other hand, losing a mother at the same stage of life (5 – 30 years old) was not a risk factor for developing T2DM during later life (p=0.36) (Table 2.2). The incidence of diabetes was higher among participants who lost a child prior to the baseline data collection when compared to those who did not experience child death (31.6% vs. 14.4%; p=0.001) (Table 2.1). The longitudinal relationship between losing a child and developing diabetes, later on, remained significant after adjustment of other covariates (p=0.04) (Table 2.2).

Table 2.1. The Relationship between Baseline Characteristics at (Wave 1) and Incident Diabetes at (Wave 4) among Study Participants

Characteristic	Total N=384 N (%)	Incident Diabetes Yes (n=65) N (%)	No (n=319) N (%)	*p*-Value
Sex				
Male	130 (33.9)	22 (16.9)	108 (83.1)	0.99
Female	254 (66.1)	43 (16.9)	211 (83.1)	
Age				
45 – 59	174 (45.3)	24 (13.8)	150 (86.2)	0.16
60 – 69	106 (27.6)	24 (22.6)	82 (77.4)	
70+	104 (27.1)	17 (16.3)	87 (83.7)	
Marital Status				
Married	252 (67)	42 (16.7)	210 (83.3)	0.95
Not married	124 (33)	21 (16.9)	103 (83.1)	
Country of Birth				
Mexico	174 (45.3)	31 (17.8)	143 (82.2)	0.7
U.S.	208 (54.2)	34 (16.3)	174 (83.7)	
Other	2 (0.5)	----	----	
Years in U.S.				
>20 years	345 (89.8)	57 (16.5)	288 (83.5)	0.53
20 years or less	39 (10.2)	8 (20.5)	31 (79.5)	
Education				
College	62 (16.1)	10 (16.1)	52 (83.9)	0.86
No college	322 (83.9)	55 (17.1)	267 (82.9)	
Subject Income				
<$7,000	219 (57)	47 (21.5)	172 (78.5)	**0.006**
$7,000 or more	165 (43)	18 (10.9)	147 (89.1)	
BMI				
Underweight	6 (1.6)	----	----	
Normal	74 (19.3)	9 (12.2)	65 (87.8)	0.22
Overweight	162 (42.2)	26 (16)	136 (84)	
Obese	142 (37)	30 (21.1)	112 (78.9)	
IADL				
Dependent	74 (19.3)	14 (18.9)	60 (81.1)	0.61
Independent	310 (80.7)	51 (16.5)	259 (83.5)	
Mental Disorder				
Yes	59 (15.4)	21 (35.6)	38 (64.4)	**<0.001**
No	325 (84.6)	44 (13.5)	281 (86.5)	
CVD				
Yes	145 (37.8)	34 (23.4)	111 (76.6)	**0.008**
No	239 (62.2)	31 (13)	208 (87)	

Comorbidities				
Yes	109 (28.4)	30 (27.5)	79 (72.5)	**<0.001**
No	275 (71.6)	35 (12.7)	240 (87.3)	
SRH				
Excellent	77 (20.1)	7 (9.1)	70 (90.9)	0.06
Good	137 (35.7)	21 (15.3)	116 (84.7)	
Fair	134 (34.9)	27 (20.1)	107 (79.9)	
Poor	36 (9.4)	10 (27.8)	26 (72.2)	
Social Support				
Daily	328 (85.4)	49 (14.9)	279 (85.1)	**0.01**
Not daily	56 (14.6)	16 (28.6)	40 (71.4)	
Child Death				
Yes	57 (14.8)	18 (31.6)	39 (68.4)	**0.001**
No	327 (85.2)	47 (14.4)	280 (85.6)	
Father Death				
Yes	84 (21.9)	22 (26.2)	62 (73.8)	**0.01**
No	300 (78.1)	43 (14.3)	257 (85.7)	
Mother Death				
Yes	52 (13.5)	8 (15.4)	44 (84.6)	0.75
No	332 (86.5)	57 (17.2)	275 (82.8)	

BMI: Body Mass Index, SRH: Self-Rated Health, IADL: Instrumental Activities of Daily Living, CVD: Cardiovascular Diseases.

Table 2.2. Logistic Regression Results for Factors Associated with Incident Diabetes

Variable	OR (95% CI)	*p*-Value
Self-Rated Health		
Excellent	1.00	
Good	2.2 (0.81 - 6)	0.12
Fair	1.57 (0.57 - 4.38)	0.39
Poor	2.4 (0.65 - 8.81)	0.19
Social Support		
Daily	1.00	
Not Daily	2.36 (1.07 - 5.21)	**0.03**
Father Death		
No	1.00	
Yes	2.22 (1.13 - 4.36)	**0.02**
Mother Death		
No	1.00	
Yes	0.65 (0.26 - 1.64)	0.36
Child Death		
No	1.00	
Yes	2.18 (1.03 - 4.64)	**0.04**

OR: Odds Ratio. Model adjusted for sex, age, duration in US, education, income, mental health, instrumental activities of daily living, body mass index, cardiovascular diseases, and comorbidities.

2.4. Discussion

This study aimed to examine psychosocial stress indicators, such as low SRH, earlier stressful life events, and lack of social support as risk factors for diabetes among older adults Mexican Americans living on the Texas-Mexico border. Study findings suggest that low social support measured as lacking daily support, losing a father between 5 – 30 years old, and losing a child are independent risk factors for developing T2DM. Each of these factors almost doubled the risk for developing T2DM at twelve years from the collection of baseline data. On the other hand, losing a mother at the same stage of life (5 – 30 years old) and lower SRH were not predictors for developing T2DM during later life.

Very few longitudinal studies have explored the association between SRH and the development of T2DM (Latham & Peek, 2013; Noh et al., 2019; Tapp et al., 2010; Wennberg et al., 2013). A population-based longitudinal study of 8,018 participants conducted across five European countries revealed that low SRH (moderate or poor) was related to an increased risk of diabetes compared with high SRH (excellent or good), after an average follow-up of 9.1 years with a multivariable adjusted Hazard Ratio (HR) (95% CI) of 1.29 (1.09–1.53) (Wennberg et al., 2013). However, in this study, the authors considered only hypertension and BMI, as physical health covariates and did not control for mental health indicators, which may affect study results.

Another prospective data from the Health and Retirement Study (HRS) conducted in the U.S. among 4,770 participants aged 51 to 61 years investigated the relationship between SRH and the risk of developing six major chronic diseases, including diabetes, reported that better self-rating of health was associated with decreased risk of diabetes onset (Latham & Peek, 2013). Yet, mental health problems were not considered in the multivariable model in this analysis. Furthermore, a large-scale longitudinal Korean study of apparently healthy adults revealed that participants who reported fair or poor SRH had a higher risk of incident diabetes when compared to those who reported very good SRH, after controlling for socioeconomic and lifestyle factors, family history of diabetes, depressive symptoms, and cardiovascular diseases HR (95% CI) were 1.63 (1.33–1.98), and 1.83 (1.47–2.27) respectively (Noh et al., 2019).

In our study, the overall univariate association between baseline poorer SRH and incident diabetes was marginally significant (p-trend =0.06). Moreover, participants who rated their health at baseline as fair (p= 0.04) or poor (p=0.01) had a significantly higher risk of developing diabetes at the end of the study when compared to those who had excellent health ratings. However, after the inclusion of socio-demographic factors, IADL, BMI, physical, and mental health disorders in the multivariable analysis this predictor was attenuated. This may be due to the relatively small sample size compared to other larger studies in addition to comprehensive adjustments of multiple covariates including income and significant comorbidities.

A longitudinal study conducted in the U.S. among non-diabetic postmenopausal women assessed the risk of social relationship factors, such as social support and SLE on developing T2DM, revealed that women with high social support had a lower risk of getting diabetes after adjustment of demographics, lifestyle factors, and depressive symptoms (HR= 0.93; 95% CI =0.89–0.97) (Hendryx et al., 2020). We found that lack of daily support at baseline is independent predictor for developing diabetes (OR=2.36; 95%CI=1.07 - 5.21) after adjustment of demographics, physical and mental health covariates. Moreover, Hendryx et al. (2020) revealed that women who experienced more SLE such as death of a spouse or having major conflicts with family members had a higher risk of developing diabetes after an average of 14 years of follow-up (HR=1.10; 95% CI=1.05–1.15).

Additionally, the prospective U.S. Health and Retirement Study (HRS) investigated the association between various SLE such as child death and the risk of incident diabetes showed that participants who experienced one lifetime stressful event had a higher risk of developing T2DM compared to no stressful event exposure after adjustment of demographics, BMI, smoking, and comorbidities (HR=1.42; 95%CI= 1.17 - 1.72) (Smith et al., 2020). In our research, we examined the effect of a single stressful lifetime event on diabetes risk and revealed that older adults who lost their fathers between 5 – 30 years old had higher risk of developing diabetes (OR=2.2; 95%CI=1.13 – 4.36) when compared to those who did not lose their fathers within the same age period. Furthermore, losing a child anytime before baseline increased the risk of diabetes among non-diabetic older adults with adjustment of other covariates (OR=2.2; 95%CI=1.03 - 4.6).

Hendryx et al. (2020) concluded that psychosocial stress such as low social support and stressful life events increased diabetes risk directly and indirectly through high-risk behaviors and depressive symptoms. These indirect effects have been explained in other studies which found that prolonged stress had increased the risk of diabetes diagnosis through its effects on high-risk behaviors, such as high-calorie intake, low physical activity, smoking, and alcohol consumption (Rod et al., 2009). Simultaneously, biological mechanisms may explain the direct effects of psychosocial stress on diabetes risk. For instance, the stress associated with negative life events or low social support may increase the risk of diabetes through activation of inflammatory responses, which lead to insulin resistance and affect glucose metabolism (Fernandez-Real et al., 2002; Hackett & Steptoe, 2016).

The strengths of this study are the investigation of the unique population residing along the Texas-Mexico border which had increased risk of diabetes, the long duration of follow-up, and the inclusion of comprehensive data on comorbidities, physical health, and mental health disorders. Limitations are relatively few and include a small analytic sample size and limited data on risk behaviors, such as smoking and alcohol consumption. However, previous studies suggested that risk behaviors have a partial mediating role in the relationship between psychosocial stress and diabetes and this relationship remained significant even after adjustment of such behaviors (Hendryx et al., 2020). Moreover, we included BMI and IADL in our analysis, which can act as a proxy for physical activity and calorie intake. Furthermore, independent variables such as social support and history of child death were assessed at baseline and the changes of these variables before the assessment of diabetes at the subsequent wave are probable, however, if these changes occurred, this will bias findings toward the null.

In conclusion, low social support and exposure to SLE, such as child death and loss of a father between ages of 5 – 30 years were associated with a higher risk of incident diabetes among late midlife Mexican Americans living across the U.S.-Mexico border. Diabetes prevention programs targeting this high-risk population should expand the traditional interventions focused mainly on dietary changes and physical activity to further consider the promotion of supportive social environments. At the individual level, health care providers may screen for social support and assess social stress levels as risk factors for diabetes among non-diabetic late midlife adults. Further studies may explore the medical and psychological interventions that could minimize the physiological outcomes of psychosocial stress to decrease the risk of diabetes among older adults.

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CHAPTER III: SECOND MANUSCRIPT

Early Parental Death and Mortality

3.1. Introduction

Stressful life events (SLE) may be defined as major life changes that mainly result in adverse stress effects on the exposed persons, such as the loss of a job, the death of significant others, or divorce (Cohen et al., 2019). Evidence suggest that exposure to SLE may have adverse effects on physical and mental health (Cohen et al., 1993; Kraaij et al., 2002; Rosengren et al., 2004; Ritchie et al., 2011). For example, research showed that exposure to adverse life events has been associated with an increased risk of depression (Kraaij et al., 2002) and cardiovascular diseases (Rosengren et al., 2004), and adversely affect cognitive functioning (Ritchie et al., 2011).

Research investigating the association between exposure to adverse life events and mortality shows inconsistent findings (Aldwin et al., 2014; Hollis et al., 1990; Rosengren et al., 1993). Some studies have revealed an elevated mortality risk among respondents who experienced SLE (Aldwin et al., 2014; Rosengren et al., 1993). For example, a study conducted among Swedish men found that exposure to three or more adverse life events during the year prior to the baseline assessment was substantially associated with all-cause mortality after seven years of follow up (Rosengren et al., 1993). In contrast, evidence from the Multiple Risk Factor Intervention Trial (MRFIT) found that accumulation of stressful life events to be inversely related to mortality after six years of follow-up (Hollis et al., 1990). Exposure to adverse life events is seldom a random occurrence, but is induced by psychological and ecological conditions (Cohen et al., 2019). Individuals with low socioeconomic status tend to be exposed more consistently to multiple sources of chronic stress, and experienced more negative life events than higher socioeconomic groups (Hatch & Dohrenwend, 2007; Lantz et al., 2005). For example, research reveals that individuals with lower socioeconomic status are more predisposed to violence, divorce, or death of a child than those with higher socioeconomic status (Lantz et al., 2005).

Lately, the life course perspective has been found to be a useful approach in improving our understanding of health disparities among various social groups (Pearlin et al., 2005). The life course approach illustrates the importance of duration and timing of exposures within an individual lifespan when examining subsequent health outcomes (Ben-Shlomo & Kuh, 2002; Kuh et al., 2003). Age related social and cultural norms may provide a timeline for the occurrence of life events and these guide personal anticipations about when major life events are supposed to occur in their lives, hence, disruptions of these expectations may lead to adverse health effects (Cohen et al., 2019). Losing a loved one is a stressful event whenever it occurs. For example, a recent study examining the risk of mortality following the death of a spouse among Mexican Americans revealed that widowhood in older men is a risk factor for mortality (Stimpson et al., 2007), further corroborating similar results for other older groups (Moon et al., 2011; Shor et al., 2012).

Moreover, Cohen, et al. (2019) suggest that adverse outcomes are less likely to be expected the older a person becomes when compared to the same event occurring at a younger age. Hence, suggesting variations in age related normative expectations according to the age of the deceased. However, evidence suggests that exposure to adverse life events at any time during the life course may lead to negative health consequences in later life (Pearlin et al., 2005). Moreover, there is significant research indicating that the occurrences of unfavorable events, particularly in childhood, increase the risk of morbidity several years later (Miller et al., 2011; Wegman & Stetler, 2009). For example, a study conducted by Miller, et al. (2011) suggested that exposure to early life stressors during childhood, such as family conflict, may increase the risk of chronic diseases in adulthood through activation of inflammatory response.

Several studies reveal that individuals who experienced early parental death had elevated risk of morbidity later in life (Krause, 1998; Phillips & Carver, 2015; Simbi et al., 2020). Moreover, recent evidence has shown that death of a parent in childhood increases the risk of all-cause mortality of the bereaved child (Li et al., 2014; Rostila & Saarela, 2011; Smith et al., 2014). However, most of the existing analyses investigating the effects of early parental death on a bereaved offspring focus the mortality risks during early or midlife, conclusions about the long-term effects of early parental death on life expectancy cannot be established from this literature. Exploring the association between early parental death in childhood or adolescence and later life mortality is novel and has not been well addressed. Furthermore, we aim to investigate the moderating effects of sex in the relationship between early parental death and all-cause mortality. We hypothesize that individuals who experienced early parental death will have higher all-cause mortality risk compared to unexposed participants. Moreover, such exposure may have different impact across gender.

3.2. Methods

3.2.1. Study Design and Sampling

Data for this study are from the Border Epidemiological Study of Aging (BESA), a population based longitudinal study conducted in South Texas from 1994 to 2006/07. We added 12 years of follow-up by requesting mortality data for the 2007 – 2019 interval from the CDC through the National Death Index (NDI) database. Data collection of the panel study started in 1995 followed by three consecutive waves conducted between 1998 and the end of the last wave in 2006/07. In this analysis, we utilized the data of the baseline wave to assess the independent variables and covariates. At baseline, respondents consented to join a 2-hr in-home face-to-face interview in either Spanish or English. The BESA study administered a broad health survey to investigate demographic, socioeconomic, physical and mental health factors.

The panel study utilized a two stage stratified random sampling. The initial sample yielded 1089 participants, 45 years or older, selected using tract data from the 1990 US Census on the 40+ population of Mexican origin for all tracts in Hidalgo County, TX, and tracts within surrounding three counties (Cameron, Willacy, and Starr). Sample recruitment for all census tracts were stratified by age and proportionally represented in the final sample. Due to missing data, 115 participants were excluded from the initial sample, resulting in an analytic sample of 974 participants.

3.2.2. Study Variables

3.2.2.1. Independent Variables

Parental Death

Participants were asked at baseline if they experienced father death and/or mother death; and if so, at what age this event happened. Two variables were created for each father or mother death: one variable with five age categories and a second dichotomous for the highest mortality risk category. The five age categories were as follows (experienced father/mother death between the ages of 0 – 4, 5 – 17, 18 – 29, and 30 – 39) and the reference group was father/mother death at age of 40 or older or did not experience father/mother death. The binary father death variable was coded as follows: (1= experienced father death between 5 – 17 years old, and 0= not experienced father death within this age period). Experiencing a mother death during the age interval of 18 – 29 years showed the highest mortality risk, consequently, this age interval was used in the dichotomous variable (1= experienced mother death between 18 – 29 years old, and 0= not experienced mother death during this age interval).

3.2.2.2. Covariates

Age, sex, marital status, and country of birth

Age at baseline is continuous in years and cross validated with year of birth. Sex was coded into male or female. Marital status was self-reported and coded as married, single/divorced, or widowed. Country of birth was self-reported and coded as U.S. or Mexico.

Income

Annual participant income was self-reported at baseline in 1995, and coded as less than $15,000, or $15,000 or more.

Education

Participants were asked to indicate years of formal education. Responses were coded as having some college education (13 years or more) or not having a college education (less than 13 years).

Cardiovascular Diseases (CVD)

Cardiovascular diseases were measured as a four-item index. Respondents were asked if they were medically diagnosed with high blood pressure, heart disease, atherosclerosis, or stroke. Consequently, the index was created by coding responses as being diagnosed with at least one of these diseases or none. A medical doctor recorded all cardiovascular diseases, which were further validated by a medical review of all physician-prescribed medications participants were taking at the time of the interview.

Comorbidities

Comorbidities were measured as a six-item index. Participants were asked if a doctor had ever diagnosed any of the following diseases: cancer, gastrointestinal diseases, such as ulcer, renal diseases, joint/bone problems, memory problems, or respiratory diseases. The index was developed by summing diseases and coding responses as 1= being diagnosed with at least one of these diseases or 0=none. All comorbidities were recorded by a medical doctor and further verified by reviewing all physician-prescribed medications respondents were taking at the time of the interview.

Self-Rated Health (SRH)

Self-rated health was assessed at baseline by using an interviewer administered instrument that asked participants to self-rate their health using a single question, "In general, how would you rate your health?" with the possible choices (excellent, good, fair, or poor). The "excellent" category was used as a reference group in the regression analysis.

Body Mass Index (BMI)

Trained staff measured height and weight for all participants in all waves. Using the Centers for Disease Control and Prevention (CDC) BMI guidelines, BMI at baseline was calculated and categorized into four groups: underweight (below 18.5 kg/m^2), normal "healthy weight" (18.5–24.99 kg/m^2), overweight (25–29.99 kg/m^2), and obese (30 kg/m^2

and above) (CDC, 2021). Having a "healthy weight" was used as a reference group in Cox regression analysis.

Type 2 Diabetes Mellitus (T2DM)

Self-reported medical diagnosis of T2DM was assessed at baseline wave and was coded as a dichotomous variable whether the respondent has the disease or not. All participants who reported diabetes had a fasting glucose test done by a local laboratory, and all were confirmed.

Mental Health

Respondents were asked at baseline if they were medically diagnosed with any mental health disorder. Responses were coded whether the respondent were diagnosed with at least one mental health disorder or none. A medical doctor recorded all mental health disorders, which were further confirmed by a medical review of all prescribed medications that participants were taking at the time of the interview, and the medical doctor who prescribed the medication.

3.2.2.3. Dependent Variable

All-Cause Mortality

Mortality data were assessed through three different methods. In 2007-2008, mortality data were obtained from death certificates requested from the Texas Department of State Health Services (DSHS). In 2020, death data of the entire BESA sample were requested from the CDC through the records of the National Death Index. For those with incorrect or missing Social Security Numbers (SSN), phone calls with the designated household member and/or published obituaries were used to obtain date of death and assess their vital status. Survival time was measured in years starting with the time of baseline data collection and ending with the death of the participant or end of follow up on December 31, 2019.

3.2.3. Statistical Analysis

IBM SPSS software version 26 was used to analyze the data (IBM Corporation). Chi-square test and independent samples t-test were used to describe the study participants, stratified by their vital status at the end of the study, and to assess the relationship between father death during (5 – 17) years and selected study variables. Kaplan-Meier survival curves were generated to obtain cumulative survival probabilities for those who lost their fathers during the 5 – 17 years of age and those who did not have such experience. The log-rank test was applied to investigate the survival difference between participants whose fathers died when they were 5 – 17 years old and those who had not experienced a father death during this age interval. Cox proportional hazard regression model was applied to assess the association between early parental death and 24-years all-cause mortality, adjusting for study covariates, as well as to examine the interaction effects of sex and early parental death on mortality. The final regression model was adjusted for baseline sex, age, country of birth, education, Body Mass Index (BMI), diabetes, Self-Rated Health (SRH), and Cardiovascular Diseases (CVD). Associations were considered significant at alpha level of 0.05.

3.3. Results

Table 3.1 shows descriptive statistics on baseline factors for the study population by vital status at the end of the study. Of the total 974 subjects, about one-third (33.5%) were male and two-thirds (66.5%) were female with an overall average age of 63.1 years. Almost half were born in Mexico (45%) and the other half were born in the U.S. (55%).

More than half (57.9%) of participants reported being married while the remaining reported single/divorced (18.3%) or widowed status (20.6%). Moreover, 12.2% of the study subjects reported 13 years or more of formal education compared to (87.8%) who had 12 years or less of formal education (Table 3.1).

At the end of the follow-up, 526 (54%) of the study participants were deceased with 448 (46%) still living. More than half (59.5%) of the males were deceased and about half of females (51.2%) were reported deceased (p= 0.01). Furthermore, a higher proportion of the U.S. born participants were deceased at the end of the study (56.2%) compared to (51.4%) of those born in Mexico. However, above difference was not statistically significant (p=0.14). Among those with no college education, 57.4% were reported deceased compared to 29.4% of those with some college education (p<0.001). Subjects with BMI in the underweight range had higher proportion of mortality (91.7%) compared to 58.8% of normal BMI, 54.9% of overweight, and 49.2% of subjects with obesity (p trend=0.006). Furthermore, participants who reported a prior diagnosis of cardiovascular diseases (p<0.001), diabetes (p<0.001), and other comorbidities (p<0.001) at baseline were more likely reported deceased during follow up. Participants with better rating of their health at baseline had lower proportion of mortality over the 24-year study period (p trend=<0.001) (Table 3.1).

Table 3.2 displays the univariate association between father death at age of 5 – 17 years old and selected participant characteristics. One hundred and five (10.8%) of the study participants experienced father death between the ages of 5 and 17 years. Participants who lost their fathers during this age interval were more likely to be female (73.3% vs. 65.7%; p=0.12), however, this difference was not statistically significant.

Both groups had similar age at baseline with an average of 62.7 vs. 63.2 years old. Respondents who lost their fathers between 5 – 17 years old were more likely to be born in Mexico (51.4% vs. 44.2%), and less likely to be born in the U.S. (48.6% vs. 55.8%) yet, this association was not statistically significant (p=0.16).

Additionally, those who experienced father death during above age interval were more likely to have a lower college education 8.6% vs. 12.7%, (p=0.23), and more likely to report lower annual income, 92.2% vs. 85%, (p=0.05). Moreover, participants who experienced father death at age of 5 – 17 years old were less likely to have a normal BMI at baseline (14.6% vs. 22%), and more likely to have a BMI within the obesity range (48.5% vs. 37.3%) (p trend=0.06). The probability of being diagnosed with diabetes (p=0.96), CVD (p=0.98), mental disorder (p=0.96), or other comorbidities (p=0.53) at baseline was not significantly different among those who lost their fathers compared to those who did not lose their fathers. Furthermore, study subjects who experienced father death between 5 – 17 years old were less likely to rate their health at baseline as "excellent" (8.6% vs. 15.7%), and more likely to rate their health as "fair" (43.8% vs. 39.5%), but, less likely to rate their health as "poor" (13.3% vs. 14.5%; p trend=0.25) (Table 3.2).

The median survival age for participants aged 45 or older at the beginning of the study who lost their fathers when they were 5 – 17 years old was 83 years compared to 86 years median survival age for those who did not lose their fathers during the same age interval (log rank p= 0.02) (Figure 3.1). Table 3.3 displays the Cox proportional hazards regression results for all-cause mortality by parental death at different ages of offspring. Compared to those who experienced father death at age 40 or older or no loss at the baseline, participants whose fathers were deceased between 5 – 17 years of age showed the highest mortality risk (HR=1.33; 95%CI=1.01 – 1.76). Hence, experiencing father death at any other age interval was not associated with elevated mortality risk. Moreover, those who lost their fathers at age of 5 – 17 years had higher mortality risk when compared to all others who did not report father death during this age interval (HR=1.37; 95%CI=1.04 – 1.8; p=0.03). With respect to maternal death, respondents who reported deceased mothers when they were aged 18 – 29 years old showed higher but insignificant mortality risk compared to those who experienced mother death at age 40 or older or no loss (HR= 1.21; 95%CI= 0.9 – 1.64; p=0.21). Furthermore, those who lost their mothers at age of 18 – 29 years had higher, though not substantial, mortality risk compared to all others who did not report mother death during this age period (HR=1.2; 95%CI=0.89 – 1.61; p=0.24) (Table 3.3). There was no interaction between the effect of sex and early parental death on all-cause mortality.

Table 3.1. Descriptive Statistics of the Study Participants by Vital Status

Characteristic	Total N= 974 N (%)	Vital Status: Deceased 526 (54%)*	Vital Status: Non-Deceased 448 (46%)	*p*-Value
Sex				
Male	326 (33.5)	194 (59.5)	132 (40.5)	0.01
Female	648 (66.5)	332 (51.2)	316 (48.8)	
Age				
Mean ± SD	63.1 ± 10.1	68.3 ± 9.3	57.1 ± 7.3	<0.001
Marital Status				
Married	564 (57.9)	280 (49.6)	284 (50.4)	<0.001
Single/divorced	178 (18.3)	75 (42.1)	103 (57.9)	
Widowed	201 (20.6)	147 (73.1)	54 (26.9)	
Unknown	31 (3.2)	----	----	
Country of Birth				
Mexico	438 (45)	225 (51.4)	213 (48.6)	0.14
U.S.	536 (55)	301 (56.2)	235 (43.8)	
Education				
College	119 (12.2)	35 (29.4)	84 (70.6)	<0.001
No college	855 (87.8)	491 (57.4)	364 (42.6)	
Annual Income				
<$15,000	806 (82.8)	463 (57.4)	343 (42.6)	<0.001
>$15,000	134 (13.7)	50 (37.3)	84 (62.7)	
Unknown	34 (3.5)	----	----	
BMI				
Underweight	12 (1.2)	11 (91.7)	1 (8.3)	0.006
Normal	204 (20.9)	120 (58.8)	84 (41.2)	
Overweight	388 (39.8)	213 (54.9)	175 (45.1)	
Obese	370 (38)	182 (49.2)	188 (50.8)	
Diabetes				
Yes	234 (24)	168 (71.8)	66 (28.2)	<0.001
No	740 (76)	358 (48.4)	382 (51.6)	
Mental Disorder				
Yes	185 (19)	103 (55.7)	82 (44.3)	0.6
No	786 (80.1)	421 (53.6)	365 (46.4)	
CVD				
Yes	465 (47.7)	303 (65.2)	162 (34.8)	<0.001
No	509 (52.3)	223 (43.8)	286 (56.2)	
Comorbidities				
Yes	611(62.8)	355 (58.1)	256 (41.9)	<0.001
No	351 (36)	162 (46.2)	189 (53.8)	
Unknown	12 (1.2)	----	----	
SRH				
Excellent	145 (14.9)	50 (34.5)	95 (65.5)	<0.001
Good	300 (30.8)	146 (48.7)	154 (51.3)	
Fair	389 (39.9)	235(60.4)	154 (39.6)	
Poor	140 (14.4)	95 (67.9)	45 (32.1)	

*Row Percentage. BMI= Body Mass Index. CVD= Cardiovascular Diseases. SRH=Self-Rated Health

Table 3.2. Univariate Association of Father Death (5 – 17 Years) and Selected Participants Characteristics

Characteristic	Father Death (5-17) Years Old: Yes N (%)* 105 (10.8)	Father Death (5-17) Years Old: No N (%) 869 (89.2)	*p*-Value
Sex			
Male	28 (26.7)	298 (34.3)	0.12
Female	77 (73.3)	571 (65.7)	
Age			
Mean ± SD	62.7 ± 9.9	63.2 ± 10.1	0.67
Country of Birth			
Mexico	54 (51.4)	384 (44.2)	0.16
U.S.	51 (48.6)	485 (55.8)	
Education			
College	9 (8.6)	110 (12.7)	0.23
No college	96 (91.4)	759 (87.3)	
Annual Income			
<$15,000	94 (92.2)	712 (85)	0.05
>$15,000	8 (7.8)	126 (15)	
BMI			
Normal	15 (14.6)	189 (22)	0.06
Overweight	38 (36.9)	350 (40.7)	
Obese	50 (48.5)	320 (37.3)	
Diabetes			
Yes	25 (23.8)	209 (24.1)	0.96
No	80 (76.2)	660 (75.9)	
Mental Disorder			
Yes	20 (19.2)	165 (19)	0.96
No	84 (80.8)	702 (81)	
CVD			
Yes	50 (47.6)	415 (47.8)	0.98
No	55 (52.4)	454 (52.2)	
Comorbidities			
Yes	69 (66.3)	542 (63.2)	0.53
No	35 (33.7)	316 (36.8)	
SRH			
Excellent	9 (8.6)	136 (15.7)	0.25
Good	36 (34.3)	264 (30.4)	
Fair	46 (43.8)	343 (39.5)	
Poor	14 (13.3)	126 (14.5)	
Vital Status			
Deceased	59 (56.2)	467 (53.7)	0.63
Alive	46 (43.8)	402 (46.3)	

*Column Percentage. BMI= Body Mass Index. CVD= Cardiovascular Diseases. SRH=Self-Rated Health

Table 3.3. Hazard Ratios for 24-years Mortality by Parental Death

Variable	HR (95% CI)	*p*-Value
Father Death		
> 40 or still alive	1.00	
0 – 4 years	1.2 (0.69 – 2.1)	0.52
5 – 17 years	1.33 (1.01 – 1.76)	0.04
18 – 29 years	0.92 (0.69 – 1.22)	0.55
30 – 39 years	0.85 (0.63 – 1.13)	0.26
Father Death (5 – 17)		
No	1.00	
Yes	1.37 (1.04 – 1.8)	**0.03**
Mother Death		
> 40 or still alive	1.00	
0 – 4 years	1.15 (0.7 – 1.89)	0.58
5 – 17 years	1.05 (0.74 – 1.49)	0.8
18 – 29 years	1.21 (0.9 – 1.64)	0.21
30 – 39 years	1.03 (0.77 – 1.38)	0.83
Mother Death (18 – 29)		
No	1.00	
Yes	1.2 (0.89 – 1.61)	0.24

HR: Hazard Ratio. Model adjusted for baseline: sex, age, country of birth, education, body mass index, diabetes, self-rated health and cardiovascular diseases.

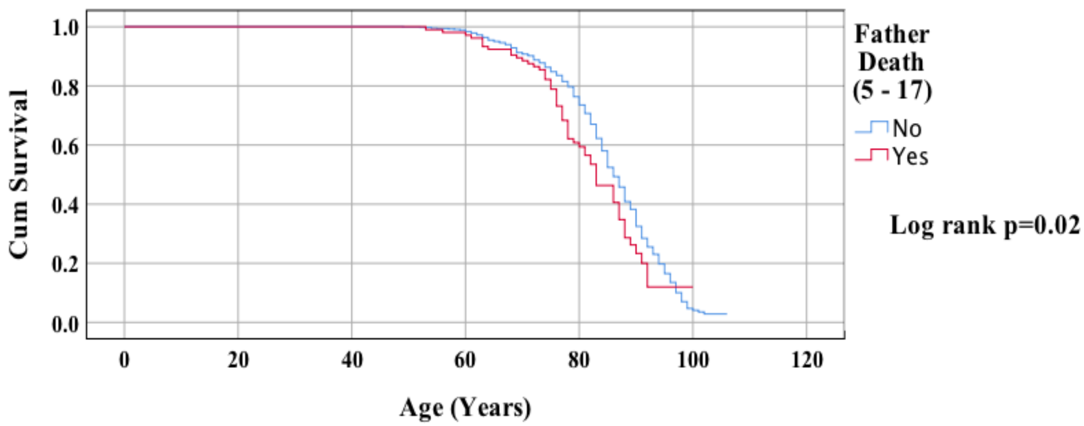

Figure 3.1. Kaplan-Meier Survival Estimates by Father Death at age (5-17) Years

3.4. Discussion

The focus of this study was to investigate the association between early parental death and all-cause mortality among Mexican Americans, aged 45 years or older, at the time of baseline data collection. Findings suggest that losing a father between the ages of 5 – 17 years increases the all-cause mortality risk decades later, even after adjusting for demographics, education, SRH, and physical health in late adulthood. The elevated mortality risk was not substantially different between males and females. Moreover, losing a mother at an older age stage (18 – 29) years old also revealed a higher but not significant mortality risk.

For a bereaved offspring, loss of a parent before the age of 18 may lead to unfavorable consequences later in life. Several studies have investigated the adverse effects of losing a parent during early life on offspring lifestyle choices, physical health, mental health, and social health. For example, a population-based Danish study aimed to examine the association between losing a parent before the age of 30 and using antidepressants later in life revealed that participants who lost their parents earlier in life had elevated risk for subsequent antidepressants use (Appel et al., 2016).

Another longitudinal nationwide Danish study observed that young women who experienced parental death before the age of 18 had a greater relationship creation and risk of separation was higher among both genders (Høeg et al., 2018). Moreover, a study conducted among middle-aged adults revealed that persons who experienced early parental death had higher chronic diseases at the age of 43 compared to non-bereaved individuals (Neeleman et al., 2002). Other studies find that early parental loss may be linked to an adoption of high-risk behaviors by the bereaved offspring, such as smoking and drug use (Høeg et al., 2017; Nielsen et al., 2012). For instance, a Danish study of 3,481 participants aged 15 – 24 years reported higher rates of regular smoking among bereaved offspring compared to non-bereaved offspring (36% vs.19.1%) (Nielsen et al., 2012).

Findings presented here were supported by a similar study conducted among an elderly Utah population, aged 65 years or older, which investigated the association between early parental death and later-life mortality finding that females who lost their fathers or mothers during any of the three different stages of early life (0 – 4, 5 – 17, 18 – 29) had higher mortality risk compared to losing parents at older ages (Smith et al., 2014). The elevated mortality risk remained significant even after controlling for later life health conditions except for the effect of mother death during the first four years of life. Furthermore, losing a father or mother at ages of 5 – 17 years showed the most significant mortality risk among females even after adjustment of other early life and later life conditions with maternal death (HR=1.12; $p < 0.0001$), and paternal death (HR=1.09; $p < 0.0001$) (Smith et al., 2014).

On the other hand, the most significant mortality risk among males was found for maternal loss during young adulthood (18–29) (HR=1.10; $p < .0001$) followed by fathers death during the same age range (18 – 29) (HR =1.04; $p < .01$). In the full-adjusted model, losing a parent during any other stage of early life did not significantly increase the mortality risk among elderly males. However, the adverse effects of a mother death (HR= 1.05; p=0.10) or a father death (adjusted HR=1.04; p=0.08) between 5 – 17 years of age were marginally non-significant among males (Smith et al., 2014).

Smith, et al. (2014) believed that the lower mortality risk of early parental death reported in their study may have resulted from the strong ties of the selected families to churches, which may increase social support to a bereaved child. The smaller effect in this study compared to our study may result from the authors controlling for other early life conditions such as parental socioeconomic status and family history of longevity. Moreover, they conducted their study on an older population than that of our study sample, which in turn may explain the difference in mortality risk of early parental death between both studies. Additionally, dissimilarities in cultural and societal context between the Utah population and Mexican Americans living on the U.S. – Mexico border may also have a role in the observed death risk difference.

A population-based longitudinal study conducted in three European countries, revealed that participants who lost a parent before the age of 18 had an overall 50% higher mortality risk when compared to those who did not lose their parents during the same age range (Li et al., 2014). Those who experienced parental death when they were 15–18 years old had relatively higher mortality risk, which increased throughout follow-up time. Moreover, stratified analysis by sex of a participant or sex of a lost parent showed similar results (Li et al., 2014). A prospective study conducted on the entire Swedish population aged 10 – 59 years who did not experience parental loss at baseline found that participants aged 10 – 19 years who lost their mothers during the follow-up had greater mortality risks compared to those who did not lose their mothers (Rostila & Saarela, 2011). Losing a father at this age range was not associated with mortality of offspring. Moreover, the increased mortality risk associated with losing a mother in this age interval was stronger among females compared to males (HR=3.75 vs.1.96).

However, the maximum follow-up period in this study was 10 years thus the study did not examine the long-term mortality risks of a bereaved offspring, compared to the 24 year follow up in the current study. Findings presented here are restricted to later life conditions of a bereaved offspring and did not include early family factors such as the parental age at death and the socioeconomic status of the bereaved families. However, a previous study revealed findings similar to those presented here, even after adjusting for the effects of parental longevity on the mortality risk of early parental death (Smith et al., 2009). The relatively small sample size of this analysis may reduce the study power for detecting the hypothesized rise in mortality risk of maternal death at early stages of the life course. However, the strength of the current study lies in that it investigated a unique socioeconomically disadvantaged population in which almost half of respondents were born in Mexico. Moreover, the comprehensive general health data collected at later midlife and the long follow-up duration of the current study improved the estimation of late life mortality risk of early paternal death.

Although some studies revealed a relationship between early parental loss and mortality, more research is needed to explore the underlying consequences of early parental death and the processual mechanisms through which it affects morbidity and mortality of the bereaved individual in later life stages. Losing a father at an earlier stage of life may alter the living and socioeconomic conditions of a bereaved family. Hence, greater attention needs to be given to families experiencing parental loses early in their children’s development. Increasing psychosocial and economic support for these families may help to reduce the adverse short and long-term impact of the grieving process.

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CHAPTER IV: THIRD MANUSCRIPT

Self-Rated Health and Mortality

4.1. Introduction

The association between self-rated health (SRH) and all-cause mortality has been investigated by several population-based longitudinal studies during the last four decades (DeSalvo et al., 2006; Idler & Benyamini, 1997; Kaplan & Camacho, 1983; Shen et al., 2014). This literature suggests that SRH appears to be an independent predictor of mortality, even after accounting for demographic, socioeconomic, behavioral, physical and mental health risk factors. For example, a review of twenty-seven community-based longitudinal studies examining SRH as a risk factor for mortality reveals impressively consistent findings. Almost all of these studies indicated that low SRH is an independent predictor of mortality, despite adjustment of other well-established mortality predictors (Idler & Benyamini, 1997).

To assess health status, researchers typically ask respondents to rate their health generally by indicating one of the following responses: excellent, good, fair, or poor. Kaplan and Camacho (1983) suggested that poor self-rating of health is a collective feature that may connect different adverse psychosocial factors, such as social isolation, depression, and stressful life events, thus proposing that self-assessment of health is a key factor for understanding the health consequences of various psychosocial factors (Idler & Benyamini, 1997). Above suggestion seems to agree with the direction of the World Health Organization's holistic definition of health as the "complete state of physical, mental, and social well-being" (Idler & Benyamini, 1997). Consequently, the self-assessment of health criterion may offer a simple and comprehensive tool for evaluating the three dimensions of health (physical, mental, and social) (Idler & Benyamini, 1997). Previous research suggested that the effect of self-rating of health on life expectancy may be moderated by gender, education, socioeconomic and cultural factors (Burström & Fredlund, 2001; Finch et al., 2002; Hays et al., 1996; Huisman et al., 2007; McFadden et al., 2009). For example, Huisman et al. (2007) revealed that the association between SRH and mortality was stronger among men with higher education when compared to men with lower education, and the moderating effect of education was not significant among women. Furthermore, a Swedish study found that the effect of SRH on mortality was higher among participants with better socioeconomic status (SES) than lower SES participants (Burström & Fredlund, 2001). Burström and Fredlund (2001) suggested that high SES groups may be more likely to voice health problems, while lower SES individuals are more likely to remain silent.

However, data from the National Health and Nutrition Examination Survey find that Mexican American immigrants rate their health lower than their U.S.-born, non-Hispanic whites counterpart (Lommel et al., 2019). Another study shows that Mexican Americans are at least three times more likely to rate their health as fair or poor when compared to non-Hispanic whites (Benjamins et al., 2012). Furthermore, over half of respondents in a community-representative study of Mexican Americans living in Hidalgo County, TX, on the U.S.–Mexico border rated their health as fair or poor (Mier et al., 2008). Previous studies indicating that foreign-born Hispanics have a significantly better health profile than US-born Hispanics (Abraido-Lanza et al., 1999; Bostean, 2013), however, they seem to rate their health as poorer than their more acculturated equivalents (Lommel et al., 2019; Shetterly et al., 1996). Some researchers suggest that Hispanics may perceive their health differently than other ethnic groups (Benjamins et al., 2012). Likewise, others indicate that greater social and psychological stressors may predict lower SRH among Mexican Americans (Finch & Vega, 2003; Lommel et al., 2019). Studies conducted on Hispanics suggested that participants who perceive their health as fair or poor have a higher burden of chronic diseases, such as diabetes and hypertension (Borrell & Dallo, 2008; Wilkinson et al., 2006). However, there is a dearth of literature examining the predictors of SRH among Mexican Americans in the United States.

Despite research interest on examining SRH in Hispanic populations, very little research has assessed the association between SRH and mortality among Hispanics in general and specifically in Mexican Americans. One study found that the relationship between poor SRH and mortality is stronger among acculturated Hispanics than the less acculturated (Finch et al., 2002). In another study conducted on older Mexican Americans, participants who rated their health as poor had lower life expectancy compared to those with excellent SRH, despite the adjustment of potential confounders (Cesari et al., 2009). Since evidence suggests that cultural and socioeconomic context may underlie the SRH and its prediction of subsequent mortality, we aim to investigate the predictors of SRH among a culturally unique and economically disadvantaged study population.

Moreover, the few studies assessing the effect of lower SRH on mortality risk by sex reveal its stronger effect on men (Hays et al., 1996; Idler & Benyamini, 1997). This may indicate a different perception of how women believe and integrate information when rating their health (Idler & Benyamini, 1997). Thus, the aim of this study is to examine the association between SRH and all cause mortality, and to assess the interaction of SRH with sex in predicting mortality risk among older Mexican Americans living on U.S.-Mexico border. We hypothesize that lower rating of self-health at baseline is associated with increased all-cause mortality risk two decades later. Further, we suggest that this association is significantly different across both genders.

4.2. Methods

4.2.1. Study Design and Sampling

Data for this study are from the Border Epidemiological Study of Aging (BESA), a longitudinal design study conducted in South Texas from 1994 to 2006/07. We added 12 years of mortality follow-up by requesting death data for the 2007 – 2019 interval from the Centers of Disease Control and Prevention (CDC) through the National Death Index (NDI) database. Data collection of the panel study started in 1995 followed by three consecutive waves conducted between 1998 and the end of the last wave in 2006/07. In this analysis, we utilized data from the baseline wave to assess independent variables and covariates that we hypothesize are contributing to SRH responses. At baseline, participants consented to participate in a 2-hr in-home face-to-face interview in either Spanish or English. The BESA general health survey questionnaire was administered to assess various aspects of demographic, socioeconomic, physical and mental health factors.

The panel study utilized a two stage stratified random sampling. The initial probability sample yielded 1089 participants, 45 years or older, selected using tract data from the 1990 US Census on the 40+ population of Mexican origin for all tracts in Hidalgo County, TX, and tracts within surrounding three counties (Willacy, Cameron, and Starr). All census tracts were stratified by age and proportionally represented in the final sample. Due to missing data, 127 participants were excluded from the initial sample resulting in an analytic sample of 962 participants.

4.2.2. Study Variables

4.2.2.1. Independent Variables

Self-Rated Health (SRH)

Self-rated health was measured at baseline by asking participants to choose one of four response-categories, excellent, good, fair, or poor, in self-rating their health. The "excellent" category was used as a reference group in the Cox regression analysis.

4.2.2.2. Covariates

Age, sex, marital status, and country of birth

Age at baseline was used as a continuous variable in the Cox regression analysis, and as a categorical variable in the ordinal logistic regression. We categorized participants into four age groups (45 – 59, 60 – 69, 70 – 79, and 80+). Sex was coded as male or female. Marital status was coded as married, single/divorced or widowed. Country of birth was self-reported and coded as U.S. or Mexico.

Education

Respondents were asked to report years of formal education. Responses were coded as having some college education (13 years or more) or not having a college education (less than 13 years).

Cardiovascular Diseases (CVD)

Cardiovascular diseases were measured as a four-item index. Participants were asked if they were medically diagnosed with high blood pressure, heart disease, atherosclerosis, or stroke. The index was created by coding responses as being diagnosed with at least one of these diseases or none. A clinical interviewer recorded all cardiovascular diseases, which were further verified by a medical review of all physician-prescribed medications that respondents were taking at the time of the interview.

Comorbidities

Comorbidities were measured as a five-item index. Participants were asked if they were medically diagnosed with any of the following diseases: cancer, gastrointestinal diseases, such as ulcer, renal diseases, joint/bone problems, or respiratory diseases. The index was created by summing diseases and coding responses as 2= being diagnosed with more than one disease, 1= being diagnosed with one of these diseases, or 0=none. All comorbidities were recorded by a clinical interviewer and further validated by reviewing all prescribed medications that participants took at the time of the interview.

Body Mass Index (BMI)

Height and weight were measured for all participants by trained staff in all waves. BMI at baseline was categorized into four groups: underweight (below 18.5 kg/m^2), normal "healthy weight" (18.5–24.99 kg/m^2), overweight (25–29.99 kg/m^2), and obese (30 kg/m^2 and above) using the CDC BMI guidelines (CDC, 2021). Having a "healthy weight" was used as a reference group in multivariate analysis.

Type 2 Diabetes Mellitus (T2DM)

Self-reported medical diagnosis of T2DM was assessed at baseline wave and was coded as a dichotomous variable whether the participant has the disease or not. All respondents who reported diabetes had a fasting glucose test done by a local laboratory, and all were confirmed.

Mental Health

A binary response question asked respondents at baseline if they were medically diagnosed with any mental health disorder, such as depression. Responses were coded whether the respondent was diagnosed with at least one mental health disorder or none. A clinical interviewer recorded all mental health disorders, which were further validated by a medical review of all physician-prescribed medications that participants took at the time of the interview and the medical doctor who prescribed the medication.

4.2.2.3. Dependent Variable

All-Cause Mortality

Mortality data were assessed through three different methods. In 2007/08, mortality data were obtained from death certificates requested from the Texas Department of State Health Services (DSHS). In 2020, death data of the entire BESA sample were requested from the CDC through the records of the National Death Index. For those with incorrect or missing Social Security Numbers (SSN), published obituaries and/or phone calls to a participant-designated family member, were used to obtain date of death and assess their vital status. Survival time was measured in years starting with the time of baseline data collection and ending with the death of the respondent or end of follow up on December 31, 2019.

4.2.3. Statistical Analysis

IBM SPSS software version 26 was used to analyze the data (IBM Corporation). Mean, standard deviations, and proportions were calculated for continuous and categorical variables respectively, to describe study participants characteristics. Ordinal logistic regression for poorer SRH was used to investigate the difference in self-rating of health across various participants' characteristics. An ordinal logistic regression model was adjusted for baseline sex, age, country of birth, education, Body Mass Index (BMI), diabetes, Cardiovascular Diseases (CVD), mental disorders, and comorbidities. Kaplan-Meier survival curves were applied to obtain cumulative survival probabilities for different SRH categories. The log-rank test was applied to investigate the survival difference between these four SRH categories. Cox proportional hazard regression model was applied to assess the association between SRH and 24-years all-cause mortality adjusting for study covariates, and to examine the interaction effects of sex and SRH on all-cause mortality. The final Cox regression model was adjusted for baseline sex, age, country of birth, education, Body Mass Index (BMI), diabetes, Cardiovascular Diseases (CVD), mental disorders, and comorbidities. Associations were considered significant at alpha level of 0.05.

4.3. Results

Table 4.1 shows descriptive statistics at baseline for study participants. Of the 962 study subjects who participated in the study, about one-third (33.4%) were male and two-thirds (66.6%) were female with an overall average age of 63.1 years. Almost half were born in Mexico (45.1%) and the other half were born in the U.S. (54.9%). More than half (57.9%) of participants reported being married while the remaining reported single/divorced (18.4%) or widowed marital status (20.5%). Moreover, 12.3% of study respondents reported they had 13 years or more of formal education compared to (87.7%) who had 12 years or less of formal education. About fifteen percent (15.1%) of participants rated their health as “excellent” and a similar proportion rated their health as “poor” (14.4%) at baseline assessment. The greatest number of participants rated their health as “fair” (39.7%) or “good” comprising 30.8% of respondents. At the end of the follow-up in 2019, 517 (53.7%) of study participants were deceased while 445 (46.3%) were not (Table 4.1).

Table 4.2 shows the ordinal logistic regression results for poorer self-rating of health at baseline assessment. Males and females had similar self-rating of health at baseline (OR= 1.05; 95%CI=0.81 – 1.38; p=0.7). Self-rating of health was not significantly different across different age groups, or between those who were born in Mexico or U.S. Participants who had less than 13 years of formal education rated their health poorer than participants who had at least 13 years of formal education (OR=2.62; 95%CI=1.74 – 3.94; p<0.001). Furthermore, participants with an overweight BMI rated their health better than participants with normal BMI, however, the difference was marginally insignificant (OR=0.74; 95%CI=0.54 – 1.03; p=0.08).

Participants with a prior diagnosis of diabetes, mental health disorders, or cardiovascular diseases have more than double the odds of poorer self-rating of health, compared to those without a prior diagnosis of such diseases (p<0.001). Moreover, being diagnosed with more than one of the other comorbidities, such as cancer or renal diseases revealed the highest odds of poorer self-rating of health compared to those who did not suffer from any of these comorbidities (OR=4.21; 95%CI=2.97 –5.98; p<0.001) (Table 4.2). The median survival age for participants aged 45 or older at the beginning of the study who rated their health as “excellent” was 91 years compared to 87, 85, and 83 years median survival age for those who self-rated their health as “good”, “fair”, and “poor” respectively (log rank p<0.001) (Figure 4.1).

Table 4.3 displays the Cox proportional hazards regression results for 24 years all-cause mortality by SRH at baseline. Compared to those who self-rate their health as “excellent” at wave 1, participants who rate their health as “good” showed 46% higher mortality risk (HR=1.46; 95%CI=1.05 – 2.02; p=0.02). Moreover, participants with “fair” self-rating of health at baseline had 1.65 times the mortality risk of the participants with “excellent” rating (HR=1.65; 95%CI=1.19 – 2.29; p<0.01). Poor self-rating of health revealed the highest all-cause mortality risk (HR=2.24; 95% CI=1.52 – 3.3; p<0.001) compared to participants who rate their health as “excellent” (Table 4.3). Further, there was no interaction between the effect of sex and SRH on all-cause mortality.

Table 4.1. Descriptive Statistics of the Study Participants

Characteristic	N= 962 N (%)
Sex	
Male	321 (33.4)
Female	641 (66.6)
Age	
Mean ± SD	63.1 ± 10.1
Marital Status	
Married	557 (57.9)
Single/divorced	177 (18.4)
Widowed	197 (20.5)
Unknown	31 (3.2)
Country of Birth	
Mexico	434 (45.1)
U.S.	528 (54.9)
Education	
College	118 (12.3)
No college	844 (87.7)
BMI	
Underweight	12 (1.2)
Normal	202 (21)
Overweight	384 (39.9)
Obese	364 (37.8)
Diabetes	
Yes	230 (23.9)
No	732 (76.1)
Mental Diseases	
Yes	181 (18.8)
No	781 (81.2)
CVD	
Yes	455 (47.3)
No	507 (52.7)
Comorbidities	
None	413 (42.9)
One disease	331 (34.4)
More than one disease	218 (22.7)
SRH	
Excellent	145 (15.1)
Good	296 (30.8)
Fair	382 (39.7)
Poor	139 (14.4)
Vital Status	
Deceased	517 (53.7)
Alive	445 (46.3)

SD, Standard Deviation. BMI, Body Mass Index. CVD, Cardiovascular Diseases. SRH, Self-Rated Health.

Table 4.2. Ordinal Logistic Regression of Poorer Self-Rated Health by Selected Participants Characteristics

Variable	OR (95% CI)	*p*-Value
Sex		
Male	1.00	
Female	1.05 (0.81 – 1.38)	0.7
Age (years)		
45 – 59	1.00	
60 – 69	1.01 (0.75 – 1.36)	0.96
70 – 79	0.87 (0.63 – 1.21)	0.41
80 +	1.15 (0.66 – 2.01)	0.62
Country of Birth		
U.S.	1.00	
Mexico	1.04 (0.81 – 1.34)	0.73
Education		
College	1.00	
No college	2.62 (1.74 – 3.94)	**<0.001**
BMI		
Normal	1.00	
Underweight	1.58 (0.52 – 4.86)	0.42
Overweight	0.74 (0.54 – 1.03)	0.08
Obese	1.15 (0.83 – 1.61)	0.41
Diabetes		
No	1.00	
Yes	2.5 (1.85 – 3.38)	**<0.001**
Mental Diseases		
No	1.00	
Yes	2.66 (1.91 – 3.72)	**<0.001**
CVD		
No	1.00	
Yes	2.22 (1.7 – 2.9)	**<0.001**
Comorbidities		
None	1.00	
One disease	2.18 (1.64 – 2.9)	**<0.001**
More than one disease	4.21 (2.97 – 5.98)	**<0.001**

OR= Odds Ratio. BMI= Body Mass Index. CVD= Cardiovascular Diseases.

Table 4.3. Hazard Ratios for 24-Years Mortality by Baseline Self-Rated Health

Variable	HR (95% CI)	*p*-Value
SRH		
Excellent	1.00	
Good	1.46 (1.05 – 2.02)	0.02
Fair	1.65 (1.19 – 2.29)	<0.01
Poor	2.24 (1.52 – 3.3)	<0.001

HR: Hazard Ratio. Model adjusted for baseline: sex, age, country of birth, education, body mass index, diabetes, cardiovascular diseases, mental health, and comorbidities.

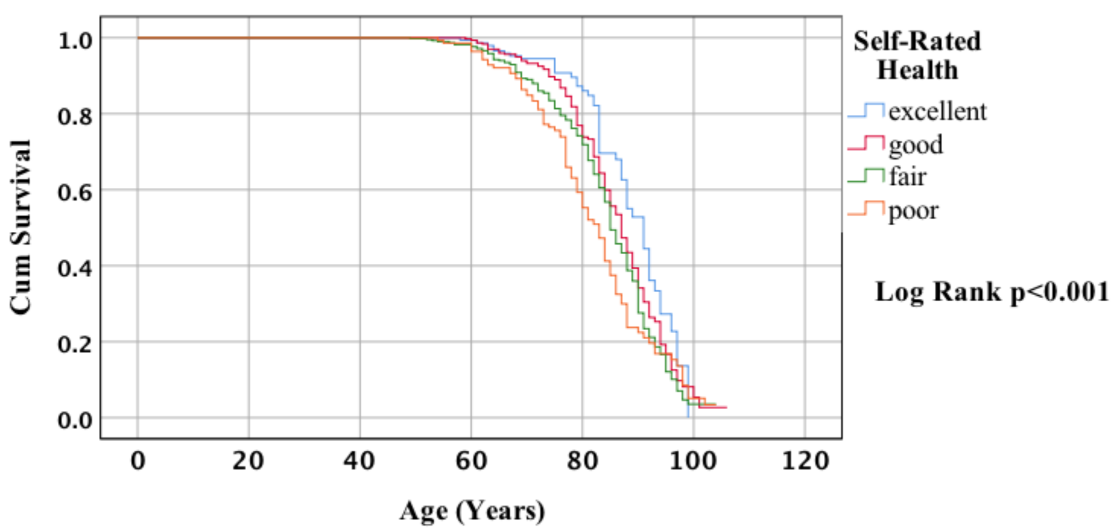

Figure 4.1. Kaplan-Meier Survival Estimates by Baseline Self-Rated Health

4.4. Discussion

The focus of this study was to investigate the association between SRH and 24 years all-cause mortality among Mexican Americans aged 45 years or older living across the U.S.-Mexico border in 1994/95. Study findings suggest that better self-rating of health at late midlife indicates greater late life expectancy, even after adjustment of demographic, socioeconomic, physical and mental health status during late adulthood. The elevated mortality prediction of poorer self-assessment of health was not significantly different between males and females. Moreover, being diagnosed at any age with a mental or physical health problem or having lower education were predictors of poorer self-rating of health among older Mexican American adults.

Above results support earlier findings suggesting that poor self-rating of health increases mortality risk among Hispanics. For example, a longitudinal study of Mexican Americans, aged 65 years or older, revealed that participants who self-rated their health at baseline as ‘poor’ had higher mortality risk at the end of the study compared to participants who reported ‘excellent’ SRH, even when controlling for confounders effects (HR=1.52; 95%CI=1.10 – 2.10) (Cesari et al., 2009). The mortality risk encountered by respondents who rated their health as ‘poor’ in our study was higher than the risk suggested by a previous Hispanic Established Populations for Epidemiologic Studies (H-EPESE) (HR=2.24 vs.1.52). This may be due to inclusion of older cohorts in the Hispanic EPESE study (age mean=72.1 vs. 63.1), additionally, our study (BESA) followed participants for longer duration (mean=16.5 vs. 5.8 years) (Cesari et al., 2009).

In another study conducted on Hispanic adults, aged 18 years or older, that utilized data from the National Health Interview Survey (NHIS) and National Death

Index (NDI) during the period from 1989 to 1997, showed that Hispanics who rated their health as fair/poor had higher mortality risk compared to those with better self-health rating (HR=1.80; 95% CI=1.58 – 2.05) (Finch et al., 2002). However, the authors of the previous study treated SRH as a dichotomous variable, which may explain the lower mortality hazards of poorer self-health rating compared to our study. Some researches have revealed that Hispanic immigrants rate their health poorer than their U.S.-born or more acculturated counterparts.

For example, a recent study utilizing data from the National Health and Nutrition Examination Survey (NHANES) showed that Mexican American immigrants with higher levels of acculturation rated their health better than less acculturated immigrants ($p < 0.001$) (Lommel et al., 2019). Further, study authors suggested that greater inflammation due to psychosocial stressors may explain the poorer self-health rating among Mexican American immigrants compared to non-Hispanic Whites. When investigating the effect of sex on SRH, women rated their health better than men among Mexican American participants (Lommel et al., 2019).

Another study conducted in Colorado revealed that Hispanics with higher acculturation rated their health similar to Non-Hispanic Whites, while lower acculturated groups were two to three times more likely than non-Hispanic Whites to have a fair/poor self-health rating after adjustment of other factors (Shetterly et al., 1996). Moreover, Hispanics in that study who reported less than 13 years of education had higher odds of poorer self-rated health, which is similar to our study finding (Shetterly et al., 1996). Similarly, to findings presented here, age and sex did not significantly predict poorer SRH in that study. Likewise, results from the Integrated Health Outreach System Project conducted in Hidalgo County among Mexican Americans in 2002 and 2003 found that more than half of the participants rated their health as fair/poor, comparable to the findings presented here (54.1%) (Mier et al., 2008). The predictive power of SRH on mortality has been well established in previous research (DeSalvo et al., 2006; Idler & Benyamini, 1997; Kaplan & Camacho, 1983; Shen et al., 2014); throughout, evidence suggests that the mortality risk associated with SRH is indicative of a gradual effect, with each worsening level, of SRH (DeSalvo et al., 2006; Idler & Benyamini, 1997).

Several studies have been conducted to explain the mechanisms involved in the predictive influences of SRH on life expectancy. It has been noted that the subjective assessment of health may be better at capturing not just the diagnosed, but the undiagnosed or preclinical health conditions not always captured in more objective health assessments (Idler & Benyamini, 1997). It is also suggested that better self-ratings of health may reflect general personality characteristics, such as having an optimistic view of life and positive projection of future health (Benyamini et al., 2000; Cesari et al., 2009; Idler & Benyamini, 1997), which may explain the sustainable and persistent effects of SRH on mortality. Jylha (2009) proposed that SRH is influenced by both individual and social context factors. Moreover, variations in the accuracy of the delivered health status information and self-understanding of one's objective health may explain the differences in the prognostic power of SRH among various cultural and age groups (Jylha, 2009).

The study has several limitations. In this analysis we did not include lifestyle data such as smoking and physical activity. However, a similar study conducted in Brazil revealed that the addition of lifestyle factors had little effect on the association between SRH and 10 years all-cause mortality (Lima-Costa et al., 2012). Our findings may not be generalizable at the individual level, since households with more than one member eligible to participate were allowed to choose who participated in the study. Thus, randomization stopped at the household level. Hence, participants represent a probability sample of households. However, all adult household residents were 45+ years old at the time of the baseline wave, thus strengthening the representativeness of all participants included in the analysis and the data presented here.

The study has several strengths. It investigated a unique, hard to reach, and socioeconomically disadvantaged population in which almost half was born in Mexico. Moreover, adjustment for comprehensive general health factors collected at baseline and the long follow-up duration improved the estimation of late life mortality risk associated with self-rating of health two decades earlier. Since evidence suggests that SRH has dose-response effect on mortality, we used ordinal logistic regression models to predict SRH as well as we treated SRH as a four level categorical variable to predict mortality.

Study findings may inform public health and clinical professionals about determinants of SRH and predictability of SRH on the mortality of Mexican Americans living on the border. Clinicians may use SRH in addition to other objective health measures as a screening tool to assess mortality risk among older adults. Further research is needed to understand the pathways that may explain the effects of SRH on mortality and to explore the predictors of SRH among older adults.

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CHAPTER V: CONCLUSION

Mexican Americans in the Rio Grande Valley (RGV) on the Texas–Mexico border reside in one of the most disadvantaged regions of the United States (Ryabov & Merino, 2017). Despite recent population growth, the area is one of the poorest in the nation with Valley residents exhibiting low educational levels, low income, and limited access to healthcare (Ryabov & Merino, 2017; U.S. Census Bureau, 2020). Although research indicates that Mexican Americans in the Valley have a higher prevalence of diabetes and obesity (Bastida & Pagán, 2002; Fisher-Hoch et al., 2010), the area, as a part of the U.S.–Mexico border, is considered to be one of the most medically underprivileged regions of the nation, experiencing recurrent increases in the proportion of uninsured individuals (Bastida et al., 2008; Salinas, 2013). Moreover, the culture of the Valley is one of the most dynamic in the country where large numbers of cultural and economic exchanges with Mexico are apparent at all societal levels (Perkins et al., 2001). Consequently, investigating the health of Valley residents may lead to important policy implications given its unique ethnic structure, population growth, and current limited economic development.

Moreover, studies comparing U.S. counties with other developed world regions indicate that Valley counties exhibit higher life expectancy than other socioeconomically similar regions (Kulkarni et al., 2011). However, Valley counties with high life expectancy are located on the US–Mexico border, an area less economically developed and where completed education is lower than in most counties and world regions. This somewhat of a demographic anomaly that adds and expands the Hispanic Paradox suggesting that this region needs to be studied and considered when examining factors that account for its longevity. In particular, the Hispanic Paradox discussed earlier needs to be extensively investigated; especially when considering factors included under the Hispanic Paradox that account for its stronger life expectancy and highlights the need to examine the relations that exist between socioeconomic factors, morbidity, and mortality. To our knowledge, very few population-based studies have investigated the role of psychosocial factors on diabetes risk and mortality among older Mexican Americans living in the border region. This dissertation aimed to examine the association between certain psychosocial factors, such as social support, SRH, and stressful life events, with incident diabetes and all-cause mortality among older adult Mexican Americans living across the border in an attempt to provide further insights into the Hispanic Paradox.

Data for this dissertation are from the Border Epidemiological Study of Aging, known as BESA, a longitudinal study consisting of four waves conducted in South Texas from 1994 to 2006/07. Additional 12 years of mortality data were requested from the CDC through the National Death Index (NDI) database resulting in a total of 24 years of survival follow-up (1995-2019). BESA utilized a two-stage stratified random sampling frame to recruit study participants. Besides the age stratum of 45+ and Mexican American origin, census tracts were used as the strata to generate recruitment quotas. The initial probability sample yielded 1089 participants, 45 years or older, selected using tract data from the 1990 US Census to estimate the number of qualifying Hispanic adults 45 years and older in four counties along the Texas Mexico border (Hidalgo, Cameron, Willacy, and Starr). Respondents consented to participate in an in-home face-to-face interview in either Spanish or English. In every wave, participants were administered a two hour general health questionnaire approved by the University of Texas IRB and prepared with the assistance of a panel of community residents and researchers.

We proposed the preparation and completion of three manuscripts to achieve the dissertation goal. The first manuscript aimed to examine psychosocial stress indicators, such as exposure to stressful events, lack of social support, and low SRH as predictors for diabetes among older Mexican American adults living on the Texas-Mexico border after 12 years of follow-up. The first and last waves were used in this manuscript by linking the factors assessed in the baseline wave (wave 1) with incident type 2 diabetes reported in the last wave (wave 4). Results show that low social support indicated by lack of daily support, loss of a father between 5 – 30 years old, and loss of a child at any time are independent predictors of the onset of diabetes. Each of these factors almost doubled the risk for developing diabetes at twelve years from the collection of baseline data, after adjusting for baseline sex, age, duration in the US, education, income, mental disorders, Instrumental Activities of Daily Living (IADL), Body Mass Index (BMI), Cardiovascular Diseases (CVD), and other comorbidities. Moreover, losing a mother during same age interval (5 – 30 years old) and poorer SRH were not risk factors for developing type 2 diabetes.

Consequently, diabetes prevention interventions targeting this high-risk population should expand established programs that focused mainly on dietary changes and physical activity to further promote social environments. Furthermore, health care professionals may screen for social support and assess psychosocial stressors as risk factors for diabetes among non-diabetic older adults. Further studies are needed to explore the medical and psychological interventions that may mitigate the physiological effects of psychosocial stress aiming to prevent diabetes among older adults.

The purpose of the second manuscript was to examine the relationship between early parental death and all-cause mortality among Mexican Americans, aged 45 years or older, at the time of baseline assessment. Furthermore, we aimed to investigate the moderation effect of sex in the association between early parental death and all-cause mortality. Results suggest that losing a father between the ages of 5 – 17 years increased the mortality risk decades later, even after controlling for demographics, education, SRH, and physical health in late adulthood. Moreover, the higher mortality risk was not significantly different between males and females. Losing a mother at older age interval (18 – 29) years showed a higher but not significant mortality risk. Although evidence revealed an adverse effect of early parental loss on life expectancy, further research is needed to explore the underlying consequences of early parental death and how it affects morbidity and mortality of a bereaved offspring. Losing a father at an earlier stage of the life course may adversely alter the living and socioeconomic conditions of a bereaved family. Therefore, enhancing the local social welfare systems and increasing the access to socio-economic resources for bereaved families may help to reduce the unfavorable short term and long-term impact of the grieving process.

The aim of the third manuscript was to evaluate the relationship between SRH and 24-year all-cause mortality among Mexican Americans aged 45 years or older living across the border. Additionally, we aimed to explore the predictors of self-health rating among older adults Mexican Americans. Results showed that better self-assessment of health at late midlife increased over all life expectancy, even after adjusting for demographics, education, physical and mental health at the time of self-health assessment. Furthermore, the elevated mortality risk of poorer self-rating of health was not significantly different between males and females. Being diagnosed with a mental or physical disease or having lower education were predictors of poorer self-assessment of health among older adults Mexican Americans. Results may inform public health and clinical professionals about the predictability of SRH on the mortality of older adults. Consequently, clinicians may use SRH in addition to other objective health assessments as a screening tool to assess the risk of mortality among older adults. Findings suggest the need to further investigate cultural domains that may underlie self-assessment of health in Hispanic populations.

Dissertation findings may not be generalizable at individual level since households with more than one member eligible to participate were allowed to decide on who would participate in the study. Thus, randomization stopped at the household level, however, respondents represent a probability sample of households. The study has several strengths. It investigated the health of a culturally unique, hard to reach, and economically disadvantaged population in which almost half of respondents were born in Mexico (45%). Moreover, the inclusion of comprehensive general health assessments and the long follow-up duration enhanced the study power to better estimate the morbidity and mortality risks associated with the investigated psychosocial factors. A medical doctor who reviewed the data with reference to history of disease, prescription medications, family physician and laboratory work whenever included further verified all health reported data. Moreover, official records of the National Death Index and the Texas Department of State Health Services verified most mortality data.

Findings presented in the dissertation may hold important policy implications by providing insights on older adults at risk for diabetes and mortality through the assessment of psychosocial stress. Moreover, a population level policy enhancing social support may be a cost-effective intervention for promoting health. The latter suggestion is supported with evidence from a Swedish study indicating that supported men have a lower risk of mortality even when they have been exposed to stressful events (Rosengren et al., 1993). The latter suggesting that sufficient emotional support modifies the association between life stress and mortality, by identifying the beneficial contribution of social support in lowering the risk of mortality, even when exposed to prior stressful events (Rosengren et al., 1993). Further research is needed to develop and investigate the efficacy of culturally tailored targeted interventions aimed to support social environments, which may in turn have stress buffering effects among older adult Mexican Americans at risk for diabetes and mortality.

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APPENDICES

Appendix A

IRB Approval

FLORIDA INTERNATIONAL UNIVERSITY

Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To:	Dr. Elena Bastida
CC:	Raed Jannadi
From:	Elizabeth Juhasz, Ph.D., IRB Coordinator EJ
Date:	April 25, 2019
Protocol Title:	"Border Epidemiological Study of Aging: The Role of Psychosocial Factors on Mortality of Mexican Americans in South Texas"

The Social and Behavioral Institutional Review Board of Florida International University has approved your study for the use of human subjects via the **Expedited Review** process. Your study was found to be in compliance with this institution's Federal Wide Assurance (00000060).

IRB Protocol Approval #:	IRB-19-0139	**IRB Approval Date:**	04/25/19
TOPAZ Reference #:	107668	**IRB Expiration Date:**	04/25/22

As a requirement of IRB Approval you are required to:

1) Submit an IRB Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved by the IRB prior to implementation.
2) Promptly submit an IRB Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
3) Utilize copies of the date stamped consent document(s) for obtaining consent from subjects (unless waived by the IRB). Signed consent documents must be retained for at least three years after the completion of the study.
4) **Receive annual review and re-approval of your study prior to your IRB expiration date**. Submit the IRB Renewal Form at least 30 days in advance of the study's expiration date.
5) Submit an IRB Project Completion Report Form when the study is finished or discontinued.

HIPAA Privacy Rule: **N/A**

Special Conditions: **N/A**

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

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PUBLICATIONS AND PRESENTATIONS

Jannadi, R., & Darrow, W (November, 2017). *Perceived risk of Zika infection, perceived severity, and mosquito repellent use by south Florida university students.* Poster presentation at the APHA 2017 Annual Meeting and Expo, Atlanta, GA.