

Social resources, pension policy, and older adults' mental, physical, and cognitive health: A cross-national comparison between China, England, Mexico, and the United States

by

Peiyi Lu

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

Major: Gerontology

Program of Study Committee:
Mack Shelley, Major Professor
Jennifer Margrett
Daniel Russell
Peter Martin
Olga Chyzh

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2021

Copyright © Peiyi Lu, 2021. All rights reserved.

TABLE OF CONTENTS

	Page
LIST OF FIGURES.....	v
LIST OF TABLES.....	vi
NOMENCLATURE.....	vii
ACKNOWLEDGMENTS.....	viii
ABSTRACT.....	ix
CHAPTER 1. INTRODUCTION.....	1
Aging in the Global Context.....	1
Health Research and Aging Policy.....	2
Research Gaps and Goals.....	2
Overall Theoretical Framework.....	5
Research Hypotheses and Design.....	8
Research Assumptions and Hypotheses.....	8
Publicly Available Datasets.....	9
Choice of Four Countries.....	11
Structure of the Dissertation.....	15
References.....	18
CHAPTER 2. RETIREMENT, PENSIONS, AND DEPRESSIVE SYMPTOMS AMONG OLDER ADULTS.....	20
Abstract.....	20
Introduction.....	21
Depression in Late Life.....	22
Retirement and Health.....	23
Pensions and Health.....	24
Retirement and Pension Policies in China, Mexico, the U.S., and the UK.....	26
Cross-National Comparison for Retirement, Pensions, and Depressive Symptoms.....	30
Research Question and Hypotheses.....	31
Methods.....	32
Data.....	32
Measures.....	33
Demographic information.....	33
Control variables.....	33
Independent variables.....	34
Dependent variable.....	34
Analysis Methods.....	36
Missing data and sensitivity analysis.....	36
Scoring method of CESD.....	39
Other Issues: Non-Normality, Multicollinearity.....	41

Results.....	42
Descriptive Statistics.....	42
Prevalence of Depressive Symptoms.....	44
Regression Results.....	45
Discussion.....	49
Conclusion.....	54
References.....	55
Appendices 1: Supplemental tables and figures.....	61
CHAPTER 3. WHY DO SPOUSES DEPRESS EACH OTHER? A CROSS-NATIONAL STUDY TO TEST THE SHARED RESOURCE HYPOTHESIS IN DEPRESSIVE SYMPTOM CONCORDANCE WITHIN OLDER ADULT COUPLES.....	66
Abstract.....	66
Introduction.....	67
Theories of Health Concordance.....	68
Cross-National Study in Health Concordance.....	70
Research Hypotheses.....	71
Methods.....	73
Data Source.....	73
Measures.....	74
<i>Outcome Variable</i>	74
<i>Predictor Variables</i>	75
Analytic Strategy.....	78
Results.....	81
Descriptive Characteristics.....	81
Multilevel model results.....	83
SEM results.....	84
Regression Results with Count Data.....	87
Discussion.....	93
Conclusion.....	97
References.....	98
Appendices 2: Supplemental tables and figures.....	102
CHAPTER 4. DIS/ADVANTAGE AND HEALTH IN LATE LIFE: A COMPARISON BETWEEN FOUR COUNTRIES.....	105
Abstract.....	105
Introduction.....	106
Theories: CDA and Welfare State.....	106
Cross-National Comparison in Health Patterns.....	108
Socioeconomic Status and Health.....	111
Research Objectives.....	112
Methods.....	113
Data.....	113
Measures.....	114
<i>Sociodemographic Information</i>	114
<i>Health and Behavior Indicators</i>	114
<i>Outcome Variables</i>	115

Analytical Strategy.....	117
Results.....	119
Descriptive Characteristics.....	119
Regression Model Results.....	122
Moderation Role of Country and Gender.....	123
Discussion.....	126
Conclusion.....	132
References.....	133
Appendices 3: Supplemental tables and figures.....	136
CHAPTER 5. GENERAL CONCLUSION.....	139
Summary of Findings.....	139
Implications.....	143
Limitations.....	144
Future Direction.....	147
Appendix 4: IRB exempt memo.....	148

LIST OF FIGURES

	Page
Figure 1 Theoretical Framework for this Dissertation Combining Social Ecological Model and Life Course Theory.....	8
Figure 2 The schematic picture of assumptions/hypotheses.....	9
Figure 3 Available cross-sectional datasets in the harmonized data.....	14
Figure 4 Boxplots of depressive symptoms among four age groups in four countries.....	45
Figure 5 SEM results for Chinese couples.....	88
Figure 6. SEM results for American couples.....	89
Figure 7 SEM results for Mexican couples.....	90
Figure 8 SEM results for British couples.....	91
Figure 9 Gender and cross-national comparison on self-reported health across age groups.....	124
Figure 10 Gender and cross-national comparison on CESD score (depressive symptoms) across age groups.....	124
Figure 11 Gender and cross-national comparison on functional ability across age groups.....	125
Figure 12 Gender and cross-national comparison on memory functioning across age groups...	125

LIST OF TABLES

	Page
Table 1 Comparing the Characteristics of Four Countries.....	15
Table 2 Comparing the three main pillars in four countries.....	28
Table 3 Variables used in this study.....	35
Table 4 Item-nonresponse rate for each measure in four countries N (%).....	39
Table 5 Results of testing the missingness mechanism using different approaches.....	39
Table 6 Items of CESD scale in four countries.....	41
Table 7 Descriptive and frequency analysis.....	43
Table 8 Regression Model Results using SEM.....	47
Table 9 Individual-level and couple-level variables used in this study.....	77
Table 10 Descriptive statistics of husbands and wives in four countries.....	82
Table 11 Multilevel model results testing APIM model.....	85
Table 12 Regression results of the effects of shared resources on couples' depression concordance.....	92
Table 13 Comparison of Health Resources in Four Countries in 2012-2013.....	110
Table 14 Variables used in this study.....	116
Table 15 Descriptive and frequency analysis results of respondents in four countries.....	120
Table 16 Analysis of variances (ANOVA) table of model results.....	122
Table 17 Summaries of the three articles in this dissertation.....	142

NOMENCLATURE

APIM	Actor Partner Interdependence Model
CESD	Center for Epidemiologic Studies Depression Scale
CDA	Cumulative (Dis)advantage
CHARLS	China Health and Retirement Longitudinal Study
ELSA	English Longitudinal Study on Ageing
FIML	Full Information Maximum Likelihood
HRS	Health and Retirement Study
MAR	Missing At Random
MCAR	Missing Completely At Random
MHAS	Mexican Health and Aging Study
SEM	Structural Equation Modelling

ACKNOWLEDGMENTS

I would like to thank my committee chair, Prof. Mack Shelley, and my committee members, Prof. Jennifer Margrett, Prof. Daniel Russell, Prof. Peter Martin, and Prof. Olga Chyzh, for their guidance and support throughout the course of this research. In particular, I want to offer my greatest appreciation to Prof. Shelley, who has continuously and generously supported and helped me in the past four years. I appreciate him taking the time to meet with me weekly, financially supporting me, carefully revising the manuscripts, and giving me all the good advice in doing research. Without him, this dissertation would not have been possible.

In addition, I would also like to thank my friends and colleagues in the Gerontology Program and Departments of Political Science and Statistics for making my time at Iowa State University a wonderful experience. I also thank my families for their support on me studying abroad. Finally, I would like to thank my twin sister Wanyi Lu, and my boyfriend Hantao He, for their consistent support in my journey of pursuing a PhD degree.

ABSTRACT

Population aging is accelerating across the globe. A cross-national comparison perspective is imperative and important because such comparison provides an opportunity to contrast experiences of different countries and learn from each other. Promoting healthy aging is one of the ultimate goals of social policies related to older adults. Guided by the integrative theoretical framework based on the social ecological model and life course perspective, this dissertation investigates the relationship of social resources with older adults' physical, mental, and cognitive health in China, the United States, England, and Mexico using the Harmonized Health and Retirement Study (HRS) dataset and its international sister studies. Four countries were chosen primarily based on their geographic location, different level of economic development, and availability in the Harmonized HRS dataset. The dissertation comprises three projects.

The first project explored the relationship between retirement/pension and depressive symptoms of older adults across the life course. Regression models were estimated using structural equation modelling. Results indicated that retirement was associated with higher levels of depressive symptoms for the U.S. and with lower levels of depressive symptoms for Mexico and England. Having a public pension was associated with lower levels of depressive symptoms for Mexico and with higher levels of depressive symptoms for the U.S. and China. Having a private pension was associated with lower levels of depressive symptoms for the U.S., China, and England. The study showed that continuity theory demonstrates cross-national variation in explaining the association between retirement and depressive symptoms.

The second project tested the cross-cultural applicability of the shared resource hypothesis in explaining mental health concordance among older couples. Dyadic data were

analyzed to examine the actor and partner effects of demographic, health, and household variables on depressive symptoms using both multilevel model and structural equation model. Results indicated both husbands' and wives' depressive symptoms were associated with their own and the spouses' social and health status. Most couple-level resources were nonsignificant predictors for Chinese and Mexican couples' concordance, but having more social and financial resources was associated with higher concordance among British and American couples. It is concluded that the shared resource hypothesis was more applicable to depressive symptom concordance within couples in the U.S. and England, but not in China and Mexico.

The third project examined health inequalities between genders and countries in the context of cumulative dis/advantage (CDA) and welfare state theories. Regression models were fitted to examine the moderation roles of country and gender. Health patterns across age groups were cross-examined by linear regression models and negative binomial models. Results indicated older Chinese and Mexican respondents had poorer health status than their British and American counterparts consistently except for Mexicans' memory. Cumulative health gaps between developing and developed countries existed only for functional ability. However, there is no evidence of gender gaps in health status across age groups. CDA explains the increasing gaps of functional ability across age groups between countries. General health and mental health, however, may depend more on individuals' intrinsic capacity and human agency.

Findings from these interconnected projects corroborate the person-in-environment perspective and suggest older adults' health is influenced by multilevel factors including micro demographic characteristics, meso household resources, and macro culture/policy contexts across countries. The cross-national comparisons provide a unique perspective on variables associated with older adults' health in different societal contexts. Suggestions were

recommended for clinical practice to work with diverse aging population and for decision makers to improve policy design, with the ultimate goal to promote healthy aging and reduce health disparity in later life.

CHAPTER 1. INTRODUCTION

Aging in the Global Context

Population aging is a common phenomenon across the globe. According to statistics from the United Nations, the global population aged 65 and above has been increasing more rapidly than other age groups (United Nations, 2019). In 2019, older adults are estimated to account for 9% of the planet's total human population. It is projected to have 2.1 billion adults aged 60 years or over by 2050, when about one out of every six people will be an older adult (United Nations, 2019). The primary drivers for population aging are low fertility and longer life expectancy (United Nations, 2015).

As a global phenomenon, population aging poses new challenges and opportunities to the social, economic, and political structures of every country, both developing and developed countries. The most focused policies are pensions, health, and social care. The globalization of aging highlights the need for research to move from being centered on a single country to a diverse and comparative perspective (Powell, 2010). Comparative research, especially cross-national comparison, could provide implications for policymaking and practice by contrasting experiences with other places. On the one hand, lessons can be learned about the aging policies implemented in each specific country. Such research could open discussion of the possibilities to borrow successful experiences for other countries. On the other hand, while some failures might be observed in one country, lessons could be learned to remind other countries not to repeat similar mistakes. In the context of global population aging, comparing aging experiences from different countries could be informative in gerontological research (Jackson, 2002).

However, caution also should be taken in cross-national comparison. Findings from the comparison may be constrained in specific contexts depending on the research topic and may not

generalize to other contexts. It is also very difficult to attribute the reasons for cross-national differences. Over-simplification could lead to dangerous conclusions. How well the experiences of one country can be copied or adapted to another country remains unknown. Therefore, results from any cross-national comparison study may be interpreted with caution and limitations in mind.

Health Research and Aging Policy

Health research on older adults has important implications for public policy related to aging. The ultimate goal of aging policy should be to improve the quality of life of older adults and secure their well-being (Beard et al., 2016). As people age, their health condition can and does change, which raises concerns about medical service and about social care provision and utilization. Studying the variables associated with older adults' health could provide implications for practice and for policymaking for health promotion.

Another important policy topic related to older adults is retirement and pensions. Economic security in late life is the prerequisite for a decent post-retirement life, which relates to older adults' health. Thus, exploring the relationship between social resources and older adults' health provides the perspective to analyze how aging policy interacts with older individuals. The research findings provide feedback to policy design and implementation and thus form a virtuous circle: aging policy is dedicated to improving health and well-being, and health research provides implications and feedback for aging policy.

Research Gaps and Goals

As will be demonstrated in the literature review sections in the three research articles of this dissertation, there are several common gaps in existing research on older adults' health. First, many studies focused on a single country. Insufficient attention has been paid to non-Western and developing countries. In particular, most of the existing research studied the aging

experience and older adults' health in developed countries. Factors associated with older adults' health in developing countries remain under-explored. However, the population aging rate in the developing countries is much faster than that in the developed countries (United Nations, 2015). The current elder care policy and system in developing countries are not ready for the challenges brought by rapid population aging (Shetty, 2012). Therefore, more empirical evidence is needed to expand knowledge of aging experiences in non-Western and developing countries.

Second, the findings in some studies have been incomparable or even mutually contradictory. Controversies commonly arise regarding the social determinants of older adults' health. It is possible one study could have observed a positive relationship while another study conducted in a different country found a negative relationship. The reasons for such differences are probably a product of different samples and methodological inconsistency across studies. Therefore, studies using the same definition of samples and comparable measures or statistical methods are warranted to address these controversies.

Third, most gerontology theories were derived from the social and cultural context in Anglo-American countries. Therefore, such theories are built on the assumptions that older adults share Anglo-American culture (e.g., individualism) and enjoy reasonably adequate social resources. However, this may not be the case in non-Western and developing countries where older adults believe in collectivism and have fewer resources. There is a lack of studies to explore the cross-national applicability of such theories considering the differences that exist between countries. Note that the dichotomous distinction of Western and non-Western countries was not very rigorous. The underlying difference between Western and non-Western countries are diverse, including political system, societal environment, and cultural values.

This dissertation endeavors to fill these research gaps by providing cross-national empirical evidence about the variables associated with older adults' health. It includes both developed and developing countries, Anglo-American, East Asian, and Hispanic cultures, and therefore provides a comparative perspective to look at national differences. Using harmonized datasets with consistent measures and methodology, the research findings are comparable across countries. It also contrasts the aging experiences in different countries and provides the opportunity to discuss how the national context influences or shapes individuals' health conditions. The dissertation also can contribute to aging research by applying key theories in different country contexts and discussing the variation in their cross-national applicability.

It should be clarified that this dissertation is not aimed at developing a new theory for older adults' health. Instead, it primarily explores the social determinants of older adults' health in the cross-national context. The research is built on previous substantive work on older adults' health and well-developed theories in Anglo-American culture. However, there are some unanswered questions when such topics and theories are situated in the cross-national comparison context. Therefore, this dissertation extends the application of aging theories to a wider cross-national context. In addition, this dissertation also is meant to fill research gaps in current literature. Findings from this dissertation provide additional or new evidence related to controversial academic arguments and thus bolster the discussion in these areas.

By comparing countries with different levels of resource availability, this dissertation facilitates the process of drawing lessons from highly-performing countries to inform policy recommendations for other countries. The dissertation also is structured to develop evidence-based recommendations for practice about how to improve older adults' health and well-being. The cross-national comparisons provide a unique perspective on the various factors associated

with older adults' health in different societal contexts. Suggestions will be recommended for practitioners, such as social workers, to work with diverse aging populations from different demographic and cultural backgrounds.

Overall Theoretical Framework

This dissertation uses the social ecological model and life course theory as the two overall theoretical frameworks. The three articles contained in this dissertation broadly explore the social determinants of older adults' health from a cross-national comparison perspective. Therefore, the fundamental mechanism of conducting research on variables associated with older adults' health is that people reside in the family/community/country and are affected by the factors from all dimensions. According to the World Health Organization (WHO), social determinants of health are defined as the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power, and resources at global, national, and local levels. Social determinants of health are mostly responsible for health inequities – the unfair and avoidable differences in health status seen within and between countries” (Centers for Disease Control and Prevention, 2021). In other words, people's health is influenced by multilevel factors, including intrapersonal characteristics, interpersonal relationship/network, and social economic, and policy factors. Therefore, the topic of social determinants of health in this dissertation matches the principles of social ecological model and life course perspective as elaborated in the following paragraphs.

The social ecological model is a well-developed and commonly-used theory in social science research and is applicable to aging studies (Bengtson & Settersten, 2016; Bronfenbrenner, 1989). The social ecological model suggests individuals are embedded in their surrounding environment and therefore are affected by the contexts of community/organization and social-cultural-political levels (Bengtson & Settersten, 2016). Human beings are social animals. As

people live in the society, they interact with others and therefore unavoidably affect or are affected by their surroundings, including visible (e.g., human being, community facility) and invisible (e.g., social policy, cultural value) influences (Stokols, 1996).

Individuals also live in a hierarchical structure based on the extent of their relationship/closeness, as Figure 1 shows. Individuals are centered at themselves and are determined primarily by their intrapersonal characteristics such as demographics and personality traits. Next, their health and behaviors are closely related to the family and household they are nested in. Therefore, their household resources and influence from other family members are critical. People also reside within a broader community. The definition of community is broad here – it could be a small town, a city, a state/province, or even a country. Residents in the same community share the public resources in their community and thereby affect or are affected by their community environment.

Looking broadly, people also live in the same societal context and therefore share similar cultural values and operate within similar policy systems. Anglo-American culture dominated by individualism highly values individual independence and freedom. In East Asian culture that enshrines Confucianism people are expected to behave as part of a collective and should sacrifice when needed for the greater good. The Hispanic culture also highly values family and emphasizes interpersonal dependence and mutual support. The different cultural values affect how individuals interact with other people by shaping their attitude and practice towards their interpersonal relationships, which generates different relationship characteristics (e.g., nurturing or non-nurturing). Such various relationships in different cultures further influence health via social support directly and social integration indirectly. The social ecological model emphasizes

the person-in-environment perspective and suggests the need to explore the social determinants of older adults' health from a multilevel approach.

Life course theory also emphasizes the contextual effect on individuals, but it recommends a dynamic perspective. Individuals' life and experience evolve as they enter or transition to different life stages. Life span developmental theory emphasizes the dynamic changes of human development in different phases (e.g., infant, adolescent, child, youth, adult, older adult). Life course theory incorporates the dynamic perspective from life span theory, and highlights the importance of the contextual effects of history, society, life events, and social roles on individuals' life (Elder 1994, 1998). According to the life course perspective, individuals' lives are unfolded and affected by historical contexts and social structures (Dannefer, 2003), which is consistent with the core principle of the social ecological model. The added horizontal line in Figure 1 shows the need to look at individuals' health change across their life span and consider the effect of life events and historic changes on individuals.

A combination of the social ecological model and life course theory is believed to be reasonable for this dissertation's overall theoretical framework. In the cross-national setting, each country has different societal environments, meaning that community resources, the policy system, and cultural values could be somewhat different. Older adults, as a subgroup population residing in the society, are also influenced by multilevel factors. They have heterogeneous intrapersonal characteristics. In the household within which they are nested, family resources may constrain or benefit their health. In a broader context, their health also may be associated with social policy (e.g., healthcare access, pensions) and resources. Such influences could be dynamic and changing across their life span. Especially, this dissertation is interested in the middle and late stages of adulthood. Guided by both theories, this dissertation will focus on

exploring the social and economic determinant of older adults' health from an integrative and multidimensional perspective. Previous studies have applied the combination of social ecological model and life course theory to aging research (e.g., Kim & Moen, 2002), which laid the groundwork for this dissertation.

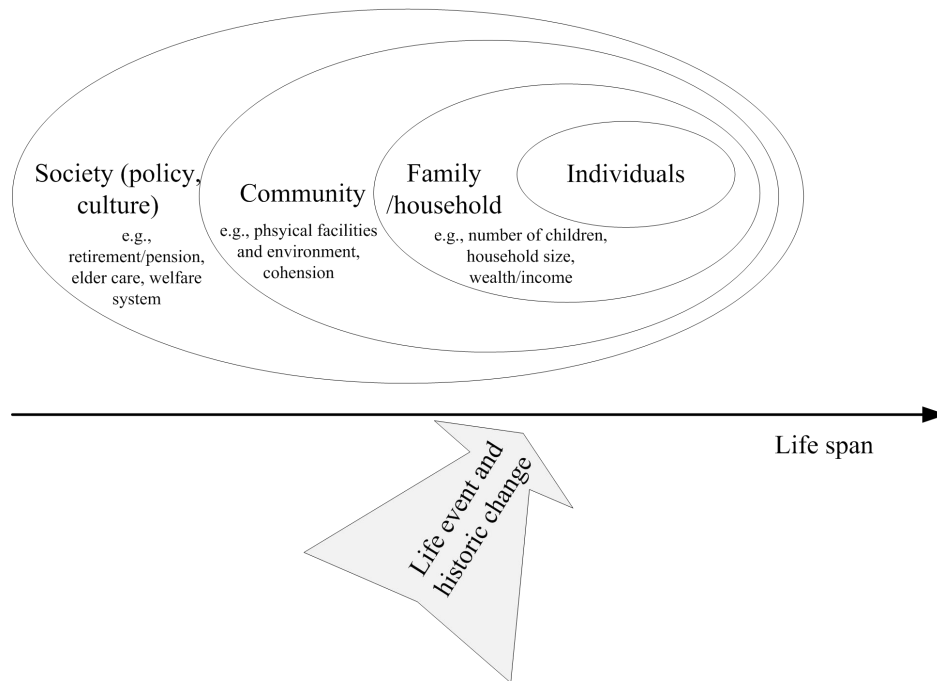


Figure 1 Theoretical Framework for this Dissertation Combining Social Ecological Model and Life Course Theory

Research Hypotheses and Design

Research Assumptions and Hypotheses

Under the theoretical framework of the social ecological model and life course theory, this dissertation assumes older adults' health is influenced by multilevel factors, including their intrapersonal characteristics, the family/household environment, and social resources available to them. Figure 2 shows the schematic picture of assumptions/hypotheses. In the cross-national comparison setting, there are great country variations in terms of social resource availability. The

assumption is that developing and developed countries differ substantially in overall resource availability due to their differences in economic development, which could shape their populations' health condition contextually. In addition, countries could differ in terms of their elder care system and cultural values. Therefore, the social policies in these countries are also different; thus, it is hypothesized that the relationship between policies and older adults' health varies from country to country. Results may also be interpreted considering cultural differences. That is, different cultural values regarding older adults and elder care could influence older adults' health. Note that this dissertation uses the wording "influence" and "effect" interchangeably with "association" and "relationship." Considering that this dissertation uses observational survey data, causal relationships cannot be derived from this study.

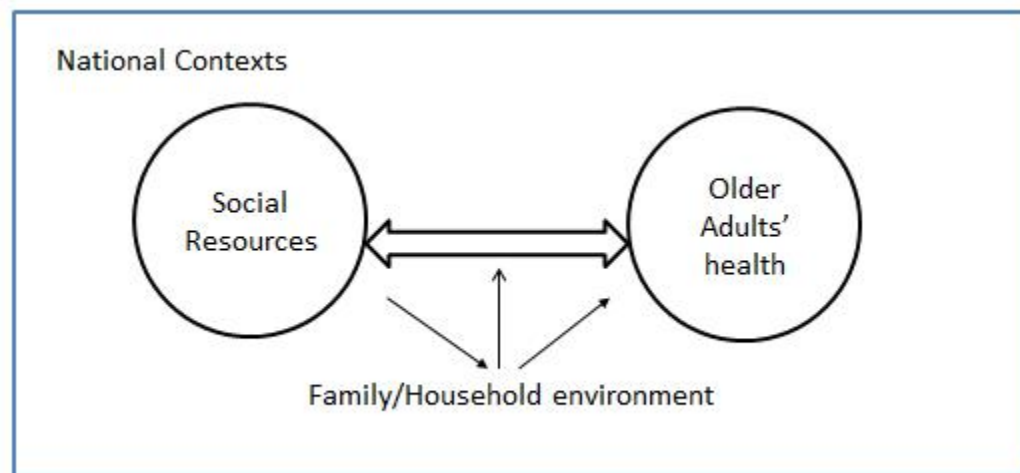


Figure 2 The schematic picture of assumptions/hypotheses

Publicly Available Datasets

This dissertation primarily uses the United States Health and Retirement Study (HRS). HRS is a nationwide longitudinal survey conducted by the University of Michigan every two years since 1992. The age-eligible sample enrolled in the 1992 survey was the cohort born

between 1931 and 1941. In 1998, HRS added a birth cohort to create a sample representative of American older adults aged over 50. Since then, HRS has refreshed the sample with a new birth cohort every six years to maintain sample size and representativeness (HRS Staff, 2017). HRS is one of the world's most extensive studies focusing on aging-related issues.

HRS investigates the demographics, retirement, pensions, and health among American older adults. It encompasses data on various health-related variables, including physical, mental, and cognitive functions, health insurance, and health service use. It also has many social and retirement variables, such as family structure, social network/support, caregiving, employment history, household income/wealth, pension/Social Security, and retirement plans and status. HRS represents one of the most comprehensive population-based cohort studies focusing on American older adults' social, financial, and health conditions. It provides gerontological researchers an opportunity to examine older adults' mental, physical, and cognitive health and their associated factors.

Using a multi-stage area probability sampling design, HRS is a nationally representative dataset. HRS data also contain oversamples of Black and Hispanic respondents, and residents in Florida (Heeringa, 1997). The sample for the HRS has been built up over time. The initial cohort recruited and enrolled in 1992 was born between 1931 and 1941. The Early Baby Boomers cohort, born 1948-1953, was added in 2004. The Mid Baby Boomers, born 1954-1959, were added in 2010 and the Late Baby Boomers, born 1960-1964, were added in 2016 (HRS Staff, 2017). The total sample in each cross-sectional survey is about 20,000. For example, in the 2012-2013 survey, the number of respondents was 20,554. The response rate among HRS participants was high, ranging from 80%-91% for every biennial survey (HRS Staff, 2017). Because this dissertation uses completely de-identified secondary datasets, Institutional Review Board (IRB)

approval is not required. The IRB exemption document is attached at the end of this dissertation as an appendix.

Choice of Four Countries

As one of the most famous large population-based cohort health surveys, HRS has a few international sister studies around the world. The questionnaire and sampling design are different in each country, reflecting the real-world conditions of each country. However, some items are shared across the HRS-series international studies. For a long time, researchers needed to clean, compile, and merge the datasets from different countries by themselves if they wanted to do cross-national comparison studies. This usually took a huge amount of time because the coding of the countries' datasets was not consistent. To make the data more accessible to researchers and facilitate cross-national comparison studies, the Gateway to Global Aging Data team at the University of Southern California created the Harmonized HRS-series dataset. These harmonized datasets provide a user-friendly version of a subset of the HRS and its international sister studies. The USC researchers choose the variables shared in each country's datasets and recode variables to make them consistent and usable across countries. For more details, please refer to www.g2aging.org.

When choosing countries for cross-national comparison, the first step is to consider the principles underlying the choice of cases (Lijphart, 1975; Geddes, 1990; Teune & Przeworski, 1970). Theoretically or ideally, comparative studies should choose the cases that are “similar in a large number of important characteristics which one wants to treat as constants, but dissimilar as far as those variables are concerned which one wants to relate to each other” (Lijphart, 1975, p. 687). In other words, cases are similar at many variables but dissimilar at one variable which is of interest to the researchers.

For example, broadly, I may assume two Asian countries, China and Japan, are similar for being at the same continental location and share a Confucian culture, but differ regarding the extent of economic development. This is, of course, a simple assumption because those two countries definitely are dissimilar in many other areas, such as the political system, elder care, social welfare, and health care systems. Additionally, I argue whether the principle is equally applicable in doing cross-national comparison on population health. In this study, the sample unit is an individual—a person, and not a whole country. The underlying mechanism of population health research is that people are heterogeneous. People residing in the same country or even the smallest residential unit — community —are heterogeneous because people have different demographic background, life experiences, intrapersonal characteristics, perception of their health, and life habits. Recognizing that inter-individual heterogeneity within the country is essential to understand the uncertainty researchers cannot control, it is essential to control individual-level demographic variables (e.g., age, sex, education, income) and societal resources (e.g., retirement, pension, health insurance) in the statistical analysis. Although it was not possible to control the country-level variables (e.g., political system, elder care policies), some control may be exerted through the individuals-level variables.

Additionally, to broaden the horizon, it will be interesting to look at countries from a global perspective, which means including cases from different geographic locations. China and the United States have the two largest economies in the world. Including them in the study provides significant implications of how older adults are doing in these two countries. To expand the geographic location, I also prioritized Mexico in Central America and European countries. No data from African countries were available at the time of analysis. However, choosing countries from Europe was difficult, as I would need to justify why I chose one country over

another. There is no clear preference. The Survey of Health, Ageing, and Retirement in Europe (SHARE) contains data from more than 20 countries, and they were commonly used in gerontological research as a whole. The English Longitudinal Study on Ageing (ELSA), however, is an independent dataset distinguished from SHARE.

A reasonable idea was to choose the countries primarily based on their geographic locations and the extent of economic development. I should try to include countries from different continents and represents different level of economic development. The assumption of this dissertation is that older adults' health in different countries is shaped by their surrounding environment and available resources. The level of economic development of a country is undoubtedly an important indicator for such environmental or societal context concepts.

However, I have encountered several difficulties when exploring the harmonized datasets. First, some countries, especially the developing countries, have relatively fewer surveys than the developed countries. Figure 3 shows the survey datasets were available at the time of this dissertation was designed. China and Mexico had two or four waves of data that could be used. India did not release any datasets. In contrast, HRS had the most complete surveys that could be used, from wave 1 to wave 13, ELSA for England and SHARE for European countries also had a generous number of datasets. I think it is important to make sure the datasets in each country were collected in the same year, to rule out period effects. Such criteria left a limited number of options because not all countries collected their data in the same year. As noted in Figure 3, the commonly-shared year for most countries was the cross-sectional survey in 2012-2013.

	HRS	MHAS	ELSA	SHARE	CRELES	KLoSA	JSTAR	TILDA	CHARLS	LASI
	United States	Mexico	England	20+ European countries & Israel	Costa Rica	Korea	Japan	Ireland	China	India
1992-93	HRS W1 AHEAD 1993 W1									
1994-95	HRS W2 AHEAD 1995 W2									
1996-97	HRS W3									
1998-99	HRS W4									
2000-01	HRS W5	MHAS W1								
2002-03	HRS W6	MHAS W2	ELSA W1							
2004-05	HRS W7		ELSA W2	SHARE W1	CRELES W1					
2006-07	HRS W8		ELSA W3	SHARE W2	CRELES W2	KLoSA W1	JSTAR W1			
2008-09	HRS W9		ELSA W4		CRELES W3	KLoSA W2	JSTAR W2			
2010-11	HRS W10		ELSA W5	SHARE W4	CRELES W4	KLoSA W3	JSTAR W3	TILDA W1	CHARLS W1	
2012-13	HRS W11	MHAS W3	ELSA W6	SHARE W5	CRELES W5	KLoSA W4	JSTAR W4	TILDA W2	CHARLS W2	
2014-15	HRS W12 UAS HRS W1	MHAS W4	ELSA W7	SHARE W6		KLoSA W5		TILDA W3		
2016-17	HRS W13		ELSA W8	SHARE W7		KLoSA W6				

Figure 3 Available cross-sectional datasets in the harmonized data.

Note: Picture was captured from the webpage of Gateway to Global Aging Data at

<https://g2aging.org/?section=surveyOverview#tab-content-1>.

Second, it was difficult to retrieve the datasets from South Korea and Japan. However, I recognize that if time permitted, including the datasets in South Korea and Japan is very critical for the cross-national comparison. These two countries are developed countries in Asia and share similar culture with China. Including them in the cross-national comparison study would produce many interesting findings.

Considering the above-mentioned reasons, both theoretically and in reality, four countries (China, Mexico, England, and the United States) were chosen primarily based on their different extent of economic development and their different geographical location. However, these four countries are both similar and dissimilar in certain aspects. As Table 1 shows, China and Mexico are similar in level of economic development, cultural values, and elder care system but dissimilar in geographical locations. England and the U.S. are similar in economic development

and culture, but dissimilar to some extent regarding the elder care system. The dissimilarities between developing and developed countries are much larger, in economic characteristics, cultural values, and elder care systems. It is important to point out that this dissertation was not designed to provide thorough cross-national comparisons. The limited number of countries included in this dissertation constrained ability to generalize the findings to many countries. I also recognized the limitations imposed by the four-country comparison and was careful not to over-interpret the results.

Table 1 Comparing the Characteristics of Four Countries

	Geographic location	Extent of economic development	Culture	Elder care system
China	Asia	developing	collectivism, family value, respecting older adults and support them in later life	mainly family/children support, partially government responsibility
US	North America	developed	individualism, independence and autonomy	private sector
Mexico	South America	developing	family value, respecting older adults and support them in later life	mainly family/children support, partially government responsibility
England	Europe	developed	individualism, independence and autonomy	private business and government support

Note: "Elder care system" is a broad definition of the sources from which older adults receive care, both financially and instrumentally, including family members, community, government, and private-sector commercial companies.

Structure of the Dissertation

This dissertation consists primarily of three main research articles. All of them are cross-national comparison studies focusing on the relationships of social resources and retirement/pension policy with older adults' health. The first article addresses if the presence of

retirement, and of public pensions and private pensions, are associated with older adults' depressive symptoms. The introduction of the manuscript provides a brief comparison of the pension systems in the four countries. Structural equation models were estimated using full information maximum likelihood to address the missing value issue within the harmonized datasets.

The second article explores the concordance of depressive symptoms within older adult couples and examines the applicability of the shared resource hypothesis, which postulates that the spouses' health resemble each other because they share the same living environment and social resources. The manuscript examines the cross-national applicability of this framework to explain spousal concordance. Different approaches were used to test the hypotheses, including correlation analysis, multilevel modelling, structural equation modeling, and regression modeling.

The third article pooled the data of four countries and explored the moderation role of country and gender in the relationship between age group and four health outcomes. It was driven by cumulative dis/advantage theory and welfare state theory. Cumulative dis/advantage theory suggests that the health inequality that exists between demographic groups was generated as the disadvantage accumulated throughout individuals' life span. Countries could be categorized as having different welfare regimes based on the roles of governments and markets, which frame the populations' health via resource availability and accessibility (Mackenbach, 2012). Regression models were fitted to disentangle the interaction of country and gender in individuals' health across late life span.

The structure of the three articles follows a hierarchical design. The first article is focused on how retirement/pension policy is associated with individuals' health. The second article expanded the analysis of this impact to the couple level by exploring if shared features/resources

of the couple explain their health concordance. In the third article, individuals were situated within the context of their country of residence, and the analysis was focused on whether nationality and gender moderated health patterns across age groups, providing a macro-level perspective. Therefore, the hierarchical design of the three articles presents individual-, couple-, and macro-level perspectives, respectively.

Note that by the time the dissertation is finalized, three related articles have been published in peer-reviewed journals in 2019. The first article, entitled “Retirement, Pensions and Depressive Symptoms among Older Adults in China, England, Mexico, and the U.S.,” was published in the *International Journal of Aging and Human Development* (Lu & Shelley, 2019c). This paper also received the Behavioral and Social Sciences Section Student Research Award – Pre-Dissertation at the 2018 Gerontological Society of America's (GSA) conference. The second article, entitled “Why Spouses Depress Each Other? A Cross-National Study to Test the Shared Resource Hypothesis in Depression Concordance within Older Adult Couples,” was published in *Asian Social Work and Policy Review* (Lu & Shelley, 2019a). The third article, entitled “Cumulative Dis/Advantage and Health Pattern in Late Life: A Comparison between Genders and Welfare State Regimes,” was published in *Social Work in Public Health* (Lu & Shelley, 2019b). This paper also received the Academy for Gerontology in Higher Education (AGHE) Graduate Student Paper Award at the 2019 GSA conference.

In responding to the comments and suggestions from the preliminary oral exam, I added many additional analyses and explanations to the research design, statistical methods, and discussions. Therefore, the structure and writing of the three articles are to some extent different from what has been published. However, the key findings in this dissertation are similar with what is reported in the published articles. This dissertation benefitted tremendously from the

committee members' comments to provide better understanding of the data, statistical methods, and study findings. The comments also helped me better recognize the limitations of the research and pointed out future research directions.

References

- Beard, J. R., Officer, A., De Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J. P., Lloyd-Sherlock, P., Epping-Jordan, J. E., Peeters, G. M. E. E., Mahanani, W. R., Thiyagarajan, J. A., & Chatterji, S. (2016). The World report on ageing and health: a policy framework for healthy ageing. *The Lancet*, 387(10033), 2145-2154. [https://doi.org/10.1016/S0140-6736\(15\)00516-4](https://doi.org/10.1016/S0140-6736(15)00516-4)
- Bengtson, V. L., & Settersten, R. A. (2016). *Handbook of theories of aging*. New York, NY: Springer.
- Bronfenbrenner, U. (1989). "Ecological systems theory". In Vasta, R (ed.). *Annals of Child Development: Vol. 6*. London, UK: Jessica Kingsley Publishers. pp. 187–249.
- Centers for Disease Control and Prevention, 2021 (2021). About Social Determinants of Health (SDOH). Retrieved January 24, 2021 from <https://www.cdc.gov/socialdeterminants/about.html>
- Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 58(6), S327-S337. <https://doi.org/10.1093/geronb/58.6.S327>
- Elder Jr, G. H. (1994). Time, human agency, and social change: Perspectives on the life course. *Social Psychology Quarterly*, 4-15. doi 10.2307/2786971
- Elder Jr., G. H. (1998). The life course as developmental theory. *Child Development*, 69(1), 1-12. <https://doi.org/10.1111/j.1467-8624.1998.tb06128.x>
- Geddes, B. (1990). How the cases you choose affect the answers you get: Selection bias in comparative politics. *Political Analysis*, 2, 131-150. <https://doi.org/10.1093/pan/2.1.131>
- Heeringa SG, Connor J. (1995). *Technical description of the Health and Retirement Study sample design*. Ann Arbor, Michigan: Institute for Social Research, University of Michigan.
- Jackson, J. S. (2002). Conceptual and methodological linkages in cross-cultural groups and cross-national aging research. *Journal of Social Issues*, 58(4), 825-835. <https://doi.org/10.1111/1540-4560.00292>

- Kim, J. E., & Moen, P. (2002). Retirement transitions, gender, and psychological well-being: A life-course, ecological model. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 57(3), P212-P222. <https://doi.org/10.1093/geronb/57.3.P212>
- Lijphart, A. (1975). II. The comparable-cases strategy in comparative research. *Comparative Political Studies*, 8(2), 158-177. <https://doi.org/10.1177/001041407500800203>
- Lu, P. & Shelley, M (2019a). Why Spouses Depress Each Other? A Cross-National Study to Test the Shared Resource Hypothesis in Depression Concordance within Older Adult Couples. *Asian Social Work and Policy Review*. 13(3), 307-319. <https://doi.org/10.1111/aswp.12183>
- Lu, P. & Shelley, M. (2019b). Cumulative Dis/Advantage and Health Pattern in Late Life: A comparison between Genders and Welfare State Regimes. *Social Work in Public Health*. 34(8), 686-700. <https://doi.org/10.1080/19371918.2019.1695035>
- Lu, P. & Shelley, M. (2019c). Retirement, Pensions and Depressive Symptoms among Older Adults in China, England, Mexico, and the US. *International Journal of Aging and Human Development*. 1-25. <https://doi.org/10.1177/0091415019868227>
- Powell, J. L. (2010). The power of global aging. *Ageing International*, 35(1), 1-14.
- Shetty, P. (2012). Grey matter: ageing in developing countries. *The Lancet*, 379(9823), 1285-1287. [https://doi.org/10.1016/S0140-6736\(12\)60541-8](https://doi.org/10.1016/S0140-6736(12)60541-8)
- Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion*, 10(4), 282-298. <https://doi.org/10.4278/0890-1171-10.4.282>
- Teune, H., & Przeworski, A. (1970). Comparative research and social science theory. *The logic of comparative social inquiry* (chapter 1, pp. 17-30). New York, NY: Wiley-Interscience.
- United Nations. (2015). *World Population Ageing 2015*. Department of Economic and Social Affairs Population Division. New York. URL: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf
- United Nations. (2019). *Ageing*. Retrieved August 1, 2019 from <https://www.un.org/en/sections/issues-depth/ageing/>

CHAPTER 2. RETIREMENT, PENSIONS, AND DEPRESSIVE SYMPTOMS AMONG OLDER ADULTS

Peiyi Lu

Graduate Student in Gerontology Program, Iowa State University

Mack Shelley

University Professor, Department of Political Science, Statistics, School of Education, Iowa

State University

Modified from a manuscript published in *International Journal of Aging and Human Development*

Abstract

This study explores the associations of retirement and of public and private pensions with older adults' depressive symptoms by comparing differences between countries and age groups. Harmonized data from China, England, Mexico, and the United States were analyzed from the family of Health and Retirement Study in 2012-2013. Respondents were asked if they were retired and received public and/or private pensions. Depressive symptoms were measured by the Center for Epidemiologic Studies Depression Scale. Retirement was significantly associated with higher depressive symptoms for the U.S. and with lower symptoms for Mexico and England. Public pension was significantly associated with lower depressive symptoms for Mexico and with higher symptoms for the U.S. and China. Private pension was significantly associated with lower depressive symptoms for the U.S., China, and England. This study shows that continuity theory demonstrates cross-national variation in explaining the association between retirement and depressive symptoms.

Introduction

Retirement as a major life event has been widely studied to explore its relationship with older adults' health. Some studies applied continuity theory of normal aging and suggested a positive association but with variations between age groups (e.g., Reitzes et al., 1996). No previous study has explored the cross-national applicability of continuity theory in explaining the relationship between retirement and health, due to methodological inconsistency and insufficient attention to non-Western countries. Pensions, as an essential part of retirement, have received less attention. Existing studies mainly have two limitations. First, they focused on socioeconomic status and considered pension as one of the sources of income by default, which led to failure to discuss the direct association of pension types with depressive symptoms (e.g., Grundy & Holt, 2001; Koster et al., 2006). Second, they constrained the discussion within local or similar socioeconomic contexts and lacked a global and comparative perspective (e.g., Esser & Palme, 2010; Kim et al., 2018).

This article explores the relationships of retirement, and of public and private pensions, with older adults' depressive symptoms by comparing differences between developing and developed countries and between age groups. Depression in late life is an important health issue in modern gerontology and psychiatric research (Fiske et al., 2009), so depressive symptoms were used to measure older adults' mental health. First, the study explores whether the associations of retirement and pensions with depressive symptoms vary across age groups. Using the life course and ecological perspective (Kim & Moen, 2002), which highlights individuals' life in a dynamic view and considers contextual circumstances, it is hypothesized that the sizes of relationships between retirement and depressive symptoms vary with age groups. Second, cross-national comparisons are conducted between countries with different social resources and

pension systems to manifest differences and further suggest implications about how to improve older adults' mental health.

Depression in Late Life

Depression is a substantially studied mental disorder among older adults. Fiske, Wetherell, and Gatz (2009) summarized that depression in late life was associated with negative health outcomes, including impaired functions, suicide ideation and behaviors, and increased comorbidity or mortality. The impact factors are complex and diverse. From the life span perspective, late life major depression could originate from genetic risks, depression history, stressful life events, and socioeconomic status in childhood and adulthood. Stressful life events (e.g., early retirement and bereavement) or disadvantaged socioeconomic status (e.g., financial difficulties) were associated with increased risk of depression in late adulthood, but protective factors, such as increased resource utilization, age-related psychological resilience, and active social engagement, could play a buffering role (Fiske et al., 2009).

Previous studies of depression among older adults focused mainly on the prevalence of major depression in various settings, such as community dwelling or long-term care (Mojtabai & Olfson, 2004; Seitz et al., 2010). Little concern was given to depressive symptoms in sub-threshold criteria (Rodda et al., 2011). Impact factors were found to be inconsistent among various populations residing in different countries. One essential reason for the inconsistency is methodological differences across studies (Djernes, 2006). In addition, the influence of socioeconomic status was compounded with economic disparities at the societal level (Fiske et al., 2009). Thus, there is a need to conduct cross-national comparisons using robust and consistent epidemiological measures (Lloyd-Sherlock et al., 2012). To fill the research gap, this study compares the prevalence of depressive symptoms in sub-threshold criteria among older adults between developing countries and developed countries.

Retirement and Health

Continuity theory is one of the commonly-used theories in exploring the relationship between retirement and older adults' health. This study adopts the life course and ecological perspective proposed by Kim and Moen (2002). Continuity theory of normal aging suggests that retirement has positive associations with people's health (Atchley, 1989; Reitzes et al., 1996). The theory posits that people are more likely to maintain the lifestyle they were used to when they enter late adulthood, which helps them to keep internal continuity and age normally (Atchley, 1989). The theory was modified and enriched by adding active engagement, strategic changing, and innovation to explain successful aging among older adults more fully (Franklin & Tate, 2009; Nimrod & Kleiber, 2007). Retirement as a major life event could have positive psychosocial influences if older adults adjusted well and found a new state of equilibrium in their psychological continuity. To avoid the maladjustment or distress caused by retirement, older adults need to have sufficient accessibility to and the ability to utilize social resources (Richardson & Kilty, 1991).

Most studies found the association of retirement was reversed with mental health and physical health. It has been suggested to be associated with better mental health (Dave et al., 2006), such as improved self-esteem (Reitzes et al., 1996) and decreased depression (Mojon-Azzi et al., 2007; Oksanen et al., 2011). The association was negative with physical health (Dave et al., 2006; Van der Heide et al., 2013), such as increased chronic illness (Behncke, 2012) and impaired cognition in the long term (Celidoni et al., 2017). Therefore, it is more appropriate to apply continuity theory to explain the association between retirement and depressive symptoms. Retirement means older adults' lifestyle changes—they are no longer work-orientated but have more flexibility and leisure time. Based on continuity theory, older adults will tend to maintain their internal continuity despite external environment changes and their depressive symptoms

will experience few fluctuations. However, some studies have suggested that the relationship between retirement and health is complex and bi-directional (Oksanen & Virtanen, 2012). There could be a reciprocal process, with people making decisions to retire based on their health condition; that is, individuals who were depressed or had poor health were more likely to retire early (Fiske et al., 2009).

Another essential concern to consider in applying continuity theory is a dynamic perspective (Richardson & Kilty, 1991). Studies have shown there were age group variations in the relationships (Butterworth et al., 2006). The greatest impact occurred in the first six months of retirement (Fiske et al., 2009), and was positive in the early few years but became negative as retirement continued (Kim & Moen, 2002). One explanation of this evolution was cumulative and structural effects. Wilkinson (2016) suggested historical changes or social contexts could impose invisible strain on older adults' financial status and mental health. Therefore, it is essential to consider the dynamic process of changes on older adults over the life span, as well as the impact of developmental and social contexts on individuals' experiences regarding retirement (Kim & Moen, 2001). Kim and Moen (2002) suggested the best approach was the life course and ecological perspective. This approach requires researchers to situate individuals into their ecological contexts (e.g., historical, societal, developmental) and explore the transitional process of retirement from a life course view (Elder & Rockwell, 1979; Kim & Moen, 2002; Reitzes & Mutran, 2004). Therefore, the life course and ecological approach will be used to explain the dynamic relationship between retirement and older adults' depressive symptoms, as well as the impact of contextual factors surrounding individuals.

Pensions and Health

The direct association between pensions and older adults' health has received less attention compared to retirement. Oksanen and Virtanen (2012) suggested that the financial and

Social Security systems might help explain the complex relationship between retirement and health. Eligibility for pensions should be considered as a factor to explain the endogeneity of the association between retirement and health (Fonseca et al., 2014). Older adults' adjustment to retirement depends on their socioeconomic status and pension after retirement (Richardson & Kilty, 1991). Existing studies have focused on the relationship between socioeconomic status and health among older adults and pooled income from all sources when measuring financial status (Grundy & Holt, 2001; Koster et al., 2006). Pensions were viewed as one of the sources of income by default. It is generally agreed that income could protect older adults' health by securing their capacity to access and utilize resources (Kahn & Pearlin, 2006; Litwin & Meir, 2013; Litwin & Sapir, 2009), and income inequality in a society could exert influences on individuals (Adeline & Delattre, 2017).

Some controversies arise in researching the association between pensions and health in different countries. A positive relationship was found in most empirical studies conducted in Europe (Esser & Palme, 2010), South Korea (Kim et al., 2018), South Africa (Case, 2004; Lloyd-Sherlock & Agrawal, 2014; Schatz et al., 2012), Brazil (Lloyd-Sherlock et al., 2012), Mexico (Salinas-Rodríguez et al., 2014), urban China (Zimmer & Kwong, 2004), and 93 high- and middle-income countries (Sjöberg, 2014). The positive relationship of pensions was realized by protecting older adults from poverty (Lloyd-Sherlock et al., 2012; Norström & Palme, 2010), insuring nutrition and sanitation (Case, 2004), encouraging medical utilization (Lloyd-Sherlock & Agrawal, 2014; Zimmer & Kwong, 2004), facilitating physical activity and leisure and social connections (Lindström et al., 2001), empowering them by raising the status in the family (Case & Menendez, 2007), raising the sense of security and well-being (Kim et al., 2018), and improving the ability to make decisions (Litwin & Meir, 2013).

However, Lloyd-Sherlock et al. (2012) suggested that pensions could have adverse impacts on older adults' health in lower- and middle-income countries because it was common to see pension pooling in household income, pensioner abuse, involuntary appropriation, and reluctance to use pensions in medical service in developing countries. These inappropriate behaviors could hurt older adults' economic well-being and subsequent health conditions. Using the World Health Organization Study of Global Ageing and Adult Health, Lloyd-Sherlock et al. (2012) did not find much reliable evidence to suggest pensions were beneficial to older adults in Ghana, Mexico, and South Africa. These findings contradict studies on other developing countries including South Africa (Lloyd-Sherlock & Agrawal, 2014), Mexico (Salinas-Rodríguez et al., 2014), and China (Zimmer & Kwong, 2004). Researchers should be aware of cross-national differences due to structural differences in social security system designs and operations (Lloyd-Sherlock et al., 2012). This study conducts a cross-national comparison about the relationship between pensions and depressive symptoms, especially focusing on comparing two developing countries (China and Mexico) with two developed countries (United States and United Kingdom).

Retirement and Pension Policies in China, Mexico, the U.S., and the UK

Pension policy has developed for over 100 years ever since the launch of the Pension Law in Germany in 1889. From the global perspective, the World Bank has played a critical role in leading or assisting the reformation of the pension system in recent decades (World Bank Group, 2005). The five-pillar framework put forward by the World Bank provides a good conceptual framework to compare the pension system in different countries. According to the framework, the base pillar is the non-contributory pension plan that aims to help poor older adults. The benefit is entitled and based on means testing. Every individual who meets the eligibility criteria is able to file a claim. The first pillar was the compulsory public pension plan

managed by the government, aiming to alleviate poverty among older adults. It is a universal benefit that covers all older adults. The second pillar was the compulsory private pension plan that was contributed by both employers and employees. The third pillar was voluntary private pension plans managed by individuals. The fourth pillar emphasizes the mutual help and informal care from family members, communities, non-profit organizations, etc. (World Bank Group, 2005).

Table 2 shows the details of the three main pillars of the pension system in the four countries. For the first pillar, unlike the U.S. and China, public pensions in Mexico and the UK are universal and cover all older adults aged above 65. One difference is that the public pension is non-contributory in Mexico (Organisation for Economic Co-operation and Development [OECD], 2016) while contributory in the UK (Disney, 2016). Public pensions in Mexico have been viewed as successful in securing the needs of the majority of its older residents (OECD, 2016). In the UK, in contrast, the public pension benefit has lagged behind inflation and salary growth, failing to realize the social security function (Disney, 2016). In the U.S., Social Security is the primary income source of the majority of older adults (Moody & Sasser, 2017). In addition, it has a high coverage rate and has played an important role in securing most older Americans' retirement lives (Moody & Sasser, 2017). For China, the age eligibility for public pensions (60 for men and 55 for women) is lower than for the other three countries, but the coverage rate and benefit level are far smaller (Yu, 2015). Generally, the public pension systems in four countries all used a defined-benefit, Pay-As-You-Go (PAYG) system, and are funded by the federal/central government.

There are great differences between the four countries on the second pillar regarding mandatory private pensions. Private pensions are not funded by the government in the U.S., but

are government-funded in the other three countries. The contribution rate is also flexible in the U.S. and negotiated between employers and employees, but in other countries the contribution rates are defined and employers are expected to contribute more than the employees do. In terms of similarities, the mandatory private pension systems in the four countries use the defined-contributory and individual account system. The participation rates in mandatory private pension systems are lower than for public pensions (OECD, 2016; Yu, 2015). For the third pillar, there are wide ranges of choices in voluntary private pension plans, but generally the participation rate is lower in developing countries than in developed countries. The most essential reason for this phenomenon is that a very high proportion of workers in developing countries are hired informally, making them unable to seek pension plans from their employers (OECD, 2016). Considering the great differences in pension systems across the four countries, this study hypothesizes the relationship between pensions and older adults' health varies from country to country.

Table 2 Comparing the three main pillars in four countries

	United States	China	Mexico	United Kingdom
<i>First-pillar: Public pension</i>				
Program	Social Security	Basic Public Pension	Pension for the elderly (65+)	State pensions
Contribution method	Contributory (government + individual)	Contributory (government + individual + employer/collective)	Non-contributory (government)	Contributory(Employee + Employer)
Age eligibility	67 ¹	60 for men; 55 for women	65	65
Funds source	Payroll tax ²	Funded by Central and Local budgets	Funded by federal budget	Funded by federal budget
Format	Defined-benefit	Defined-benefit	Defined-benefit	Defined-benefit

Table 2 continued

	United States	China	Mexico	United Kingdom
Benefit level	Credit-based (determined by retirement age, earning history, and current employment) 3	20% of local average regional salary	Secure basic living	17.8% of average wage over the same period of society or 32.6% of pre-retirement salary
Adjustment rate	Based on inflation rate	Based on inflation rate and local average salary	Based on inflation rate	Based on wage growth and inflation rate
Funds management	PAYG	PAYG	PAYG	PAYG
<i>Second-pillar: Mandatory Private Pension</i>				
Program	Employer-provided pension plans (e.g., 401(k))	Urban Worker: Employee's social security package Unemployed rural and urban residents: N.A.	The Retirement Savings System: Public-sector worker and private-sector workers	Automatically enrolled occupational pensions
Format	Defined-contribution	Defined-contribution	Defined-contribution	Defined-contribution
Contribution parties	Employee + employer ²	government + individual + employer	government + individual + employer/collective	government + employee + employer
Funds management	Individual account	Individual account	Individual account	Individual account
<i>Third-pillar: Voluntary Private Pension</i>				
Program	personal saving, financial investment, commercial pension plan, life insurance, etc.			

Note: 1. According to the Social Security Administration website (<https://www.ssa.gov/benefits/retirement/planner/agereduction.html>) of the United States government, the earliest age to claim Social Security retirement benefits is 62 but to receive full benefits, one must reach the full retirement age. For cohorts born in 1960 and later, the full retirement age is 67.

2. The financial source of Social Security is payroll taxes. Employers and employees in the U.S. each pay 6.2% of wages up to the taxable maximum of \$137,700 (in 2020), while the self-employed pay 12.4% (<https://www.ssa.gov/news/press/factsheets/HowAreSocialSecurity.htm>).

3. There is no universal or established criterion of basic benefits on the Social Security Administration website. It is determined by multiple factors. Please see <https://www.ssa.gov/benefits/retirement/learn.html>.

Cross-National Comparison for Retirement, Pensions, and Depressive Symptoms

Previous studies have shown that the continuity theory of normal aging could be applied to explain the positive relationship between retirement and mental health (Reitzes et al., 1996), but no study has explored the cross-national applicability of continuity theory. It is important to examine the relationship in a dynamic and comparative view (Richardson & Kilty, 1991). The life course and ecological perspective requires that individuals be situated in their historical and social contexts (Kim & Moen, 2002). Thus, this study uses the life course and ecological perspective to study the cross-national applicability and dynamics of continuity theory when trying to explore the relationship between retirement and older adults' depressive symptoms. Note that this study did not use longitudinal data, so the application of continuity theory and dynamic perspective was approximated by looking at the variation across different age groups.

As suggested, the relationship between pensions and older adults' health is compounded by many factors, including individuals' gender and cohort and the political and economic contexts of the countries (Lloyd-Sherlock et al., 2012; Schatz et al., 2012; Sjöberg, 2014). Norström and Palme (2010) suggested that types of pension benefits also mattered. Based on the data for 18 OECD countries, they found that pensions providing basic security (but not income security) were beneficial to old-age mortality. However, Norström and Palme (2010) included only developed countries and focused on national-level effects. The constraints on limiting the discussion within local or similar socioeconomic contexts also characterize most other studies (Lloyd-Sherlock et al., 2012). More studies should expand their perspective to cover the globe and compare developing and developed countries. Sjöberg (2014) compared 93 high- and middle-income countries but did not focus on personal-level effects nor discuss pension types. To address these needs or gaps, this study will explore the direct relationship between pension

types and older adults' depressive symptoms and will examine differences between developing countries and developed countries. The assumption of cross-national comparisons between developing and developed countries is the great gap of social resources for older adults' finance and health in different countries due to their differences in economic development. By comparing countries with different levels of resource availability, lessons may be drawn from advanced countries to inform policy recommendations for other countries.

Research Question and Hypotheses

This study explores the relationship of retirement and pension types with older adults' depressive symptoms and examines cross-country and cross-age group variations. The following two questions are addressed: (1) Does the association between retirement and depressive symptoms vary across countries and age groups? (2) What is the relationship between pension types and depressive symptoms, and does the relationship vary across countries?

Applying continuity theory to explain the relationship between retirement and depressive symptoms, it is hypothesized that older adults adapt to retirement and retain their psychological continuity, and thus their depressive symptoms will not increase (Hypothesis 1). However, combined with the life course and ecological perspective, which highlights individuals' life changes from a dynamic view and considers contextual circumstances, it is further hypothesized that the sizes of relationships between retirement and depressive symptoms vary across age groups and countries. Older adults have more time to adapt to the post-retirement life, and thus are more able to maintain their internal continuity. Therefore, the association between retirement and lower depressive symptoms is hypothesized to be stronger among older age-groups (Hypothesis 2). In the context of comparing across countries, due to differential resource availability older adults living in developing countries may be less able to utilize resources to

adapt to post-retirement life and thus demonstrate higher depressive symptoms than those living in developed countries (Hypothesis 3).

Hypothesis 1: Retirement is associated with lower levels of depressive symptoms.

Hypothesis 2: The association between retirement and lower depressive symptoms is stronger among older age-groups than younger age-groups.

Hypothesis 3: The association between retirement and lower depressive symptoms is stronger among older adults in developed countries than in developing countries.

The primary function of pensions, both public and private, is to secure older adults' financial status and material needs in later life. Therefore, it is hypothesized that the presence of public/private pension is associated with lower levels of depressive symptoms (Hypothesis 4). However, due to lack of access to pensions or less generous pensions in developing countries, the association between pension and depressive symptoms may be weaker in developing countries compared with developed countries (Hypothesis 5).

Hypothesis 4: Public/private pension is associated with lower levels of depressive symptoms.

Hypothesis 5: The association between public/private pension and lower depressive symptoms is stronger in developed countries than in developing countries.

Methods

Data

Harmonized data were analyzed from the international family of Health and Retirement Study (HRS) surveys carried out by the University of Southern California Program on Global Aging, Health, and Policy. The program, also called Gateway to Global Aging Data, is dedicated to promote cross-national comparative studies on aging. Harmonized files provided by Gateway to Global Aging Data are user-friendly and able to facilitate cross-national comparisons on aging

studies (Lee et al., 2017). Four countries were chosen based on their geographical location and levels of economic development: the U.S., China, Mexico, and England, consisting of two developing countries and two developed countries located in three different continents. Harmonized data were retrieved from RAND HRS data file version P, China Health and Retirement Longitudinal Study (CHARLS) Version B.4, Mexican Health and Aging Study (MHAS) Version A, and English Longitudinal Study on Ageing (ELSA) Version D. At the time the data were retrieved, the latest version for all four countries is wave 2012-2013. Longitudinal datasets were not available for all four countries, so this study used cross-sectional data. For more information about the harmonized studies, please refer to www.g2aging.org. This study used a completely de-identified secondary dataset; thus Institutional Review Board approval was not required.

Measures

Table 3 shows the variables used in this study.

Demographic information

Four demographic variables were included. First is the respondents' age in years at the time of the interview. Categorical variables were used for the convenience of data analysis. Comparisons between age groups are based on dividing age into four categories: younger adults (< 65), young-old (65-74), middle-old (75-84), and old-old (\geq 85). Gender is a binary variable with male coded 1 and female coded 0. Education has two levels, with lower education coded 0 and higher education coded 1. Current marital/partnership status was recoded into two levels: 1=with partner; 0=without partner.

Control variables

Previous studies have shown physical health is an important covariate when studying depression in late life because they are highly comorbid (e.g., Moussavi et al., 2007). Fiske et al.

(2009) suggested researchers must consider the presence of physical illness because depressive symptoms might be either under-diagnosed or over-diagnosed in the presence of physical complaints. In this study, the self-reported health variable was chosen to indicate general health status using a score ranging from 1 for excellent to 5 for poor. For the convenience of analysis, this variable was treated as continuous. Social relationship is another critical variable in the literature related to older adults' depression (Santini et al., 2015; Schwarzbach et al., 2014). Therefore, this article used household size as a covariate.

Independent variables

The presence of retirement and pension were measures of interest in this article. Questions asked respondents whether they were retired and whether they received any public pension or private pension. Each variable has two levels, with yes=1 and no=0. The extent of retirement (e.g., years of retirement) and pension (age to receive public pension and private pension) were not considered because these measures were not available in all four harmonized datasets. In addition, although the amounts of public/private pension were available in the dataset they were incomparable due to inconsistent measure criteria in each country.

Dependent variable

The Center for Epidemiologic Studies Depression Scale (CESD) was used to measure depressive symptoms in the HRS-family studies. Respondents were asked how often they felt negative thoughts in the past week (e.g., feeling depressed, feeling everything was an effort, restless). Depressive symptom was measured by the sum of all questions in the scales. However, the number of items was different in the four datasets—10 in CHARLS, 8 in HRS and ELSA, and 9 in MHAS. To make measures comparable, the average score ranging from 0 (no) to 1 (severe) was used, with higher scores meaning the respondent had more depressive symptoms. The reliability results were high for the scales in each study (Cronbach's alpha coefficients > 0.7).

Table 3 Variables used in this study

	Type	Coding	Remarks
<i>Demographic variable</i>			
Age	4-level categorical	younger adults (<65), young-old (65~74), middle-old (75~84), and old-old (>=85)	
Gender	binary	0=female; 1=male	
Education	binary	0=lower education; 1=higher education	The education measure in the harmonized dataset used the simplified version of 1997 International Standard Classification of Education (ISCED-97) codes: 1=Less than lower secondary education, 2=Upper secondary and vocational training, and 3=Tertiary education. However, there were no observations in “Less than lower secondary education” in the harmonized ELSA. This was attributed to a large amount of answers that could not be classified. Education was re-categorized into two levels by combining “less than lower secondary education” and “Upper secondary” into “0=lower education” and recoding “Tertiary education” into “1=higher education.”
Marital Status	binary	0=without partner; 1= with partner	There were eight levels in the original marital status variable. “Married” and “partnered” were recoded into “with partner,” and “married, spouse absent,” “separated,” “divorced,” “separated/divorced,” “widowed,” and “never married” into “without partner.”
<i>Covariates</i>			
Self-reported Health	continuous	1=excellent; 2=very good; 3=good; 4=fair; 5=poor	This variable is technically an ordinal variable. For the convenience of analysis, it was treated as a continuous variable. Treating it as a continuous or an ordinal variable only slightly changed the degrees of freedom in the model but did not affect the key findings of this study.
Household Size	continuous	number of people living in the household	

Table 3 continued

	Type	Coding	Remarks
<i>Independent Variables</i>			
Retired	binary	0=no; 1=yes	
Received Public Pension	binary	0=no; 1=yes	
Received Private Pension	binary	0=no; 1=yes	
<i>Dependent Variable</i>			
Depressive Symptoms	continuous	the average CESD score, ranging from 0 to 1	Higher values mean more depressive symptoms, which is a worse mental health outcome.

Analysis Methods

Missing data and sensitivity analysis

The dataset had some missing values. Table 4 shows the item-nonresponse rate for each measure in the four countries' datasets, separately. HRS data had the lowest item nonresponse rate (< 7%). ELSA also had high data quality except for the education variable. This is because many values were coded as "not applicable" or "inability to be mapped to ISCED-97." CHARLS and MHAS had a much higher proportion of missing values, possibly because conducting this kind of investigation in a developing country encounters greater difficulties than in developed countries. Many older respondents in a developing country have lower education or may be illiterate, or had bad or inaccurate memory of their birthdate due to the lack of a birth certificate (Zeng, 2008). Particularly in certain ethnic minority areas some older adults exaggerated their age to demonstrate their longevity (Zeng, 2008); in such cases, it was difficult for researchers to record the older respondents' true age. For MHAS, the high item nonresponse rate in health measures occurred because when the survey used a proxy interview the health measure would not be asked (Michaels-Obregon et al., 2017). From the perspective of gerontological research,

most measures used in the current study should be missing at random except for some cultural reasons in reporting age or national differences in conducting surveys. However, HRS-series researchers have utilized several methods to cross-examine the true age of older respondents (Zeng, 2008).

In addition, some formal statistical tests were conducted to examine the missingness mechanism in the datasets. Table 5 shows the results. Little's MCAR test is a global test for the Missing Completely at Random (MCAR) condition under the assumption of multivariate normally distributed data (Little, 1988). Another test developed by Jamshidian and Jalal (2010) is modified from the Hawkins test (Hawkins 1981) for normally-distributed data and adapts the nonparametric k-sample test for non-normal data. The small p -values in both tests consistently indicated violation of the MCAR assumption for each country. This is not surprising considering that MCAR is the strictest assumption for missing data and not realistic for most real-world datasets.

Missing at Random (MAR) is another acceptable assumption that relaxes MCAR a bit by allowing the missed value to depend on observed values and covariates (Little & Rubin, 2019). Theoretically, it is impossible to test for MAR because the missing values cannot be obtained. However, Ridout (1991) suggested that, by fitting a logistic regression model for the probability of item nonresponse being predicted by covariates, it is possible to examine the factors associated with the item nonresponse. Therefore, by the definition of MAR (Little & Rubin, 2019), the covariate-dependent item nonresponse suggests whether the data are MCAR or MAR. By identifying the significant predictor variables in the model, it is also possible to screen out the auxiliary information for applying further imputation and likelihood-based methods. In Table 5, the demographic and health covariates demonstrated their significant association with the CESD

item nonresponse, implying the potential importance of incorporating such useful auxiliary information into further model fitting procedures to deal with missing values.

A good approach to handle the missing values is suggested to be Full Information Maximum Likelihood (FIML) estimation in Structural Equation Modelling (SEM) (Enders, 2001b; Enders & Bandalos, 2001). According to Enders (2001b) and Enders and Bandalos (2001), FIML maximizes the likelihood function by summing up the discrepancy between observed data and current parameters for each observation. Conceptually FIML is analogous to calculating the conditional expectation based on the values of independent variables but without imputation of the dependent variable (Enders, 2001b, p. 714; Enders & Bandalos, 2001, p. 434). Compared to three other ad hoc techniques (listwise deletion, pairwise deletion, and mean imputation), FIML has been suggested to have less bias, less sampling variability, and fewer convergence failures, and to be more efficient and provide near-optimal Type 1 error (Enders, 2001b; Enders & Bandalos, 2001; Larsen, 2011).

Data analysis also was conducted using complete cases and using multiple imputation approaches, to compare model results with those from FIML estimation. Estimates were broadly similar between the listwise deletion and FIML, although standard errors were larger for the complete case. Results using complete cases are shown in Supplemental Table 1 using HRS as a demonstrating example. Analysis results using multiple imputation are shown in Supplemental Table 2, which also indicates similar key findings using FIML. Because findings are comparable between FIML and complete case/multiple imputation methods, and because FIML estimation results in more stable parameter estimates (smaller standard errors), interpretations of findings from this study are focused on the results using FIML estimation without loss of generality.

Table 4 Item-nonresponse rate for each measure in four countries N (%)

	China	U.S.	Mexico	England
Sample Size	18,612	20,544	13,704	10,601
Age	3441 (18.49)	0 (0)	4213 (30.74)	0 (0)
Gender	3 (0.02)	0 (0)	0 (0)	0 (0)
Education	26 (0.14)	4 (0.02)	90 (0.66)	5124 (48.34)
Marital Status	3 (0.02)	3 (0.01)	4193 (30.60)	3 (0.03)
Household Size	0 (0)	0 (0)	4106 (29.96)	0 (0)
Retirement	570 (3.06)	1323 (6.44)	4200 (30.65)	2 (0.02)
Public Pension	253 (1.36)	0 (0)	4206 (30.69)	56 (0.53)
Private Pension	264 (1.42)	355 (1.73)	4206 (30.69)	12 (0.11)
Self-rated Health Mean	1021 (5.49)	21 (0.10)	5118 (37.35)	622 (5.87)
CESD	2045 (10.99)	1154 (5.61)	5188 (37.86)	679 (6.41)

Table 5 Results of testing the missingness mechanism using different approaches

	China	U.S.	Mexico	England
Little's MCAR test	$\chi^2 = 296.43, p < 0.001$	$\chi^2 = 1089.92, p < 0.001$	$\chi^2 = 439.49, p < 0.001$	$\chi^2 = 22.50, p < 0.001$
Hawkins test + nonparametric k-sample test	$P < 0.001$	$P < 0.001$	$P < 0.001$	$P < 0.001$
<i>Ridout's logistic regression method (the dependent variable is the item nonresponse of CESD)</i>				
Age	-0.036***	-0.070***	-0.032*	-0.026
Gender	-0.210**	-0.419***	-0.691**	0.483
Education	-0.733***	0.376***	-0.776	0.076
Marital Status	0.377***	1.680***	0.448	-0.970
Self-reported Health	-0.078	-0.455***	-0.374*	-0.410*
Household Size	-0.058**	-1.819***	-0.120**	0.720

Note: Little's MCAR test and Hawkins test + nonparametric k-sample test tested the MCAR condition assuming multivariate continuous data, so only the continuous variables (i.e., age, self-reported health, and CESD) were examined. For Ridout's method, a corresponding response indicator variable for CESD was created with 1=item response and 0=item nonresponse.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Scoring method of CESD

There are two issues related to CESD measurement in the current study. First, the CESD items were not exactly the same in each country's dataset. Table 6 presents the item used in the four countries, separately. Only five items in bold (i.e., depressed, effort, restless, happy, and lonely) were shared by all four countries. It would have been possible to use the five-item

version of CESD to measure depressive symptoms, which would ensure consistent measurement of CESD across countries. However, doing so would lower the reliability of the CESD scale (dropping from 0.767 to 0.656 in the CHARLS dataset) and lose great amount of information in distinguishing people with different levels of depressive symptoms. Therefore, it is not the best option to choose the five-shared-item CESD scale for this study.

The second issue was the coding/scoring method of the CESD scale. To harmonize the coding and make the score comparable across countries, the Harmonized dataset developed by the Gateway to Global Aging Data team used the binary coding method (0=no; 1=yes) to indicate the absence/presence of each depressive symptom. However, in the original design of CESD, for example, in CHARLS, the coding of each CESD item had four levels: 1=rarely or none of the time < 1 day; 2=some or a little of the time 1-2 days; 3=occasionally or a moderate amount of 3 days; 4=most or all of the time 5-7 days. The dichotomous coding method is simpler and can facilitate cross-national comparison, but it loses information measuring the level of older respondents' depressive symptoms.

To examine if the scoring method of CESD influences the findings from this analysis, two versions of the CESD measure were used in the CHARLS dataset, one using binary coding and another using four-level coding, to fit the regression model, separately. Model results comparing these two scoring methods are presented in Supplemental Table 3. The key findings were essentially the same between the two CESD scoring methods, implying the feasibility of using the dichotomous coding method for CESD in the cross-national study. This sensitivity analysis result also is consistent with the conclusion of Kohout et al. (1993) that the shorter item and binary choice version of CESD retained acceptable reliability without sacrificing precision.

Table 6 Items of CESD scale in four countries

No.	Item	China	US	Mexico	England
1	I was bothered by things that don't usually bother me.	√			
2	I did not feel like eating; my appetite was poor.				
3	I felt I could not shake off the blues.				
4*	I felt as good as other people.				
5	I had trouble keeping my mind on what I was doing.	√			
6	I felt depressed.	√	√	√	√
7	I felt everything I did was an effort.	√	√	√	√
8*	I felt hopeful about the future.	√			
9	I thought my life had been a failure.				
10	I felt fearful.	√			
11	My sleep was restless.	√	√	√	√
12*	I was happy.	√	√	√	√
13	I talked less than usual.				
14	I felt lonely.	√	√	√	√
15	People were unfriendly.				
No.	Item	China	US	Mexico	England
16*	I enjoyed life.		√	√	√
17	I had crying spells.				
18	I felt sad.		√	√	√
19	I felt that people disliked me.				
20	I could not get "going".	√	√		√
21	I felt tired.			√	
22	I had a lot of energy			√	
	# of items	10	8	9	8

Note: * the coding of the item need to be reversed.

Other Issues: Non-Normality, Multicollinearity

In addition, some continuous variables, which in this analysis are the number of household members and CESD, are severely skewed. Non-normality in FIML estimation could inflate the negative bias of standard errors and model rejection rates (Enders, 2001a). Enders (2001a) suggested this situation may be remedied by rescaling and/or bootstrapping. Rescaling was unsuccessful, so the bootstrap method was used to alleviate the problems of non-normality. Another option would be to consider the CESD score as a count variable because the measure was equivalent to counting the number of depressive symptoms. The Poisson regression model

was first considered; however, over-dispersion was a major issue. To remedy the over-dispersion, the negative binomial model was employed. Results using negative binomial regression for the HRS data are shown in Supplemental Table 4. As is shown, the significance levels of the predictor variables were the same between the negative binomial model and linear regression model results. However, interpreting the regression coefficients of the negative binomial model was more difficult. To facilitate interpretation, this study focuses on results from the linear regression model.

To detect age group variations, multi-group SEM analysis was used. Finally, to address the bias of sample design and non-response, all observations in the dataset have been given a person-level weight that is applied to all analyses to make it more reasonable to extrapolate to the general population. All data analysis was conducted in R. The latent variable analysis (lavaan) package was used for FIML estimation (Rosseel, 2018). A regression model was fitted using CESD score as the dependent variable, with sociodemographic variables, covariates, and variables of interest as predictors. The variance inflation factor (VIF) was difficult to compute in the SEM model, so the standardized covariances in the SEM outputs for the U.S. data is shown in Supplemental Table 5. Results indicated that correlations among independent variables were low.

Results

Descriptive Statistics

Table 2 shows the descriptive information for older adults in the four countries. In the 2012-2013 wave, there were 18,612 respondents in CHARLS, 20,544 in HRS, 13,704 in MHAS, and 10,601 in ELSA. The mean ages in the U.S. and England were over 65, while China and Mexico had lower mean ages (58.94 in China and 61.18 in Mexico). This difference in mean age is attributable to the fact that different age eligibility was used to screen participants. China had

the highest mean self-rated health, followed by Mexico and the U.S.; England had the lowest mean score. Further, Tukey Honestly Significant Difference (Tukey HSD) multiple comparison analysis shows that the differences among all pairs of countries were statistically significant ($p < 0.001$), indicating that Chinese and Mexican older adults had poorer self-rated health than American and British older adults. The distributions of the number of household members and CESD scores were skewed. Half of Chinese respondents reported at least three household members while the other three countries had two. The median depressive symptoms was highest in China (0.60), followed by Mexico (0.33), with the U.S. and England lowest (both 0.13).

Table 7 Descriptive and frequency analysis

	China	U.S.	Mexico	England
age mean (SD)	58.94 (10.47)	65.77(10.06)	61.18(11.00)	65.35(10.52)
Self-rated health mean (SD)	3.80(0.93)	2.77(1.09)	3.63(0.86)	2.82(1.14)
Household size median (Skewness)	3(1.06)	2(-0.50)	2(1.98)	2(-0.67)
CESD score median (Skewness)	0.60(1.00)	0.13(1.66)	0.33(0.56)	0.13(1.58)
Gender (N, %)				
Male	10979(47.89)	21064(45.95)	12069(45.67)	9817(52.58)
Female	10148(52.11)	16424(54.05)	9300(54.33)	8163(47.42)
Education (N, %)				
lower education	20563(96.95)	22551 (46.06)	19195 (90.06)	6418 (78.5)
higher education	521(3.05)	14923 (53.94)	2061 (9.94)	2048 (21.5)
Marital Status (N, %)				
Partnered	16211(85.45)	12868 (64.37)	10941 (71.58)	7594 (69.45)
Non-partnered	2398(14.55)	7683 (35.63)	4782 (28.42)	3004 (30.55)
Retirement (N, %)				
Retired	5435(33.78)	11989(58.66)	1978(9.57)	5943(50.45)
Unretired	12607(66.22)	7242(41.34)	13736(90.44)	4656(49.55)
Public Pension (N, %)				
Received	5889(30.69)	26675(61.93)	2911(12.70)	3333(28.20)
Not received	12470(69.31)	10820(38.07)	12782(87.30)	7212(71.80)
Private Pension (N, %)				
Received	2244(15.39)	4489(22.54)	22(0.11)	5299(45.54)
Not received	16104(84.61)	15710(77.46)	15671(99.89)	5290(54.46)

Table 7 also shows frequencies and proportions for categorical variables. After applying the person-level weights, there were more women than men in all countries except England. Overall, most Chinese and Mexican respondents had less than lower secondary education (> 80%) while more American and British respondents had upper secondary, vocational training, and tertiary education (> 50%). Pearson's chi-square tests indicated these education attainment differences were statistically significant ($p < 0.001$), meaning that more Chinese and Mexican older adults had lower education attainment than their American and British counterparts. More than half of respondents were partnered (> 50%) in all four countries.

Most respondents were not retired in China and Mexico, whereas higher percentages of participants were retired in the U.S. and England. Majorities of older adults in all countries except the U.S. did not receive any public pensions; more had private pensions in England when fewer received them in China, Mexico, and the U.S. Chi-square tests showed there were significant relationships in retirement, public pensions, and private pensions between countries ($p < 0.001$); American and British older adults were more likely to be retired and to receive pensions than their Chinese and Mexican counterparts.

Prevalence of Depressive Symptoms

Figure 4 shows the boxplots of CESD scores of age groups in the four countries. They were all skewed. Old-old adults in Mexico had the highest median CESD scores, while the young-old in England and the U.S. had the lowest. Most respondents did not reach the suggested sub-threshold criterion of 16 points out of 20 items (Rodda et al., 2011). The prevalence of reaching the sub-threshold criterion was higher in China (7.00%) and Mexico (7.16%) than in the U.S. (4.21%) and England (3.98%).

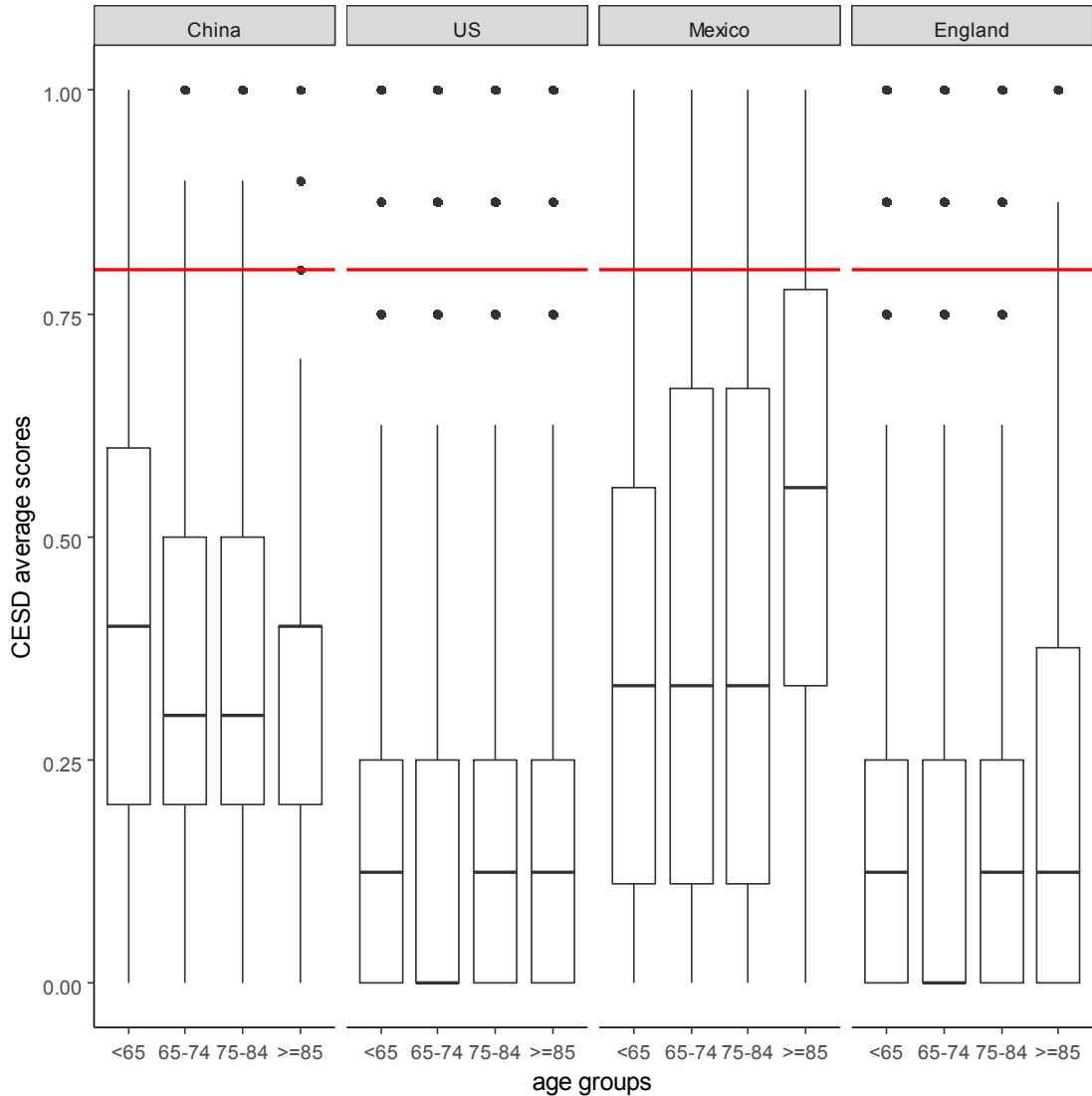


Figure 4 Boxplots of depressive symptoms among four age groups in four countries

Note. The red horizontal line showed the sub-threshold criterion of CESD. CHARLS used different coding for the items in CESD, but they have been recoded. To make the scale scores comparable, the average score was taken. Missing values are omitted. Person-weights have been applied. The plot is generated using R package “ggplot2.”

Regression Results

Table 8 shows the standardized regression results of the four countries separately. All multi-group analyses achieved good relative model fit results for all four models (CFI > 0.999; RMSEA < 0.001) although fair overall model fit ($p < 0.001$). Most of the covariates were

significant predictors ($p < 0.001$). Demographic predictors of more depressive symptoms included being female, having lower education, and being without a partner across all four countries. Number of household members was not a statistically significant predictor; poor self-rated health was the most consistent and negative predictor across all age groups in all countries. Most regression values were modest ($|b| < 0.1$).

Retirement. There was no significant association between retirement and depressive symptoms in China. In the U.S., retirement was associated with higher depressive symptoms for younger adults. Retirement was associated with lower depressive symptoms for younger adults in England, as well as the young-old and middle-old in Mexico.

Public Pension. There was no significant association between public pension and depressive symptoms in England. In China, the level of depressive symptoms was higher among Chinese young-old with a public pension. Similarly, a public pension was associated with higher depressive symptoms for younger adults in the U.S. However, presence of public pension was associated with lower depressive symptoms among all Mexican age groups except the middle-old. Public pension had a relatively stronger relationship with depressive symptoms among Mexican old-old ($|b| = 0.171$).

Private Pension. There was no significant relationship between private pension and depressive symptoms in Mexico. The association of presence of private pension with lower depressive symptoms was significant for both Chinese and Americans except the old-old group. Significantly lower levels of depressive symptoms were also associated with private pension among younger adult and young-old groups in England.

Table 8 Regression Model Results using SEM

	all age	Younger adult (< 65)	Young-old (65-74)	Middle-old (75-84)	Old-old (>= 85)
China					
<i>N</i>	18,612	13,470	2,960	1,102	150
Age	-0.009 (0.001)				
Gender	-0.105*** (0.008)	-0.116*** (0.010)	-0.083*** (0.023)	-0.013 (0.049)	-0.030 (0.179)
Education	-0.030*** (0.021)	-0.031*** (0.032)	-0.017 (0.055)	-0.062** (0.088)	-0.083 (0.391)
Marital status	-0.079*** (0.015)	-0.096*** (0.023)	-0.047* (0.028)	-0.076 (0.045)	0.023 (0.203)
Retired	0.003 (0.011)	0.017 (0.014)	-0.016 (0.023)	0.052 (0.049)	0.014 (0.262)
Public pension	0.019 (0.013)	0.018 (0.013)	0.054* (0.031)	-0.013 (0.051)	0.161 (0.251)
Private pension	-0.078*** (0.014)	-0.077*** (0.017)	-0.075** (0.035)	-0.075* (0.054)	0.051 (0.179)
Self-rated health	0.362*** (0.004)	0.358*** (0.006)	0.347*** (0.012)	0.317*** (0.023)	0.345 (0.112)
Number of family members	-0.007 (0.002)	-0.011 (0.003)	-0.005 (0.006)	-0.002 (0.011)	-0.190 (0.038)
<i>R</i> ²	0.175	0.178	0.160	0.133	0.225
U.S.					
<i>N</i>	20,544	10,315	5,153	3,736	1,350
Age	-0.167*** (0.000)				
Gender	-0.042*** (0.003)	-0.047*** (0.005)	-0.062*** (0.006)	-0.039* (0.008)	-0.011 (0.016)
Education	-0.045*** (0.003)	-0.052*** (0.005)	-0.037** (0.006)	-0.059*** (0.007)	-0.037 (0.014)
Marital status	-0.123*** (0.009)	-0.103*** (0.011)	-0.085* (0.017)	-0.163** (0.023)	-0.121 (0.040)
Retired	0.038*** (0.005)	0.039** (0.007)	0.014 (0.009)	0.013 (0.017)	-0.014 (0.049)
Public pension	0.059*** (0.005)	0.057*** (0.007)	-0.017 (0.020)	-0.005 (0.024)	0.029 (0.046)
Private pension	-0.050** (0.004)	-0.057** (0.008)	-0.047*** (0.006)	-0.045** (0.008)	-0.019 (0.014)

Table 8 continued

	all age	Younger adult (< 65)	Young-old (65-74)	Middle-old (75-84)	Old-old (>= 85)
U.S.					
Self-rated health	0.407*** (0.002)	0.414*** (0.002)	0.402*** (0.003)	0.380*** (0.004)	0.363*** (0.007)
Number of family members	-0.020 (0.008)	-0.021 (0.010)	-0.041 (0.017)	0.021 (0.023)	-0.020 (0.040)
R^2	0.233	0.253	0.211	0.199	0.165
Mexico					
N	13,704	9,031	4,085	2,018	530
Age	0.030** (0.000)				
Gender	-0.139*** (0.005)	-0.163*** (0.006)	-0.106*** (0.010)	-0.091*** (0.014)	-0.090 (0.035)
Education	-0.042*** (0.007)	-0.038*** (0.008)	-0.058*** (0.014)	-0.068*** (0.025)	0.010 (0.065)
Marital status	-0.085*** (0.005)	-0.083*** (0.007)	-0.072*** (0.010)	-0.092*** (0.014)	-0.132* (0.037)
Retired	-0.024** (0.008)	-0.003 (0.013)	-0.043* (0.014)	-0.054* (0.020)	-0.010 (0.053)
Public pension	-0.045*** (0.007)	-0.041** (0.011)	-0.039* (0.012)	-0.032 (0.017)	-0.171* (0.048)
Private pension	0.002 (0.051)	-0.003 (0.095)	-0.010 (0.049)	0.016 (0.141)	0.049 (0.169)
Self-rated health	0.370*** (0.003)	0.361*** (0.003)	0.378*** (0.005)	0.382*** (0.007)	0.400*** (0.018)
Number of family members	0.008 (0.001)	0.020 (0.002)	-0.005 (0.002)	-0.002 (0.003)	-0.007 (0.008)
R^2	0.206	0.199	0.205	0.207	0.233
England					
N	10,601	5,380	3,036	1,703	482
Age	-0.038** (0.000)				
Gender	-0.088*** (0.004)	-0.082*** (0.006)	-0.110*** (0.008)	-0.094*** (0.012)	-0.058 (0.028)
Education	-0.019 (0.007)	-0.017 (0.009)	-0.035 (0.012)	0.014 (0.021)	-0.008 (0.046)
Marital status	-0.101*** (0.012)	-0.120*** (0.016)	-0.011 (0.021)	-0.147* (0.031)	-0.047 (0.067)
Retired	-0.047*** (0.006)	-0.049** (0.008)	-0.004 (0.010)	-0.004 (0.021)	-0.123 (0.061)
Public pension	0.009 (0.006)	0.005 (0.010)	-0.001 (0.010)	0.013 (0.018)	0.078 (0.046)

Table 8 continued

	all age	Younger adult (< 65)	Young-old (65-74)	Middle-old (75-84)	Old-old (>= 85)
Private pension	-0.068*** (0.005)	-0.060*** (0.008)	-0.081*** (0.009)	-0.050 (0.013)	-0.033 (0.028)
Self-rated health	0.408*** (0.002)	0.411*** (0.003)	0.383*** (0.004)	0.384*** (0.005)	0.455*** (0.012)
Number of family members	-0.039 (0.011)	-0.014 (0.014)	-0.110** (0.019)	0.017 (0.027)	-0.094 (0.062)
R^2	0.215	0.220	0.205	0.196	0.240

Note: The regression coefficients are all standardized. Standard errors are in parentheses.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Discussion

This study is the first to explore the association of retirement and pension types with older adults' depressive symptoms in a cross-national context and to distinguish age group variations. Using the life course and ecological perspective to apply continuity theory to explain the relationship between retirement and depressive symptoms, the theory was situated in four countries and discussed its cross-national applicability and dynamic pattern across age groups. The research also concerned the sub-threshold criteria of depressive symptoms among older adults and studied the direct association of pension types across different institutional arrangements. The descriptive findings suggest that older adults in developing countries had more disadvantaged socioeconomic status than their counterparts in developed countries: Chinese and Mexican older adults had lower education and poorer self-rated health, and were more likely not to be retired and not receiving public or private pensions than their American and British counterparts. The descriptive findings were consistent with the research assumption underlying the relatively fewer social resources available in developing countries.

Comparison of sub-threshold depressive symptoms prevalence between countries further revealed the disadvantaged condition of older adults in developing countries. Although most respondents did not meet the sub-threshold criterion of depressive symptoms, the prevalence was

still about three percentage points higher in China and Mexico than in the U.S. and England. This finding was not very surprising given that low socioeconomic status was an important risk factor for older adults' depressive symptoms (Fiske et al., 2009; Van de Velde et al., 2010). Demographic risk factors, such as being female, having low education, being without a partner, and poor self-rated health, were consistent across countries. Because people living in China and Mexico had lower education and received fewer amounts of government financial benefits, they were more likely to develop severer depressive symptoms, implying the ecological influence of national economic development on individual citizens' depressive symptoms.

Our analysis also illustrated that cross-national variations arise in applying continuity theory, providing evidence for testing Hypotheses 1 and 3. Retirement did not have a significant relationship with depressive symptoms among Chinese older adults, but was significantly associated with higher depressive symptoms among younger adults in the U.S. and lower depressive symptoms in Mexico and England. In other words, the theory was not applicable to China, but worked for Mexico and England while reversely for American younger adults. One reason to explain China's situation could be that many Chinese retirees do not have sufficient resources to maintain their continuity after retirement. The majority of older Chinese do not have pensions and the benefit level is low (Table 2 and Table 7). Many older Chinese need to work hard to support themselves although their physical functioning worsens in later life (Pang et al. 2004). Some provide grandchild care after retirement and experience physical exhaustion and psychological stress (Goh, 2009).

The importance of working roles might explain the negative association between retirement and Americans' depressive symptoms. Some American retirees still choose to work, which could benefit their overall life satisfaction (Kim & Feldman, 2000). From a dynamic view,

continuity theory works only for Mexican young-old and middle-old and British younger adults. There is no clear pattern in the effect size of retirement across age groups, but age group variations are clear, providing inconclusive evidence to argue with Hypothesis 2. Further studies concerning the detailed characteristics of retirement (e.g., age when retired, years of retirement) are warranted.

Another major focus of this study was to explore the direct association between pension types and depressive symptoms. Cross-national differences were found in the direction of this relationship, although they were not completely supportive of Hypotheses 4 and 5. Public pension was associated with lower depressive symptoms among Mexican older adults but with higher depressive symptoms in the U.S. and China. Private pension was associated with lower depressive symptoms among Chinese, American, and British older adults but the relationship was not significant in Mexico. Although public pension systems in these four countries have different institutional arrangements, they generally are designed to secure basic living needs of their retired older citizens, and governments undertake the primary responsibility to do so. However, the fact that a beneficial impact of public pension was found only among Mexican older adults implies the possible failure of subsistence functions of public pensions in the other three countries. Public pensions use the defined-benefit system, which may not fulfill the goal of securing the basic needs of older adults (Yu, 2015). In contrast, private pensions are more flexible, using a defined-contribution system and individual accounts, voluntary, and depend on employee pension, enterprise annuity, and investment returns (Turner, 2010; Yu, 2015).

In Mexico's case, the beneficial influences of public pension might be attributed to its public pension system reform and private pension dilemma. In 2013, the Mexican government initiated public pension reform financed by general taxation. It aimed to cover all Mexican adults

aged 65 and above without public pensions (Gao, 2014; OECD, 2016). Considering the cross-sectional data this study used were collected in 2012-2013, it is possible the Mexican pension reform had not been fully implemented. Despite the high proportion of not receiving public pension among Mexican older adults, the benefit level of Mexican public pension was decent and expected to secure the basic living needs. Meanwhile, the coverage rate of private pension among Mexicans was very low because most of the workers were not formally employed and did not participate in private pension plans (Gao, 2014). In China's case, a majority of older adults did not receive any public pension. In addition, the benefit level of public pension in China is very low (20% of local average salary), which might hinder the opportunity for their health status to benefit from welfare programs. It was unexpected that public pensions did not have significant relationship with older adults' depressive symptoms in the U.S. and England, considering that most Americans (61.93%) receive public pensions and that the United Kingdom is a welfare state. However, this study considered only the presence of public pensions and did not consider the amount of pension benefits. Future studies may consider including the amount of pension in the four countries to test the inference of those results in this study.

Considering cross-national differences in the relationship of retirement and pension types with older adults' depressive symptoms, differential policy implications are recommended for each country. In China, practitioners may help older adults develop their post-retirement plan, including securing sufficient income and optimizing the caregiving task for their grandchildren. Promoting reasonable retirement plans is recommended for Mexico and England, while the U.S. may consider promoting bridge employment whereby older adults work for pay after they retire from their major or longer-term job. Put together, educating older adults to plan retirement is of great importance across the four countries. By helping older adults develop a good plan for their

retirement, they can better enjoy the benefits brought by retirement and maintain mental continuity.

Mexico may have generous public pensions to provide basic security, while the other three countries are not able to do so and still have a long way to go to realize the function of their public pension system. But China, the U.S., and England may have diverse choices of private pensions to enrich older adults' income sources while Mexico fails to do so. Therefore, providing larger public pensions is suggested for China, the U.S., and England, while providing more private pension choices should benefit Mexico's older adults. Either way, expanding pension coverage and improving pension benefit undoubtedly could bring more benefits to older adults' mental health. In the context of recent national policy changes or reformulation, especially in Mexico and China, academic efforts are needed to keep track of the changes and examine the relationship between pension policy and older adults' well-being from a dynamic and comparative perspective.

There are some limitations to this study. First of all, the cross-sectional design prevents this study from examining the causality or dynamics of how retirement relates to older adults' health. The relationship between retirement and depression could be reciprocal (i.e., depressed people are more likely to retire). The relationship was examined by comparing age group differences, but tests were not conducted for cohort or period effects. Future studies may use longitudinal data to explore how retirement status transition influences older adults' health, or examine the time-changing and cohort differences of the relationship. Second, the CESD scale in HRS-series studies is a measure of depressive symptoms but not a clinical diagnostic criterion of depression. The differences of CESD scores between countries could be attributed to cultural differences in interpretations of responses to the psychological scale; therefore, it may not

necessarily reflect the true cross-national differences in depressive symptoms. A culturally adjusted or comparable psychological scale may need to be developed. Third, only the presence of retirement, public pensions, and private pensions were considered, but more detailed characteristics were not included due to some variables not being available in all countries within the harmonized datasets. This may limit the depth of explanation of cross-national differences in understanding the effects of the predictor variables. Again, a comparable or universal measure on pension benefits may need to be developed for future cross-national comparisons.

Fourth, effect sizes measured in terms of the magnitudes of standardized regression coefficients generally were modest, so it was not possible to find clear effect patterns. More reliable and valid measures could improve overall model results. Fifth, a substantially smaller sample size of old-old respondents was available in the harmonized datasets compared to other age groups. The higher survival probabilities of the very old might be attributed to their higher socioeconomic status, which could affect their performance in depressive symptoms and potentially distort the estimated relationship between pension and depressive symptoms. Future research may benefit from focusing on old-old population groups. Finally, including only four countries in this analysis restricts the comparability and generalizability of our results to other national contexts. HRS-family studies have many sister studies; future researchers may consider including more countries, although this study encountered major limitations in the HRS-series data regarding how many countries can be assessed by the same statistical model due to differences in variables that make comparisons across a substantial number of countries quite difficult.

Conclusion

Continuity theory has been used to explain positive relationships between retirement and older adults' depressive symptoms; and the life course and ecological perspective provides a

dynamic and systematic view that situates individuals in their societal contexts. This study found variations between age groups and countries when applying continuity theory. Within this context, reasonable retirement plans are recommended for Mexico and England and bridge employment for the U.S. Retirement planning education programs targeted at older adults are suggested for all countries. The direct association of public and private pensions with depressive symptoms was also studied and the inconsistent direction of this relationship across countries was illustrated. These cross-national differences might be attributed to the failure of the subsistence function of public pensions and the flexibility of private pensions in China, England, and the U.S. Cross-national differences in applying aging theory attest that care should be taken in assessing impacts appropriately in different social, political, and cultural contexts.

References

- Adeline, A., & Delattre, E. (2017). Some microeconomic evidence on the relationship between health and income. *Health Economics Review*, 7(1), 27. doi: 10.1186/s13561-017-0163-5
- Atchley, R. C. (1989). A continuity theory of normal aging. *The Gerontologist*, 29(2), 183-190. <https://doi.org/10.1093/geront/29.2.183>
- Behncke, S. (2012). Does retirement trigger ill health? *Health Economics*, 21(3), 282-300. <https://doi.org/10.1002/hec.1712>
- Butterworth, P., Gill, S. C., Rodgers, B., Anstey, K. J., Villamil, E., & Melzer, D. (2006). Retirement and mental health: analysis of the Australian national survey of mental health and well-being. *Social Science & Medicine*, 62(5), 1179-1191. DOI: 10.1016/j.socscimed.2005.07.013
- Case, A. (2004). Does money protect health status? Evidence from South African pensions. In D. A. Wise (Ed.), *Perspectives on the Economics of Aging* (Vol. 7, pp. 287-312). Chicago: University of Chicago Press.
- Case, A., & Menendez, A. (2007). Does money empower the elderly? Evidence from the Agincourt demographic surveillance site, South Africa. *Scandinavian Journal of Public Health*, 35(69_suppl), 157-164. doi: 10.1080/14034950701355445

- Celidoni, M., Dal Bianco, C., & Weber, G. (2017). Retirement and cognitive decline. A longitudinal analysis using SHARE data. *Journal of Health Economics*, *56*, 113-125. <https://doi.org/10.1016/j.jhealeco.2017.09.003>
- Dave, D., Rashad, I., & Spasojevic, J. (2006). The effects of retirement on physical and mental health outcomes *Working Paper 12123*. Cambridge, MA: National Bureau of Economic Research.
- Djernes, J. K. (2006). Prevalence and predictors of depression in populations of elderly: a review. *Acta Psychiatrica Scandinavica*, *113*(5), 372-387. doi: 10.1111/j.1600-0447.2006.00770.x.
- Elder Jr, G. H., & Rockwell, R. C. (1979). The life-course and human development: An ecological perspective. *International Journal of Behavioral Development*, *2*(1), 1-21. <https://doi.org/10.1177/016502547900200101>
- Enders, C. K. (2001a). The impact of nonnormality on full information maximum-likelihood estimation for structural equation models with missing data. *Psychological Methods*, *6*(4), 352. <https://doi.org/10.1037/1082-989X.6.4.352>
- Enders, C. K. (2001b). The performance of the full information maximum likelihood estimator in multiple regression models with missing data. *Educational and Psychological Measurement*, *61*(5), 713-740. <https://doi.org/10.1177/0013164401615001>
- Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, *8*(3), 430-457. https://doi.org/10.1207/S15328007SEM0803_5
- Esser, I., & Palme, J. (2010). Do public pensions matter for health and wellbeing among retired persons? Basic and income security pensions across 13 Western European countries. *International Journal of Social Welfare*, *19*, S103-S120. <https://doi.org/10.1111/j.1468-2397.2010.00737.x>
- Fiske, A., Wetherell, J. L., & Gatz, M. (2009). Depression in older adults. *Annual Review of Clinical Psychology*, *5*, 363-389. <https://doi.org/10.1146/annurev.clinpsy.032408.153621>
- Fonseca, R., Kapteyn, A., Lee, J., Zamorro, G., & Feeney, K. (2014). A longitudinal study of well-being of older Europeans: does retirement matter? *Journal of Population Ageing*, *7*(1), 21-41. doi: 10.1007/s12062-014-9094-7
- Franklin, N. C., & Tate, C. A. (2009). Lifestyle and successful aging: An overview. *American Journal of Lifestyle Medicine*, *3*(1), 6-11. <https://doi.org/10.1177/1559827608326125>
- Gao, H. (2014). The development and perfection of the pension system in Mexico. *Journal of Latin American Studies*, *4*, 40-43.

- Goh, E. C. (2009). Grandparents as childcare providers: An in-depth analysis of the case of Xiamen, China. *Journal of Aging Studies*, 23(1), 60-68. <https://doi.org/10.1016/j.jaging.2007.08.001>
- Grundy, E., & Holt, G. (2001). The socioeconomic status of older adults: How should we measure it in studies of health inequalities? *Journal of Epidemiology & Community Health*, 55(12), 895-904. doi: 10.1136/jech.55.12.895
- Hawkins, D. M. (1981). A new test for multivariate normality and homoscedasticity. *Technometrics*, 23(1), 105-110. <https://doi.org/10.1080/00401706.1981.10486244>
- Jamshidian, M., & Jalal, S. (2010). Tests of homoscedasticity, normality, and missing completely at random for incomplete multivariate data. *Psychometrika*, 75(4), 649-674. doi: 10.1007/s11336-010-9175-3.
- Kahn, J. R., & Pearlin, L. I. (2006). Financial strain over the life course and health among older adults. *Journal of Health and Social Behavior*, 47(1), 17-31. doi: 10.1177/002214650604700102.
- Kim, J. E., & Moen, P. (2001). Is retirement good or bad for subjective well-being? *Current Directions in Psychological Science*, 10(3), 83-86. <https://doi.org/10.1111/1467-8721.00121>
- Kim, J. E., & Moen, P. (2002). Retirement transitions, gender, and psychological well-being: A life-course, ecological model. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 57(3), 212-222. <https://doi.org/10.1093/geronb/57.3.P212>
- Kim, S., & Feldman, D. C. (2000). Working in retirement: The antecedents of bridge employment and its consequences for quality of life in retirement. *Academy of Management Journal*, 43(6), 1195-1210. doi: 10.2307/1556345
- Kim, S., Kwon, S., & Subramanian, S. (2018). The Effects of Public Pensions on Depression: evidence from South Korea. Retrieved April 7, 2018, from [https://paa.confex.com/paa/2016/mediafile/ExtendedAbstract/Paper4364/PAA_Public%20pension%20_extended2%20\(002\).pdf](https://paa.confex.com/paa/2016/mediafile/ExtendedAbstract/Paper4364/PAA_Public%20pension%20_extended2%20(002).pdf)
- Koster, A., Bosma, H., Kempen, G. I., Penninx, B. W., Beekman, A. T., Deeg, D. J., & van Eijk, J. T. M. (2006). Socioeconomic differences in incident depression in older adults: the role of psychosocial factors, physical health status, and behavioral factors. *Journal of Psychosomatic Research*, 61(5), 619-627. <https://doi.org/10.1016/j.jpsychores.2006.05.009>
- Kohout, F. J., Berkman, L. F., Evans, D. A., & Cornoni-Huntley, J. (1993). Two shorter forms of the CES-D depression symptoms index. *Journal of Aging and Health*, 5(2), 179-193. DOI: 10.1177/089826439300500202

- Larsen, R. (2011). Missing data imputation versus full information maximum likelihood with second-level dependencies. *Structural Equation Modeling: A Multidisciplinary Journal*, 18(4), 649-662. <https://doi.org/10.1080/10705511.2011.607721>
- Lee, J., Phillips, D., Wilkens, J., Chien, S., Lin, Y.-C., Angrisani, M., & Crimmins, E. (2017). Cross-Country Comparisons of Disability and Morbidity: Evidence from the Gateway to Global Aging Data. *The Journals of Gerontology: Series A*, 1-6. doi: 10.1093/gerona/glx224
- Lindström, M., Hanson, B. S., & Östergren, P.-O. (2001). Socioeconomic differences in leisure-time physical activity: the role of social participation and social capital in shaping health related behaviour. *Social Science & Medicine*, 52(3), 441-451. [https://doi.org/10.1016/S0277-9536\(00\)00153-2](https://doi.org/10.1016/S0277-9536(00)00153-2)
- Little, R. J. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, 83(404), 1198-1202. doi: 10.2307/2290157
- Little, R. J., & Rubin, D. B. (2019). *Statistical analysis with missing data*. New York: John Wiley & Sons.
- Litwin, H., & Meir, A. (2013). Financial worry among older people: Who worries and why? *Journal of Aging Studies*, 27(2), 113-120. doi: 10.1016/j.jaging.2012.12.003
- Litwin, H., & Sapir, E. V. (2009). Perceived income adequacy among older adults in 12 countries: findings from the survey of health, ageing, and retirement in Europe. *The Gerontologist*, 49(3), 397-406. doi: 10.1093/geront/gnp036
- Lloyd-Sherlock, P., & Agrawal, S. (2014). Pensions and the health of older people in South Africa: is there an effect? *The Journal of Development Studies*, 50(11), 1570-1586. doi: 10.1080/00220388.2014.936399
- Lloyd-Sherlock, P., Barrientos, A., Moller, V., & Saboia, J. (2012). Pensions, poverty and wellbeing in later life: Comparative research from South Africa and Brazil. *Journal of Aging Studies*, 26(3), 243-252. <https://doi.org/10.1016/j.jaging.2012.02.003>
- Lloyd-Sherlock, P., Minicuci, N., Beard, J., & Chatterji, S. (2012). Social protection and preventing illness in developing countries: Establishing the health effects of pensions and health insurance. *International Social Security Review*, 65(4), 51-68. <https://doi.org/10.1111/j.1468-246X.2012.01447.x>
- Michaels-Obregon, A., Lin, A., Phillips, D., Wilkens, J., Wong, R., & Lee, J. (2017). *Harmonized MHAS Documentation*. The Program on Global Aging, Health, and Policy, University of Southern California, Los Angeles, CA.
- Mojon-Azzi, S., Sousa-Poza, A., & Widmer, R. (2007). The effect of retirement on health: a panel analysis using data from the Swiss Household Panel. *Swiss Medical Weekly*, 137(41-42), 581-585.

- Mojtabai, R., & Olfson, M. (2004). Major depression in community-dwelling middle-aged and older adults: prevalence and 2-and 4-year follow-up symptoms. *Psychological Medicine*, 34(4), 623-634. DOI: 10.1017/S0033291703001764
- Moody, H. R., & Sasser, J. R. (2017). Controversy 9. What Is the Future for Social Security? *Aging: Concepts and controversies* (pp. 161-173). Thousand Oaks, CA: SAGE Publications, Inc.
- Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Patel, V., & Ustun, B. (2007). Depression, chronic diseases, and decrements in health: results from the World Health Surveys. *The Lancet*, 370(9590), 851-858. [https://doi.org/10.1016/S0140-6736\(07\)61415-9](https://doi.org/10.1016/S0140-6736(07)61415-9)
- Nimrod, G., & Kleiber, D. A. (2007). Reconsidering change and continuity in later life: Toward an innovation theory of successful aging. *The International Journal of Aging and Human Development*, 65(1), 1-22. DOI: 10.2190/Q4G5-7176-51Q2-3754
- Norström, T., & Palme, J. (2010). Public pension institutions and old-age mortality in a comparative perspective. *International Journal of Social Welfare*, 19, S121-S130. <https://doi.org/10.1111/j.1468-2397.2010.00731.x>
- OECD. (2016). OECD Reviews of Pension Systems: Mexico. from <https://www.oecd-ilibrary.org/content/publication/9789264245938-en>
- Oksanen, T., & Virtanen, M. (2012). Health and retirement: a complex relationship. *European Journal of Ageing*, 9(3), 221-225. doi: 10.1007/s10433-012-0243-7
- Oksanen, T., Vahtera, J., Westerlund, H., Pentti, J., Sjösten, N., Virtanen, M., Kawachi, I., & Kivimäki, M. (2011). Is retirement beneficial for mental health? Antidepressant use before and after retirement. *Epidemiology (Cambridge, Mass.)*, 22(4), 553. doi: 10.1097/EDE.0b013e31821c41bd
- Pang, L., De Brauw, A., & Rozelle, S. (2004). Working until you drop: The elderly of rural China. *The China Journal*(52), 73-94. doi: 10.2307/4127885
- Reitzes, D. C., & Mutran, E. J. (2004). The transition to retirement: Stages and factors that influence retirement adjustment. *The International Journal of Aging and Human Development*, 59(1), 63-84. DOI: 10.2190/NYPP-RFFP-5RFB-8EB8
- Reitzes, D. C., Mutran, E. J., & Fernandez, M. E. (1996). Does retirement hurt well-being? Factors influencing self-esteem and depression among retirees and workers. *The Gerontologist*, 36(5), 649-656. DOI: 10.1093/geront/36.5.649
- Richardson, V., & Kilty, K. M. (1991). Adjustment to retirement: Continuity vs. discontinuity. *The International Journal of Aging and Human Development*, 33(2), 151-169. DOI: 10.2190/6RPT-U8GN-VUCV-P0TU
- Ridout, M. S. (1991). Testing for random dropouts in repeated measurement data. *Biometrics*, 47(4), 1617-1621.

- Rodda, J., Walker, Z., & Carter, J. (2011). Depression in older adults. *BMJ-British Medical Journal*, *343*(8), d5219. <https://doi.org/10.1136/bmj.d5219>
- Rosseel, Y. (2018). R package `lavaan': a package for latent variable analysis from <http://lavaan.ugent.be/>
- Salinas-Rodríguez, A., Torres-Pereda, M. D. P., Manrique-Espinoza, B., Moreno-Tamayo, K., & Solís, M. M. T.-R. (2014). Impact of the non-contributory social pension program 70 y mas on older adults' mental well-being. *PloS One*, *9*(11), e113085. <https://doi.org/10.1371/journal.pone.0113085>
- Santini, Z. I., Koyanagi, A., Tyrovolas, S., Mason, C., & Haro, J. M. (2015). The association between social relationships and depression: a systematic review. *Journal of Affective Disorders*, *175*, 53-65. doi: 10.1016/j.jad.2014.12.049.
- Schatz, E., Gómez-Olivé, X., Ralston, M., Menken, J., & Tollman, S. (2012). The impact of pensions on health and wellbeing in rural South Africa: Does gender matter? *Social Science & Medicine*, *75*(10), 1864-1873. <https://doi.org/10.1016/j.socscimed.2012.07.004>
- Schwarzbach, M., Luppá, M., Forstmeier, S., König, H. H., & Riedel-Heller, S. G. (2014). Social relations and depression in late life—a systematic review. *International Journal of Geriatric Psychiatry*, *29*(1), 1-21. doi: 10.1002/gps.3971
- Seitz, D., Purandare, N., & Conn, D. (2010). Prevalence of psychiatric disorders among older adults in long-term care homes: a systematic review. *International Psychogeriatrics*, *22*(7), 1025-1039. doi: 10.1017/S1041610210000608.
- Sjöberg, O. (2014). Old-age pensions and population health: A global and cross-national perspective. *Global Public Health*, *9*(3), 271-285. <https://doi.org/10.1080/17441692.2014.882374>
- Turner, J. A. (2010). *Pension Policy: The Search for Better Solutions*. Kalamazoo, Michigan: W.E. Upjohn Institute for Employment Research.
- Van de Velde, S., Bracke, P., & Levecque, K. (2010). Gender differences in depression in 23 European countries. Cross-national variation in the gender gap in depression. *Social Science & Medicine*, *71*(2), 305-313. doi: 10.1016/j.socscimed.2010.03.035
- Van der Heide, I., van Rijn, R. M., Robroek, S. J., Burdorf, A., & Proper, K. I. (2013). Is retirement good for your health? A systematic review of longitudinal studies. *BMC Public Health*, *13*(1), 1180. doi: 10.1186/1471-2458-13-1180.
- Wilkinson, L. R. (2016). Financial strain and mental health among older adults during the great recession. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *71*(4), 745-754. doi: 10.1093/geronb/gbw001.

World Bank Group. (2005). The World Bank Pension Conceptual Framework. Retrieved Feb 13, 2019 from http://siteresources.worldbank.org/INTPENSIONS/Resources/395443-1121194657824/PRPNoteConcept_Sept2008.pdf

Yi Z. (2008) Reliability of Age Reporting Among the Chinese Oldest-Old in the CLHLS Datasets. In: Yi Z., Poston D.L., Vlosky D.A., Gu D. (eds) *Healthy longevity in China. Demographic methods and population analysis*, vol 20. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6752-5_4

Yu, J. (2015). *Old Age Insurance: Theory and Policy*. Shanghai: Fudan University Press.

Zimmer, Z., & Kwong, J. (2004). Socioeconomic status and health among older adults in rural and urban China. *Journal of Aging and Health*, 16(1), 44-70. doi: 10.1177/0898264303260440.

Appendices 1: Supplemental tables and figures

Supplemental Table 1 Regression model results for US using complete cases (listwise deletion)

	younger adults	young old	middle old	old old
Number of observation	9499	4651	3195	910
regression coefficient				
Gender	-0.043**	-0.050**	-0.023	-0.001
Education	-0.034*	-0.040*	-0.049**	-0.044
Marital status	-0.093**	-0.093*	-0.197***	-0.092
Retired	0.020	0.029*	0.013	-0.001
Public pension	0.049**	-0.009	0.010	0.011
Private pension	-0.048***	-0.047**	-0.048**	-0.067*
Self-rated health	0.420***	0.402***	0.380***	0.344***
Number of family members	-0.037	-0.030	0.046	-0.066
covariance				
Gender~~				
Education	0.024	0.060**	0.058**	0.151***
Marital Status	0.104***	0.214***	0.367***	0.458***
Retired	-0.020	-0.027	-0.029	0.025
Public Pension	-0.040**	0.032	-0.020	-0.062
Private Pension	0.056***	0.144***	0.138***	0.055
Self-rated Health	0.003	-0.007	-0.008	-0.040
Number of Family Members	0.093***	0.207***	0.354***	0.445***
Education ~~				
Marital Status	0.061***	0.080***	0.098***	0.129**
Retired	-0.068***	-0.084***	-0.045*	0.067

Supplemental Table 1 continued

	younger adults	young old	middle old	old old
Public Pension	-0.144***	-0.072***	-0.092***	-0.007
Private Pension	0.075***	0.121***	0.125***	0.077*
Self-rated Health	-0.261***	-0.195***	-0.139***	-0.174***
Number of Family Members	0.057***	0.065***	0.090***	0.134***
Marital Status ~				
Retired	-0.082***	-0.026	-0.015	0.044
Public Pension	-0.123***	-0.026	0.002	-0.011
Private Pension	-0.030*	-0.082***	-0.038*	-0.027
Self-rated Health	-0.143***	-0.112***	-0.083***	-0.033
Number of Family Members	0.924***	0.944***	0.957***	0.943***
Retired ~				
Public Pension	0.582***	0.084**	-0.001	0.009
Private Pension	0.322***	0.143***	0.076***	0.071*
Self-rated Health	0.217***	0.141***	0.082***	-0.068
Number of Family Members	-0.073***	-0.024	-0.018	0.042
Public Pension ~				
Private Pension	0.194***	-0.039	-0.093***	-0.027
Self-rated Health	0.279***	0.068**	-0.022	0.010
Number of Family Members	-0.111***	-0.023	0.008	-0.013
Private pension ~				
Self-rated Health	-0.029*	-0.043*	-0.064**	0.009
Number of Family Members	-0.044**	-0.087***	-0.041*	-0.032
Self-rated Health ~				
Number of Family Members	-0.116***	-0.104***	-0.084***	-0.053
R²	0.243	0.209	0.196	0.161

Supplemental Table 2 Regression model results for US using multiple imputation

	younger adults	young old	middle old	old old
Number of observation	9535	4784	3418	1184
Gender	-0.026***	-0.027***	-0.016	0.002
Education	-0.028***	-0.018**	-0.026**	-0.017
Marital status	-0.064***	-0.051*	-0.069**	-0.065
Retired	0.022**	0.009	0.013	0.003
Public pension	0.034***	-0.029	0.012	0.055
Private pension	-0.053***	-0.022**	-0.021*	-0.020
Self-rated health	0.100***	0.090***	0.082***	0.074***
Number of family members	-0.006	-0.10	0.002	-0.009

Supplemental Table 3 Regression model results for China using binary-choice and multiple-choice CESD

	all age		Younger adult (<65)		Young-old (65~74)		Middle-old (75~84)		Old-old (>=85)	
	Binary-choice	Multiple-choice	Binary-choice	Multiple-choice	Binary-choice	Multiple-choice	Binary-choice	Multiple-choice	Binary-choice	Multiple-choice
Age	-0.009	0.011								
Gender	-	-	-	-	-	-	-	-	-	-
	0.105***	0.111***	0.116**	0.119***	0.083***	0.082**	-0.013	-0.047	-0.030	-0.182
Education	-	-	-	-	-	-	-	-	-	-
	0.030***	0.028***	0.031**	0.030***	-0.017	-0.012	0.062**	-0.065*	-0.083	-0.000
Marital status	-	-	-	-	-	-	-	-	-	-
	0.079***	0.085***	0.096**	0.094***	0.047*	0.064*	-0.076	-0.070	0.023	0.203
Retired	0.003	0.003	0.017	0.019	-0.016	-0.019	0.052	0.044	0.014	0.136
Public pension	0.019	0.014**	0.018	0.019*	0.054*	0.056*	-0.013	-0.029	0.161	0.294
Private pension	-	-	-	-	-	-	-	-	-	-
	0.078***	0.085***	0.077**	0.078***	0.075**	0.081*	0.075*	0.118*	0.051	-0.139
Self-rated health	0.362***	0.366***	0.358**	0.363***	0.347***	0.359*	0.317***	0.335**	0.345	0.215
Number of family members	-0.007	-0.003	-0.011	-0.009	-0.005	0.008	-0.002	0.013	-0.190	-0.157
R²	0.175	0.183	0.178	0.182	0.160	0.174	0.133	0.164	0.225	0.277

Supplemental Table 4 Negative binomial regression model for US data

	younger adults	young old	middle old	old old
Intercept	-0.681***	-0.962***	-1.093***	-0.739
Gender	-0.124***	-0.179***	-0.110*	-0.033
Education	-0.194***	-0.149***	-0.181***	-0.062
Marital status	-0.355***	-0.343*	-0.541***	-0.307
Retired	0.045	0.104	0.121	-0.056
Public pension	0.128***	-0.190	0.066	0.306
Private pension	-0.235***	-0.156***	-0.098*	-0.090
Self-rated health	0.474***	0.554***	0.449***	0.380***
Number of family members	0.011	-0.042	0.147	-0.124

Supplemental Table 5 Covariance results between all predictors in SEM for the U.S. (FIML estimation)

Correlation	Younger adults (<65)	Young old (65~74)	Middle old (75~84)	old old (>=85)
Gender~~				
Education	0.009 (0.002)	0.059*** (0.003)	0.065*** (0.004)	0.162*** (0.006)
Marital Status	0.128*** (0.002)	0.248*** (0.003)	0.359*** (0.004)	0.436*** (0.006)
Retired	-0.001 (0.002)	-0.009 (0.002)	-0.020 (0.002)	0.012 (0.002)
Public Pension	-0.030** (0.002)	0.028* (0.001)	-0.006 (0.001)	-0.059 (0.002)
Private Pension	0.052*** (0.001)	0.138*** (0.003)	0.136*** (0.004)	0.094** (0.006)
Self-rated Health	-0.020* (0.005)	0.000 (0.007)	-0.004 (0.009)	-0.046 (0.015)
Number of Family Members	0.123*** (0.002)	0.234*** (0.003)	0.354*** (0.004)	0.422*** (0.006)
Education ~~				
Marital Status	0.039*** (0.002)	0.084*** (0.003)	0.117*** (0.004)	0.145*** (0.006)
Retired	-0.053*** (0.002)	-0.073*** (0.002)	-0.041* (0.002)	0.016 (0.002)
Public Pension	-0.126*** (0.002)	-0.075*** (0.001)	-0.072*** (0.001)	0.020 (0.002)
Private Pension	0.100*** (0.001)	0.150*** (0.003)	0.145*** (0.004)	0.109*** (0.006)

Supplemental Table 5 continued

Correlation	Younger adults (<65)	Young old (65~74)	Middle old (75~84)	old old (>=85)
Self-rated Health	-0.250*** (0.005)	-0.213*** (0.007)	-0.157*** (0.009)	-0.159*** (0.015)
Number of Family Members	0.035*** (0.002)	0.066*** (0.003)	0.111*** (0.004)	0.143*** (0.006)
Marital Status ~~				
Retired	-0.110*** (0.002)	-0.011 (0.002)	-0.011 (0.002)	0.022 (0.001)
Public Pension	-0.162*** (0.002)	-0.030* (0.001)	-0.010 (0.001)	-0.013 (0.002)
Private Pension	-0.048*** (0.001)	-0.071*** (0.003)	-0.029 (0.004)	-0.007 (0.006)
Self-rated Health	-0.136*** (0.005)	-0.114*** (0.007)	-0.083*** (0.009)	-0.032 (0.014)
Number of Family Members	0.906*** (0.002)	0.931*** (0.002)	0.940*** (0.001)	0.920*** (0.006)
Retired ~~				
Public Pension	0.586*** (0.002)	0.067** (0.001)	0.003 (0.000)	0.034 (0.001)
Private Pension	0.290*** (0.002)	0.120*** (0.002)	0.064*** (0.001)	0.052* (0.002)
Self-rated Health	0.223*** (0.005)	0.140*** (0.005)	0.076*** (0.004)	-0.038 (0.005)
Number of Family Members	-0.101*** (0.002)	-0.017 (0.002)	-0.009 (0.002)	0.023 (0.001)
Public Pension ~~				
Private Pension	0.160*** (0.002)	-0.041** (0.001)	-0.079*** (0.001)	-0.020 (0.002)
Self-rated Health	0.281*** (0.005)	0.038** (0.002)	-0.021 (0.002)	-0.032 (0.004)
Number of Family Members	-0.146*** (0.002)	-0.028* (0.001)	0.000 (0.001)	-0.012 (0.002)
Private Pension ~~				
Self-rated Health	-0.042*** (0.003)	-0.065*** (0.007)	-0.065*** (0.009)	0.014 (0.015)
Number of Family Members	-0.059*** (0.001)	-0.079*** (0.003)	-0.035* (0.004)	-0.026 (0.006)
Self-rated Health ~~				
Number of Family Members	-0.113*** (0.005)	-0.102*** (0.007)	-0.070*** (0.009)	-0.031 (0.013)

CHAPTER 3. WHY DO SPOUSES DEPRESS EACH OTHER? A CROSS-NATIONAL STUDY TO TEST THE SHARED RESOURCE HYPOTHESIS IN DEPRESSIVE SYMPTOM CONCORDANCE WITHIN OLDER ADULT COUPLES

Peiyi Lu

Graduate Student in Gerontology Program, Iowa State University

Mack Shelley

University Professor, Department of Political Science, Statistics, School of Education, Iowa State University

Modified from a manuscript published in *Social Work and Policy Review*

Abstract

The shared resource hypothesis suggests that married couples share the same environmental resources, which shape their health concordance. This study tests its cross-national applicability. Cross-sectional 2012-2013 Health and Retirement Study data from China, England, Mexico, and the United States were analyzed. Heterosexual couples (age ≥ 60) who were married or partnered were studied (20,565 pairs). Dyadic data were analyzed by multilevel models to examine the effect of self and spousal social and physical health status on depressive symptoms. Regression models were used to test the relationship between couples' shared resources and depressive symptom concordance. Results indicated both husbands and wives' depressive symptoms were associated with their own and spouses' social and health resources. Most couple-level resources were nonsignificant predictors for Chinese and Mexican couples' concordance, but having more social resources was associated with higher concordance among British and American couples. Self-reported health was the most robust predictor in all countries. The shared resource hypothesis was more applicable to depressive symptoms concordance within couples in the U.S. and England, but not in China and Mexico. Couple-centered

intervention is suggested for clinical practice, and the spousal effect should be considered in policy-making.

Introduction

Health concordance is commonly found within couples who are legally married or long-term partnered. Health concordance is generally defined as similarity or strong correlation between the couples' health status (Meyler, Stimpson, & Peek, 2007). Studies have suggested that spouses resemble each other in physical health (Stimpson, Peek, & Markides, 2006; Wang et al., 2017), mental health (Ruthig, Trisko, & Stewart, 2012), health behavior (Lee et al., 2018), and medical utilization (Kendler et al., 2018). A majority of these studies concerning health concordance utilized empirical evidence from surveys targeting older adults. For older adults, mental health concordance in depression was stronger than in anxiety or cognition (Dufouil & Alperovitch, 2000; Meyler et al., 2007). However, most studies about depression concordance within older adult couples were conducted in Western countries; few have concerned non-Western countries or were conducted as cross-national comparisons.

Despite consistent findings of depression concordance among older adult couples, there has been disagreement about its theoretical explanation. Three theories have been used frequently to explain spousal health concordance. Two of these, assortative mating and affective contagion, have been widely tested and supported, while the shared resource hypothesis remains controversial due to inconsistent measures in different studies (e.g., Butterworth & Rodgers, 2006; Jurj et al., 2006; Meyler et al., 2007; Nordsletten et al., 2016). In addition, most existing studies were not theory-driven (Meyler et al., 2007). To address these research gaps and shortcomings, this study uses harmonized data from the international family surveys of the Health and Retirement Study (HRS) for China, the United States, Mexico, and England, to test

the shared resource hypothesis and explore its cross-national applicability in four countries using consistent measures.

Theories of Health Concordance

Currently, there are three major theories explaining couples' health concordance. Assortative Mating Theory suggests spouses have initial similarities prior to their marriage. Selectivity or preference in the mating process results in people tending to choose life partners who are similar to them in socioeconomic status or health conditions (Meyler et al., 2007). Consequently, the health behavior or condition of one partner prior to marriage influenced the other partner's health trajectory (Di Castelnuovo et al., 2008; Homish & Leonard, 2008). The assortative mating hypothesis has been widely supported in studies about physical health, health behavior, and psychiatric disorders (e.g., Nordsletten et al., 2016; Treur et al., 2015). Affective Contagion Theory, also called mood convergence or affective infection, suggests the affective states between couples are mutually contagious, meaning the emotional symptomatology of one spouse can substantially infect the other (Ruthig et al., 2012). Marital satisfaction and relationship closeness were keys to couples' mental health and sleep convergence (Kiecolt-Glaser & Wilson, 2017). Affective contagion theory also has been widely tested and supported regarding mental health concordance (e.g., Meyler et al., 2007; Stimpson et al., 2006).

The shared resource hypothesis focuses on the impact of interactive environmental and marital arrangements on couples. Contrasted with affective contagion theory, the shared resource hypothesis explores health concordance from the societal and economic perspective rather than from the viewpoint of emotional resonance. Married couples share the same environments and resources, which could translate into shared health risks or advantages that could either harm or benefit the couples' health (Meyler et al., 2007). It is believed that the benefits of marriage include improving the spouses' health, longevity, and income. The beneficial impact was

achieved by making long-term commitments, sharing economic and social resources, and expanding economic and social networks (Ross, Mirowsky, & Goldsteen, 1990; Waite, 1995). The health benefits would dissipate with divorce and the termination of shared environments and loss of mutual support (Smith & Zick, 1994).

However, unlike the assortative mating and affective contagion theories, research findings were inconsistent when testing the applicability of the shared resource hypothesis. Some studies argue that there is insufficient evidence to support the hypothesis. For example, Butterworth and Rodgers (2006) found that most personal-, couple-, and area-level risk factors could not explain spousal mental health concordance among Australian couples. Another Australian study also implied the insufficiency of spousal interaction to explain spousal health behavior (Grant et al., 2007). Modest explanatory power of shared resources or environment was also found in the United States (Ferrer, Palmer, & Burge, 2005) and the Netherlands (Monden, 2007). In contrast, evidence from some other studies strongly supports the shared resource hypothesis. For examples, studies about older American married couples found that individual-level and couple-level characteristics were significant predictors of depressive symptoms and health status (Townsend, Miller, & Guo, 2001; Wilson, 2002). A study of Chinese couples living in Shanghai also supported the shared resource hypothesis through shared health habits and risks (Jurj et al., 2006).

Several reasons could explain these inconsistent findings about applicability of the shared resource hypothesis. First, these studies addressed various aspects of health concordance among different age groups (Ferrer et al., 2005; Townsend et al., 2001). Second, some studies did not use nationwide representative samples, making it difficult to generalize findings (e.g., Jurj et al., 2006). Third, they focused on only one country and used different measures, reducing the

comparability between countries (Meyler et al., 2007). Therefore, these studies were unable to consider cross-national variations in social contexts. This study focuses on older adult couples and cross-national comparisons using representative samples and consistent measures.

Cross-National Study in Health Concordance

Existing studies have found health concordance, either for good or ill, among couples in many countries, including the U.S. (e.g., Kiecolt-Glaser & Wilson, 2017), Europe (Huijts, Monden, & Kraaykamp, 2009), and China (Jurj et al., 2006), among others. Overwhelming evidence has illustrated depression concordance within couples (Meyler et al., 2007). However, Walker and Luszcz (2009) found that many of the health concordance studies on older adult couples focused on Caucasians in the United States and called for more studies on couples with diverse racial and cultural backgrounds. In addition, many studies have been conducted within a single-country context without a comparative cross-national perspective. Comparative research, especially cross-national comparison, could provide implications for policy-making and clinical practice by contrasting experiences with other places. In the context of population aging as a common phenomenon across the globe, comparing aging experiences from different countries could be informative in gerontological research (Jackson, 2002).

However, few studies have focused on cross-national comparisons. For example, Roberts et al. (2017) found spousal concordance in the use of alternative tobacco products, with United States couples having the highest concordance compared to their counterparts in Austria, Greece, Israel, the Netherlands, and Slovakia. Therefore, it can be inferred from previous studies that there are cross-national variations in the level of health concordance within older adult couples (e.g., Roberts et al., 2017). Machado et al. (2017) found spousal concordance in drinking and smoking habits in Latin American couples but did not discuss cross-national comparisons. These studies also did not consider concordance in mental health, so in-depth cross-national

comparison about spousal mental health concordance is warranted. To expand knowledge about the health concordance study in different country settings, this study provides a cross-national perspective on depressive symptoms concordance and explores differences in the applicability of the shared resource hypothesis. Following the case selection strategy in comparative research (Lijphart, 1975), four countries—China, the U.S., Mexico, and England—were chosen based primarily on their different levels of economic development and their distinct geographical-cultural features. For example, China and the U.S. are dissimilar both in economic characteristics and in geographical locations. The assumption is that developing and developed countries differ substantially in overall resource availability, which could shape their populations' mental health condition contextually via family resources adequacy.

Research Hypotheses

As indicated from the literature review, depression concordance is most consistent and robust among older adult couples (Meyler et al., 2007). However, there is currently no conclusive explanation about why depression concordance is stronger than other aspects of psychological health. Dufouil and Alperovitch (2000) suggested one possible reason was that shared life events had stronger influences on the older couples' depression than on other psychological traits. In addition, there are still unsettled arguments about the applicability of the shared resource hypothesis, so this study endeavors to fill the research gap by testing whether the shared resource hypothesis can explain spousal depression concordance. Previous studies also illustrated the need to give more attention to non-Western countries and to cross-national comparisons (Meyler et al., 2007; Walker & Luszcz, 2009), so this study further explores cross-national applicability of the shared resource hypothesis in different socioeconomic contexts. By learning if the shared resource hypothesis could explain concordance in older adult couples' depressive symptoms, this study aims to draw some implications for mental health policy design.

It also aims to develop some recommendations for clinical practices about how to improve older adults' mental well-being via couple-level intervention. This study addresses three specific research hypotheses.

H1: Older people's depressive symptoms are related to both their own and their spouse's social and physical health status. The assumption of health concordance that the couple's health status affects and resembles each other has been supported by previous studies (e.g., Stimpson et al., 2006; Townsend et al., 2001). The joint effect of living together and sharing similar social network and resources also bolsters the couple's mental health similarity. The shared resource hypothesis emphasized the communal interaction between the couple who depends on each other. This is equivalent to the Actor-Partner Interdependence Model (APIM) in marriage research by exploring the effect of actor and partner simultaneously in the same model (Kenny et al., 2006). The APIM is a widely used statistical model to test the interdependent relationship between actors and partners in dyadic data (Cook & Kenny 2005). It is assumed that there is interdependence between two individuals when exploring their interpersonal relationship. The emotion or behavior of one person (actor) could affect those of another person (partner). APIM has been applied to sleep concordance research (Hasler & Troxel, 2010) among others. It is applicable to the current study considering that the study explores depressive symptoms concordance within the interdependent couple. In other words, the individual's mental health is affected by his/her own resources and by his/her partner's resources.

H2: Having more resources is associated with a higher level of depressive symptoms concordance. The shared resource hypothesis emphasizes the mutual benefits of marriage. In the marital arrangement, couples can share financial assets and social networks and enjoy mutual support from each other. Logically, having more resources (e.g., financial, social, or health-

related aspects) should enhance benefits to emotional connectedness between couples, thereby strengthening concordance in low levels of depression.

H3: There are cross-national variations in the applicability of the shared resource hypothesis. Contextual backgrounds should not be ignored when addressing older adult couples' health concordance (Walker & Luszcz, 2009). Couples and their marriage are embedded in the socio-political contexts they live in and therefore are affected by them. Considering national differences in social resources such as elder care, especially between developing and developed countries, this study is predicated on the premise that cross-national variations are important in applying the shared resource hypothesis to explain patterns of depressive symptoms concordance within couples.

Methods

Data Source

This study used data from the international family surveys of HRS harmonized by the Program on Global Aging, Health, and Policy at the University of Southern California (www.g2aging.org). The program, also called Gateway to Global Aging Data, unifies the coding of HRS-series studies to provide researchers with handy data and facilitate cross-national studies. Two developed countries (the United States and England) and two developing countries (China and Mexico) located in different continents were chosen. Harmonized data were retrieved from RAND HRS for the United States, the China Health and Retirement Longitudinal Study (CHARLS), the Mexican Health and Aging Study (MHAS), and the English Longitudinal Study on Ageing (ELSA). Cross-sectional 2012-2013 data were the latest version available when the data were retrieved for analysis. Respondents and their spouses/partners responded to the same questionnaire. This study focuses on heterosexual older couples, so only couples who were legally married or long-term partnered, heterosexual, and both individuals were aged at least 60

years old were included in the analyses, resulting in 4,347 Chinese couples, 7,026 American couples, 4,848 Mexican couples, and 4,344 British couples. This study used a completely de-identified secondary dataset; thus Institutional Review Board approval was not required.

Measures

This study used both individual- and couple-level measures. Couple-level measures are recoded or transformed by combining the information from both individuals within the couple. Currently, there were no well-established scales or indicators to measure resources within the couples. Thus all available variables in the HRS-family questionnaires were retrieved that might help measure the financial and social aspects of resources based on their face validity and relevance in previous studies. Table 9 shows the variables used in this study.

Outcome Variable

The scale of the Center for Epidemiologic Studies Depression (CESD) was used to measure older adults' depressive symptoms in the HRS-series studies. The number of items in the CESD were different in the four harmonized datasets (eight items in HRS, nine items in MHAS, eight items in ELSA, and ten items in CHARLS), so average scores were used to make results comparable similar to previous cross-national studies using HRS-series data (e.g., Díaz-Venegas et al., 2016). The CESD scores were further rescaled by the least common multiple (i.e., 360) of the number of items (i.e., 10, 8, 8, 9) in the four datasets. Rescaling the dependent variable would not change the major findings of model results but helped facilitate the interpretation of coefficients in the multilevel and regression analyses. Thus, in the individual-level measure, the range of CESD was 0 to 360; a higher score implies greater severity of depressive symptoms. Reliability of CESD was above 0.7 in all four countries' dataset.

To measure health concordance at the couple-level, the depressive symptoms difference was calculated by subtracting the couple's scores from each other. The analysis further used the

absolute values of CESD score differences to measure the extent of dissimilarity of depressive symptoms between the members of the couple. The negative sign of within-couple difference values is not relevant for the analysis because gender difference is not this study's focus and it could introduce inaccurate estimation into the model if data with different directionality were used. In this case, a lower absolute value of the difference indicated a smaller difference, i.e., higher depressive symptoms concordance within couples.

Predictor Variables

Demographic information. Gender, age, and education were included as demographic variables. Gender had two levels as only heterosexual couples were included in this study. Age is a continuous variable. At the couple-level, the average of the couples' ages was used. It is hypothesized that the higher the average age of the couple, their depressive symptoms concordance is more likely to be higher assuming the older couples have spent a longer time being married and living together. Education was categorized by two and three years of college and above as "higher education" and other responses as "lower education." Thus, education had two levels in the individual-level measure. At the couple-level, a new count variable was created by calculating the number of members among the couples having higher education. The range was 0 to 2, with 0=neither of the members of the couple were highly educated, 1=only one among the couple was highly educated, and 2=both members of the couple were highly educated.

Employment, pensions, and insurance coverage. Employment, pensions, and health insurance were considered as financial resources in this study because of their close association with older adults' income. At the individual level, employment status had two categories: currently working for pay and not working. The number of people currently working for pay among the couple was calculated, with values ranging 0 (none were working) to 2 (both were working). For the pension and health insurance measures, the HRS-series studies asked

respondents and spouses whether they received public and private pensions and health insurance. The amount of pension income was incomparable across the four countries. Thus, at the individual level, the sources of pensions/health insurances had three values, with 0 (no public or private pensions/insurance), 1 (have public or private pension/insurance), and 2 (have both public and private pensions/insurance). At the couple level, the number of pension sources for the couple ranged from 0 (the couple had no pensions/insurance) to 4 (both members of the couple have both public and private pensions/insurance).

Family network and income. Many measures related to social support are not available across all four countries' datasets; therefore, the number of living children is used as a simplified indicator of social network. The second indicator is household income, measured at the couple or household level. Household income was further transformed into purchasing power based on U.S. dollars to make the metric comparable across all four countries. Finally, household income was recoded into a categorical variable with five levels: \$<5,000; \$5,000-7,000; \$7,001-10,000; \$10,001-20,000; \$> 20,000. Number of living children and household income were couple-level measures, and thus were the same for both couple members in dyadic data.

Health covariate. Physical health is an important covariate in predicting older adults' depression (Fiske, Wetherell, & Gatz, 2009). In studying health concordance, spouses' physical health was also a significant risk factor for respondents' depression (Siegel, Bradley, Gallo, & Kasl, 2004). Therefore, self-reported health was included as a simplified indicator of physical health. A five-point Likert range was used with values from 0=excellent to 5=poor. At the couple-level, the average scores of each couple's self-reported health was used.

Table 9 Individual-level and couple-level variables used in this study

	Individual-level	Couple-level	Remark
<i>Outcome variable</i>			
Depressive symptoms	<ul style="list-style-type: none"> • Average score of CESD, rescaled by multiplying 360, ranging from 0 to 360. • Higher score means more depressive symptoms. 	<ul style="list-style-type: none"> • Absolute value of the difference score between the couple. • Lower absolute value means smaller difference thus higher concordance. 	<ul style="list-style-type: none"> • CESD score is rescaled to facilitate interpretation. • Sign of difference score is of no interest to this study.
<i>Predictor variables</i>			
Gender	Binary: female (wife), male (husband)		This study addressed only heterosexual couples.
Age	Continuous	Average of the couple's age	
Education	Binary: lower and higher	<ul style="list-style-type: none"> • Number of members have higher education • Value=0, neither of the members of the couple were highly educated • Value=1, only one among the couple was highly educated • Value=2, both members of the couple were highly educated 	<ul style="list-style-type: none"> • higher education: two and three years of college and above • lower education: otherwise
Employment	Binary: working and not working	<ul style="list-style-type: none"> • number of people currently working for pay among the couple • similar to education, values=0, 1, 2 	
Pension	Three-level categorical: 0 (no public or private pensions), 1 (have public or private pension), and 2 (have both public and private pensions)	<ul style="list-style-type: none"> • number of pension sources for the couple ranged from • similar to education, value=0 (the couple had no pensions), 1, 2, 3, 4 (both members of the couple have both public and private pensions) 	The sources of pension were identified and only two common sources were considered in the four countries: private and public.

Table 9 continued

	Individual-level	Couple-level	Remark
Health insurance	Similar to pension, three-level categorical Values=0,1,2	<ul style="list-style-type: none"> number of insurance sources for the couple ranged from similar to pension, values=0,1,2,3,4 	The sources of health insurance were identified and only two common sources were considered in the four countries: private and public.
Family network		Number of living children	
Household income		<ul style="list-style-type: none"> transformed into purchasing power Five-level categorical: \$<5,000; \$5,000~7,000; \$7,001~10,000; \$10,001~20,000; \$> 20,000 	
Self-reported health	Ordinal: 0=excellent to 5=poor	average scores of each couple's self-reported health	

Analytic Strategy

First, descriptive analyses were conducted for the older adults in four countries. In particular, Pearson correlation significance tests were conducted to examine the linear relationship between the couple's CESD score as previous health concordance studies did (e.g., Hasler & Troxel 2010; Dufoui & Alperovitch 2000). Second, the data have a dyadic structure with two individuals nested within the same couple. Thus multilevel model estimation was employed to address the interdependence of dyadic data. Referring to the APIM (Kenny et al., 2006), the husband's CESD score was regressed on both his own and the wife's social, financial, and physical health predictors using a multilevel approach to test hypothesis 1. A similar regression approach has been applied in previous studies (e.g., Stimpson et al. 2006; Townsend et al. 2001). The wife's CESD score was not included as a predictor because of potential endogeneity bias. A similar model was estimated for the wife's CESD score regressed on her own and the husband's demographic and physical health predictors. In such cases, it would be

possible to compare gender difference in the relationships. The multilevel equations for husband's CESD follow.

Level 1:

$$\begin{aligned} HusbandCESD_{ij} = & \beta_{0j} + \beta_{1j}HusbandAge_{1ij} + \beta_{2j}WifeAge_{2ij} + \beta_{3j}HusbandEdu_{3ij} + \\ & \beta_{4j}WifeEdu_{4ij} + \beta_{5j}HusbandWork_{5ij} + \beta_{6j}WifeWork_{6ij} + \beta_{7j}HusbandPension_{7ij} + \\ & \beta_{8j}WifePension_{8ij} + \beta_{9j}HusbandInsurance_{9ij} + \beta_{10j}WifeInsurance_{10ij} + \\ & \beta_{11j}HusbandPhysicalhealth_{11ij} + \beta_{12j}WifePhysicalhealth_{12ij} + r_{ij} \quad [1] \end{aligned}$$

Level 2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}NChildren_{1j} + \gamma_{02}HouseholdIncome_{2j} + \mu_{0j} \quad [2]$$

where the outcome variable is the CESD score of the *i*th husband nested within the *j*th dyad, β_{qj} refers to the coefficients of individual-level predictors, and γ_{01} and γ_{02} represent the coefficients of couple-level measures. All errors terms are assumed to be independently and normally distributed with mean 0 and constant variance.

Another approach to test the APIM is Structural Equation Modelling (SEM). SEM is a popular and useful statistical approach to examine the complex and reciprocal relationship between variables in social science research. Similar to the multilevel regression model, the husband's CESD score was regressed on both his own and the wife's social, financial, and physical health predictors. The wife's CESD score also was regressed on her own and the husband's demographic and physical health predictors. To account for health concordance, the covariance between the husband's CESD and the wife's CESD was estimated. However, unlike the multilevel model, the path coefficients of actor and partner effect were allowed to be free and not constrained to be the same between genders. In this case, male/female effect differences can be observed in the SEM model. The coefficients of the shared household variable were fixed to make sure they had the same effect on the couple's depressive symptoms. SEM results were visualized by drawing the figure and highlighting significant coefficient. SEM analysis was

conducted for each of the four countries, separately. Therefore, country differences could be seen by comparing the significance of path coefficients. However, it is also optional to pool the four countries' datasets and perform multi-group SEM analysis.

This study presented the APIM results using both multilevel modelling and SEM methods to cross-examine the key findings. There are both pros and cons associated with each of these two approaches. SEM is a straightforward approach. Its results can be visualized and it is very flexible and capable of dealing with categorical variables. Multilevel models can also test gender effects and require a special form of data. APIM is built for multiple regression. Therefore, depending on the specific research questions, either a multilevel model or SEM could be utilized to analyze the data as long as they address the research questions.

Third, to further test the effect of shared resources on depressive symptoms concordance proposed by hypotheses 2 and 3, a model was fitted in which the CESD difference score is regressed on all couple-level predictors. Using an absolute value of difference score could mask the original size of the couples' CESD scores. Adding the average score of CESD as a covariate was not pursued as it would generate a multicollinearity problem in the model because CESD was significantly correlated with self-report physical health (correlation coefficient > 0.400 , $p < 0.001$). Thus having the average score of self-reported health as independent variable could provide similar information about the original CESD score of the couple.

Linear regression analysis showed that using ordinary least square estimation violated the normality assumption, although that outcome might be acceptable in a large sample size study. Supplemental Table 6 shows the results using the linear regression model and Supplemental Figure 1-4 show the QQ-plot of residuals. As can be seen, the assumption of normally-distributed residuals was seriously violated in models for the four countries. Thus, using the

linear regression model results seems suboptimal. Another option is to consider the CESD difference score as count data. However, the distribution of CESD difference scores was over-dispersed and/or zero-inflated, so negative binomial and zero-inflated models were fitted for each of the four countries' data separately. Model-fitting metrics such as the Wald chi-square test, the Akaike information criterion (AIC), and log-likelihood were compiled.

Finally, as there was no household-level weight in the British dataset, all analyses were unweighted. Analyses were conducted in R using the packages “psych,” “lme4,” “optimx,” “car,” “MASS,” “lavaan,” and “pscl.”

Results

Descriptive Characteristics

Table 10 shows the descriptive analysis of older couples in four countries. The median age of husbands was higher than wives' in four countries. The majority of Chinese older adults did not have higher education and were currently working for pay. A similar situation was found among Mexican older respondents. Most Mexican older adults did not have pensions and but had more than five children. For the U.S. and England, many older adults had higher education and fewer than 30% were currently working for pay. In addition, there were significant differences between the four countries, with American and British couples having much higher income and more likely to be highly educated than their Chinese and Mexican counterparts. Regarding health measures, the couples in the U.S. and England also had better performance in their self-reported physical health and CESD scores than those in China and Mexico.

Depressive symptoms score differences between the couples ranged from 0 to 360. Paired *t*-test results showed the difference between the couples' CESD scores were statistically nonsignificant ($p = 0.31$ for China; $p = 0.98$ for US; $p > 0.99$ for Mexico and England), indicating no difference between the couples' depressive symptoms. Furthermore, all pairwise

correlations between the couples' CESD scores were statistically significant ($p < 0.001$). The correlations were 0.32 for Chinese couples, 0.17 for American couples, 0.22 for Mexican couples, and 0.24 for British couples.

Table 10 Descriptive statistics of husbands and wives in four countries

	China		United States		Mexico		England	
	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives
Sample size (<i>N</i>)	4347	4347	7026	7026	4848	4848	4344	4344
age Median (<i>Skewness</i>)	68 (1.08)	65 (1.08)	73 (0.24)	70 (0.46)	70 (0.68)	67 (0.96)	70 (0.49)	68 (0.67)
education - higher <i>N</i> (%)	134 (3.08)	38 (0.87)	3450 (49.24)	3214 (45.87)	974 (20.32)	831 (17.23)	783 (31.51)	429 (21.53)
Working status – yes <i>N</i> (%)	2393 (55.72)	2183 (50.96)	1891 (27.37)	1615 (23.37)	1848 (38.13)	578 (11.93)	987 (22.72)	750 (17.28)
physical health Mean (<i>SD</i>)	3.90 (0.89)	4.01 (0.89)	2.88 (1.08)	2.78 (1.05)	3.70 (0.86)	3.85 (0.77)	2.85 (1.08)	2.75 (1.07)
Number of pensions Median (<i>Skewness</i>)	1 (-0.69)	1 (-1.34)	1 (0.03)	1 (0.09)	0 (0.62)	0 (3.09)	2 (-0.8)	1 (-0.31)
Number of health insurances Median (<i>Skewness</i>)	1 (-3.63)	1 (-3.93)	1 (0.16)	1 (-0.05)	1 (-1.62)	1 (-1.93)	1 (2.38)	1 (2.42)
CESD score Median (<i>Skewness</i>)	72 (0.83)	108 (0.44)	0 (2.20)	0 (1.81)	80 (0.77)	120 (0.37)	0 (2.26)	45 (1.80)
Number of children Median (<i>Skewness</i>)	3 (0.61)		3 (1.50)		5 (0.61)		2 (1.31)	

Table 10 continued

	China	United States	Mexico	England
Household income ^a				
\$<5,000	1762 (56.37)	61 (0.87)	3182 (65.64)	28 (0.65)
\$5,000~7,000	232 (7.42)	39 (0.56)	318 (6.56)	4 (0.09)
\$7,001~10,000	279 (8.93)	74 (1.05)	306 (6.31)	24 (0.56)
\$10,001~20,000	583 (18.65)	592 (8.43)	490 (10.11)	429 (9.92)
\$> 20,000	270 (8.64)	6260 (89.10)	552 (11.39)	3839 (88.78)

Note: when the distribution of a continuous variable was skewed, median and skewness were used to describe the variable.

a Household income has been transformed into purchasing power in units of US dollars.

Multilevel model results

Table 11 shows the multilevel model results testing APIM for the husband and wife in the four countries, separately. The intraclass correlation coefficient was highest in China's model (0.29), followed by the Mexico and England models (0.18), and lowest in the U.S. model (0.09). The coefficients of the self and spouse predictors were exactly the same in both husbands' and wives' models. For all four countries, self and spouse age and physical health were consistently significant predictors. In particular, better self-reported health was associated with the self and spouse reporting lower depressive symptoms. Physical health had the largest coefficient compared to other predictors. Number of living children and household income were significant only for the China and Mexico models. That is, having fewer children but more household income was associated with lower depressive symptoms for both husband and wife living in China and Mexico.

In the China models, both of the couples' working statuses were significant predictors. Looking at the simple effect, husband's working status was associated with more depressive symptoms for both him and his wife, while the wife's working status was associated with lower

depressive symptoms for both her and her husband's symptoms. In the US models, only self education, working status, and pension status significantly predicted self CESD score. There was no spousal effect of social and financial status on American couples' depressive symptoms. In the Mexico models, spouse's lower education, self working for pay, self having more types of pensions, self having fewer sources of health insurance, but spouse's more sources of health insurance were associated with self lower depressive symptoms. In the England models, self working for pay but spouse not working for pay, self having more types of pensions while spouse having fewer sources of pensions were associated with self lower depressive symptoms.

SEM results

SEM results for each of the four countries' couples showed reasonable-fitting indices (Comparative Fit Index [CFI] > 0.990; Tucker-Lewis Index [TLI] > 0.960; Root Mean Square Error of Approximation [RMSEA] < 0.05). Specific model results were visualized in Figure 5 for Chinese couples, Figure 6 for American couples, Figure 7 for Mexican couples, and Figure 8 for British couples. Coefficients were unstandardized. The significance level was set to 0.05. To help distinguish among paths, nonsignificant coefficients were not shown in the figures; the red coefficients and paths show the significant predictors of wife's CESD while the blue coefficients and paths show the significant predictors of husband's CESD. The SEM coefficients were not identical to those in the multilevel models owing to different computational and conceptual approaches, but the key findings were similar. That is, for all four countries, self and spouse physical health were consistently the significant predictors with the largest effect size. For both wife and husband, their CESD was associated with their spouse's demographic and financial status to some extent.

Table 11 Multilevel model results testing APIM model

	China		US		Mexico		England	
	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband
<i>Fixed effect</i>								
Intercept	16.68 (21.19)	16.68 (21.19)	7.22 (11.07)	7.22 (11.07)	-96.65*** (15.89)	-96.65*** (15.89)	-14.05 (22.06)	-14.05 (22.06)
Wife's age	-1.90*** (0.25)	1.01*** (0.25)	-0.87*** (0.13)	0.41** (0.13)	-0.79*** (0.19)	0.99*** (0.19)	-1.29*** (0.26)	1.47*** (0.26)
Husband's age	1.01*** (0.25)	-1.90*** (0.25)	0.41** (0.13)	-0.87*** (0.13)	0.99*** (0.19)	-0.79*** (0.19)	1.47*** (0.26)	-1.29*** (0.26)
Wife's education – higher	-14.09 (7.82)	1.87 (7.69)	-3.22* (1.38)	1.11 (1.38)	4.84 (2.67)	5.98* (2.66)	-1.69 (2.49)	-3.75 (2.50)
Husband's education – higher	1.87 (7.69)	-14.09 (7.82)	1.11 (1.38)	-3.22* (1.38)	5.98* (2.66)	4.84 (2.67)	-3.75 (2.50)	-1.69 (2.49)
Wife's working – yes	-5.92* (2.44)	7.96** (2.44)	-12.22*** (1.58)	2.12 (1.59)	-15.38*** (2.47)	3.68 (2.47)	-13.07*** (3.06)	10.20*** (3.06)
Husband's working –yes	7.96** (2.44)	-5.92* (2.44)	2.12 (1.59)	-12.22*** (1.58)	3.68 (2.47)	-15.38*** (2.47)	10.20*** (3.06)	-13.07*** (3.06)
Number of wife's pension	-4.50 (2.96)	0.22 (2.99)	-3.83** (1.29)	1.15 (1.28)	-25.94*** (2.71)	-1.86 (2.71)	-8.71*** (1.92)	4.33* (1.92)
Number of husband' pensions	0.22 (2.99)	-4.50 (2.96)	1.15 (1.28)	-3.83** (1.29)	-1.86 (2.71)	-25.94*** (2.71)	4.33* (1.92)	-8.71*** (1.92)
Number of wife's health insurance	4.05 (6.04)	2.32 (5.89)	-1.54 (1.50)	-1.41 (1.50)	9.81** (3.81)	-10.92** (3.81)	-1.94 (6.32)	-1.75 (6.31)
Number of husband's health insurance	2.32 (5.89)	4.05 (6.04)	-1.41 (1.50)	-1.54 (1.50)	-10.92** (3.81)	9.81** (3.81)	-1.75 (6.31)	-1.94 (6.32)
Wife's self-reported health	29.34*** (1.20)	10.13*** (1.21)	28.52*** (0.63)	6.59*** (0.62)	49.99*** (1.27)	7.53*** (1.27)	20.13*** (1.21)	3.26** (1.20)
Husband's self-reported health	10.13*** (1.21)	29.34*** (1.20)	6.59*** (0.62)	28.52*** (0.63)	7.53*** (1.27)	49.99*** (1.27)	3.26** (1.20)	20.13*** (1.21)

Table 11 continued

	China		US		Mexico		England	
	Wife	Husband	Wife	Husband	Wife	Husband	Wife	Husband
Number of living children	2.53** (0.88)	2.53** (0.88)	-0.06 (0.32)	-0.06 (0.32)	1.24** (0.40)	1.24** (0.40)	-0.73 (0.88)	-0.73 (0.88)
Household income								
5,001~7,000	-3.28 (4.72)	-3.28 (4.72)	4.84 (12.20)	4.84 (12.20)	-0.66 (4.47)	-0.66 (4.47)	-48.40 (35.85)	-48.40 (35.85)
7,001~10,000	-16.01*** (4.34)	-16.01*** (4.34)	-6.93 (10.17)	-6.93 (10.17)	2.79 (4.80)	2.79 (4.80)	-15.81 (35.79)	-15.81 (35.79)
10,001~20,000	-15.00*** (3.40)	-15.00*** (3.40)	-3.99 (8.19)	-3.99 (8.19)	-5.06 (3.94)	-5.06 (3.94)	-23.27 (17.15)	-23.27 (17.15)
$\geq 20,001$	-21.16*** (4.76)	-21.16*** (4.76)	-13.77 (7.97)	-13.77 (7.97)	-10.36* (3.87)	-10.36* (3.87)	-5.81 (16.21)	-5.81 (16.21)
Random effect								
Dyad (intercept)	1781	1781	451	451	1551	1551	639.6	639.6
Residuals	4517	4517	4195	4195	6731	6731	2800.4	2800.4

Note: Standard errors are in the parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

However, number of living children and household income have differential effects in the models for each of the four countries. The couple-level variables were significant in less developed countries, but not in more developed countries. Although further reasons need to be explored, this finding could occur because of the simplified measure used in the study. Number of children cannot capture the demographic characteristics (e.g., sex, education, age) of the children, or the relationship between the older couple and their adult children. Therefore, it may not be surprising that number of living children was a nonsignificant predictor of the couple's CESD. In addition, the household income measure was re-categorized in a somewhat arbitrary way. Using the continuous scale, log transformation, or another categorization coding could lead to different results. Further analyses are needed to validate these results or test the sensitivity of the results.

Regression Results with Count Data

Zero-inflation and over-dispersion issues in the depressive symptoms concordance measure led to using different models in the four countries (Table 12). General model fitting statistics indicated all models were reasonable. The regression model results again illustrate the robust association between physical health and depressive symptoms concordance across all countries (odds ratio [OR] > 1 , $p < 0.001$). That is, the better average physical health the couple reported, the stronger the concordance of their depressive symptoms.

Most other coefficients were nonsignificant in the models for China and Mexico. For the U.S. model, having more people working for pay and more sources of health insurance were associated with higher depressive symptom concordance (OR < 1 , $p < 0.05$). For the England model, having more household income, more people having higher education, fewer people working for pay, fewer sources of pension, but more sources of health insurance were associated with higher depressive symptom concordance.

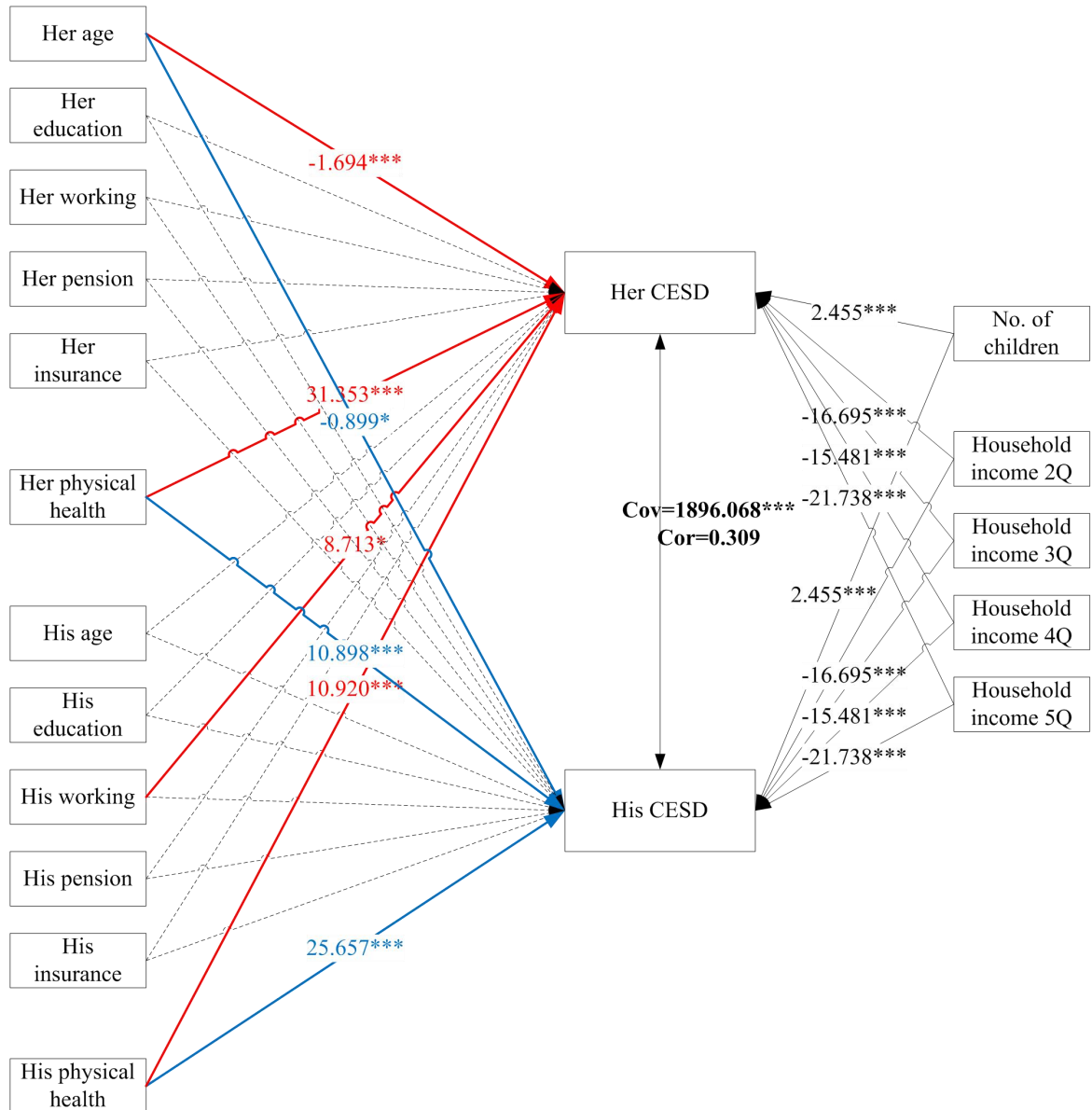


Figure 5 SEM results for Chinese couples

Note. Coefficients are unstandardized. Chi-square test statistic = 6.211, $df = 5$, $p = 0.286$, Comparative Fit Index (CFI) = 0.999, Tucker-Lewis Index (TLI) = 0.994, Root Mean Square Error of Approximation (RMSEA) = 0.009, $p > 0.05$.

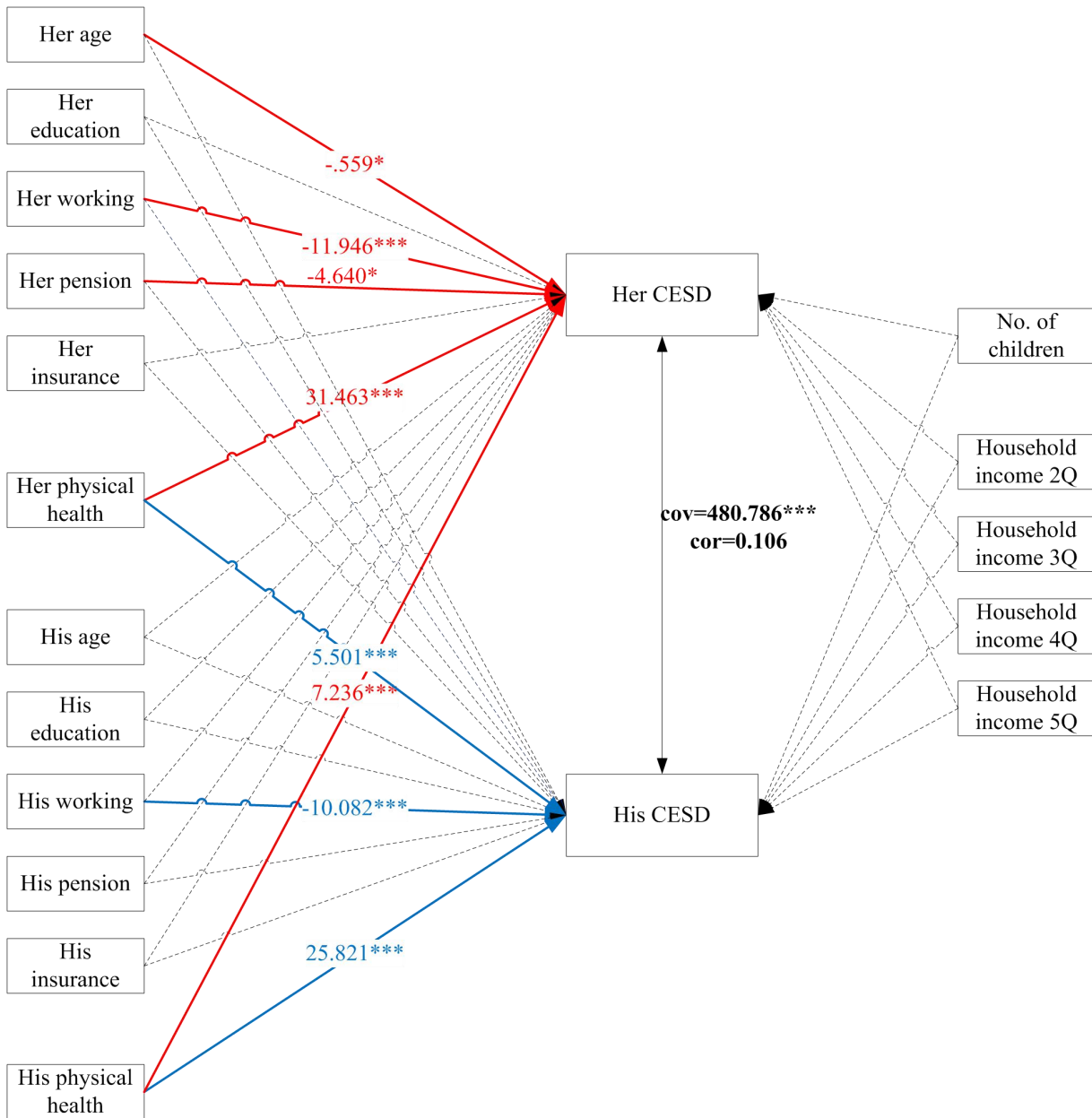


Figure 6. SEM results for American couples

Note: Coefficients are unstandardized. Chi-square test statistic = 20.286, $df = 5$, $p = 0.001$, Comparative Fit Index (CFI) = 0.997, Tucker-Lewis Index (TLI) = 0.976, Root Mean Square Error of Approximation (RMSEA) = 0.022, $p > 0.05$.

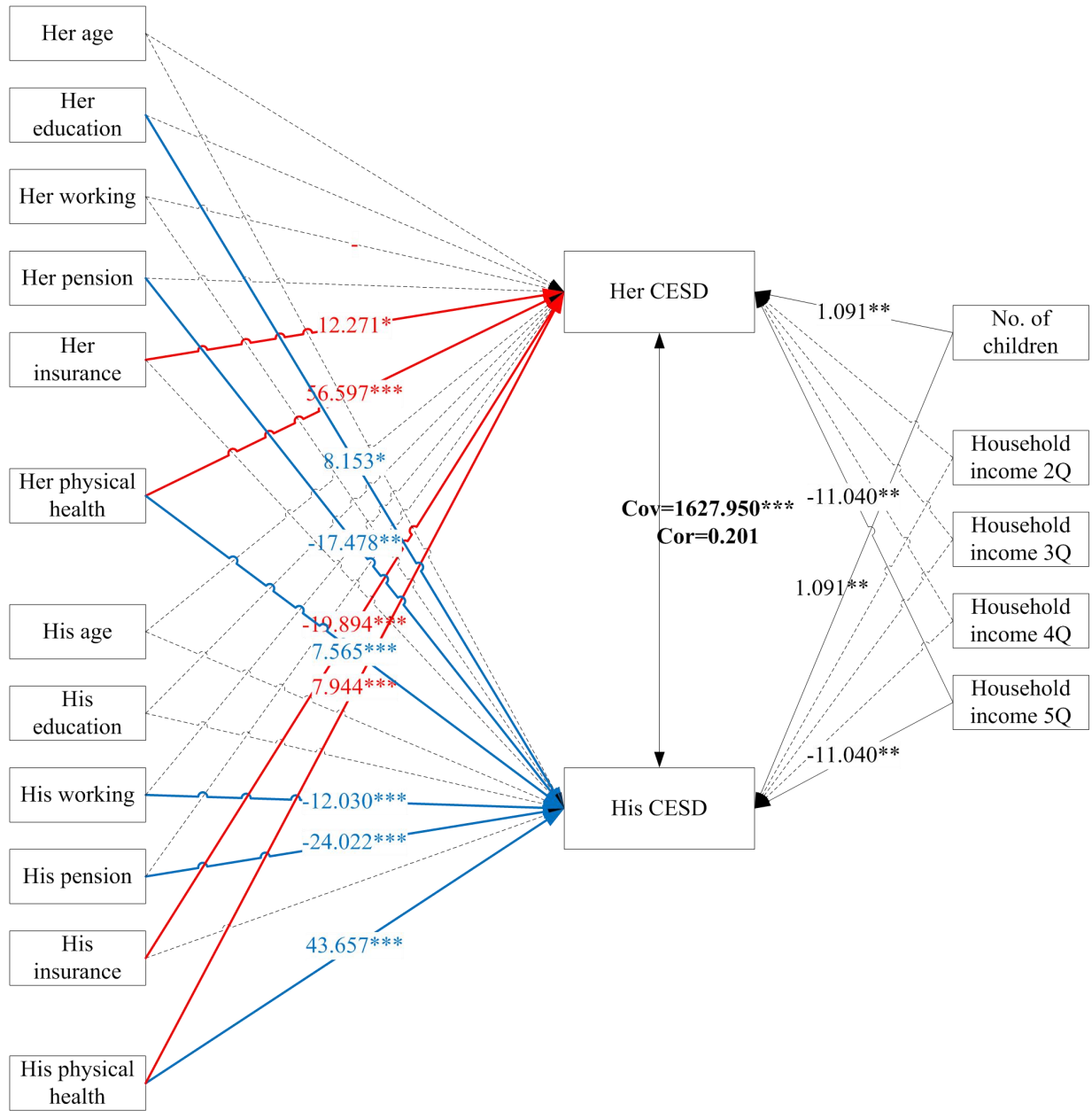


Figure 7 SEM results for Mexican couples

Note: Coefficients are unstandardized. Chi-square test statistic = 7.389, $df = 5$, $p = 0.193$, Comparative Fit Index (CFI) = 0.999, Tucker-Lewis Index (TLI) = 0.992, Root Mean Square Error of Approximation (RMSEA) = 0.011, $p > 0.05$.

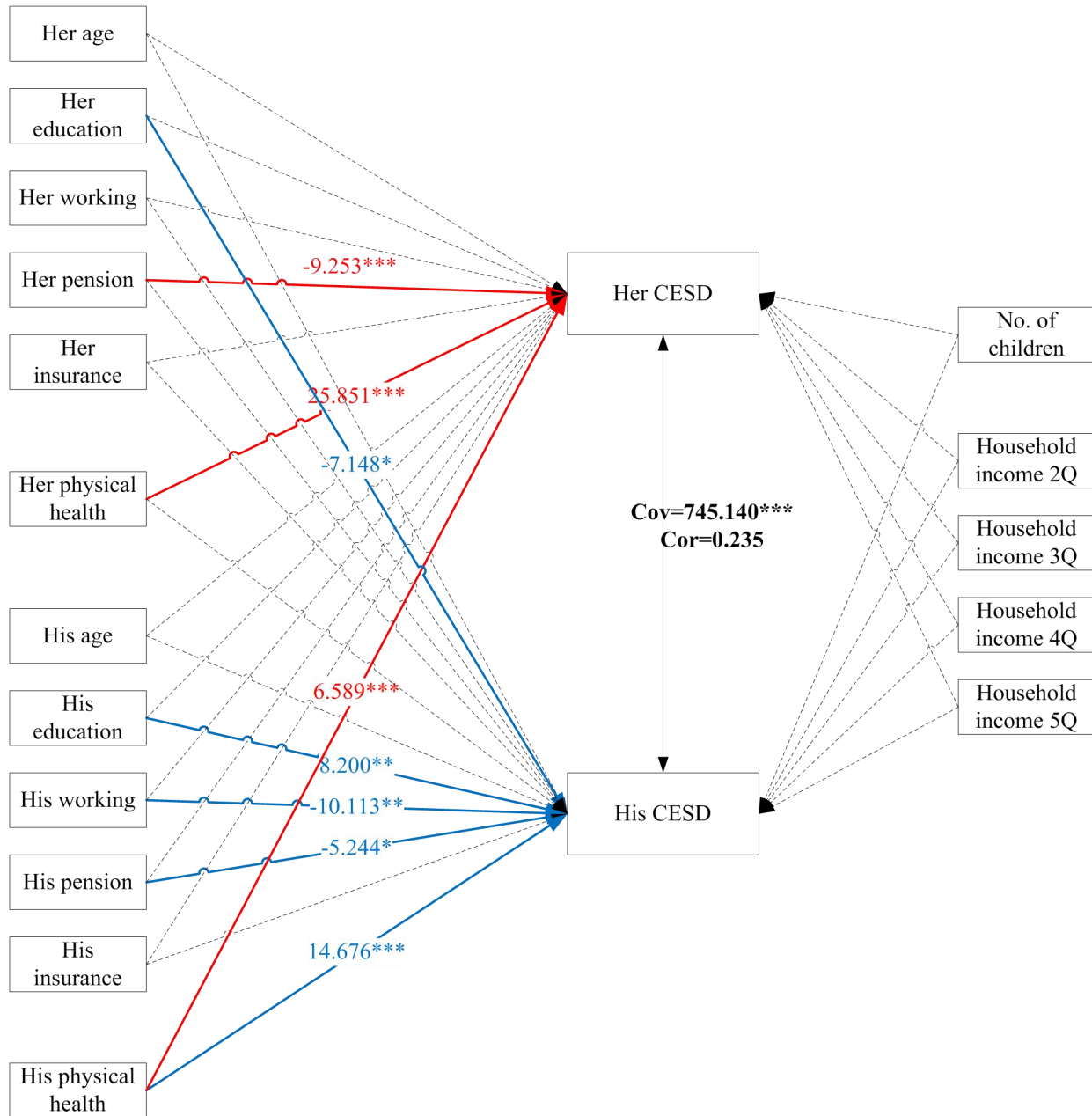


Figure 8 SEM results for British couples

Note: Coefficients are unstandardized. Chi-square test statistic = 18.288, $df = 5$, $p = 0.003$, Comparative Fit Index (CFI) = 0.995, Tucker-Lewis Index (TLI) = 0.964, Root Mean Square Error of Approximation (RMSEA) = 0.044, $p = 0.648$.

Table 12 Regression results of the effects of shared resources on couples' depression concordance

Model	China	US	Mexico	England
	Zero-inflated Negative Binomial Model	Zero-inflated Negative Binomial Model	Negative Binomial Model	Zero-inflated Poisson Model
Intercept	83.17*** (0.23)	103.22*** (0.17)	57.69*** (0.28)	101.49*** (0.06)
Average age between couples	1.00 (0.00)	0.99*** (0.00)	1.00 (0.00)	1.00*** (0.00)
Average Self-rated health between couples	1.10*** (0.02)	1.27*** (0.01)	1.20*** (0.03)	1.26*** (0.01)
Number of living children	1.01 (0.01)	1.01 (0.00)	1.01* (0.01)	0.95*** (0.00)
	China	US	Mexico	England
Household income				
5,001-7,000	1.09 (0.05)	0.77 (0.21)	1.05 (0.08)	0.00 (91.83)
7,001-10,000	0.90* (0.05)	0.77 (0.15)	1.11 (0.09)	0.24*** (0.11)
10,001-20,000	1.00 (0.04)	0.92 (0.12)	1.08 (0.07)	0.64*** (0.04)
>=20,001	0.94 (0.05)	0.91 (0.12)	0.91 (0.07)	0.64*** (0.04)
Education attainment of couples	1.10 (0.06)	1.01 (0.01)	0.97 (1.04)	0.98*** (0.01)
Number of people are working	1.00 (0.02)	0.93*** (0.02)	1.01 (0.04)	1.03*** (0.01)
Number of pensions the couples have	0.98 (0.02)	1.00 (0.02)	0.96 (0.04)	1.01** (0.00)
Number of medical insurance the couples have	1.03 (0.04)	0.96** (0.01)	0.98 (0.04)	0.98** (0.01)
<i>p</i> -value ^a	< 0.001	< 0.001	< 0.001	< 0.001
Log-likelihood	-12670	-22690	-22285.82	-14930
AIC	25373.68	45401.94	44598	29879.34

Note: The coefficients were transformed to odds ratio. Standard errors are indicated in parentheses. The coefficients of the zero-inflation model were not presented because they were statistically insignificant.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

^a Wald Chi-Square Test between the full model and the null model.

Discussion

This study has contributed to testing the cross-national applicability of the shared resource hypothesis in explaining depressive symptoms concordance among older adult couples by conducting a study with representative samples and consistent measures across the four countries. The findings have expanded knowledge about cross-national variations in the importance of shared resources and the spousal effect on older adults' depressive symptoms. First, descriptive results indicated that the American and British older couples had relatively better economic and health status than their Chinese and Mexican counterparts. This study also found patterns of depressive symptom concordance between older spouses in the four countries consistent with previous studies (Meyler et al., 2007).

The APIM model results from both multilevel and SEM approaches indicated the self and spousal effects of social and economic status were not consistent for all four countries, which partially supported Hypothesis 1. Self-reported physical health was the most robust predictor of depressive symptoms for both individuals within the couple, again validating the strong associations between physical health and mental health (Fiske et al., 2009). Household income significantly predicted older couples' depressive symptoms only in China and Mexico, probably because of their relatively disadvantaged financial status. Having more living children was a nonsignificant predictor for American and British couples' depressive symptoms and a significantly negative predictor in the China and Mexico models. These inconsistent results may need to be addressed from the perspective of cultural differences and changing societal contexts. In Western countries, especially in the European American culture, independence and autonomy are enshrined as respected values in individualistic societies (De Medeiros, 2016). Older adults are expected to be independent in their late life unless a severe condition such as a major illness occurs (Uchida et al., 2008). Therefore, the loose cultural constraint on filial obligation may

partially lead to the finding of nonsignificant association of the number of children with older couples' depressive symptoms in the U.S. and UK. In addition, modernization around the world also reduces filial support to older adults because adult children are focused more on their nuclear family (e.g., Aboderin, 2004; Xu & Xia, 2014). Therefore, the decreasing support from children may explain why the number of children could not bolster the older adults' mental health in the four countries.

The model regressing health concordance on couple-level predictors further illustrates that the shared resource hypothesis was not fully supported in the four countries (Hypothesis 2) and demonstrated cross-national variation (Hypothesis 3). Setting aside the physical health indicator, most social and financial measures were not significant predictors in the models for China and Mexico. For American couples, having more people working for pay and more sources of health insurance were associated with higher depressive symptom concordance, consistent with Hypothesis 2. For British couples all predictors were significant, but only the signs of household income, education, and health insurance were consistent with Hypothesis 2. However, it needs to be clarified that this study used the absolute value of a difference score as a simple measure of depressive symptoms concordance, which covered the sign of gender differences and original size of CESD scores, thus losing some information about the couple's mental health status. The limitation should be remedied by using other approaches to supplement the research findings.

Generally, having higher social status and sufficient social welfare benefits was associated with higher depressive symptoms concordance among American and British couples. The shared resource hypothesis emphasizes the importance of mutual support and common assets between couples, and the beneficial effect associated with sharing environments between

couples. From this perspective, the results imply the important spousal effect by finding that more resources were associated with higher mental health concordance. Therefore, the results have highlighted the synergistic effect of family-centered intervention (Carman et al., 2013).

In addition, no strong evidence of the applicability of the shared resource hypothesis was found in China and Mexico, meaning that the shared resource hypothesis was not very useful in explaining older adult couples' depressive symptoms concordance in these two developing countries. Although the reason for this contradiction needs to be researched further, it could be attributed to national variations in policy environments and social resource disparity. This inference is consistent with previous studies. For example, in comparing spousal concordance in using e-cigarettes, Roberts et al. (2017) found that concordance was higher among American couples than for couples in other countries, attributing that result to the more heavily regulated federal law in the U.S. The socioeconomic disparity in resource allocation between countries also affected spousal concordance among European couples (Huijts et al., 2009). As the ecological models indicate, people are embedded within social contexts and affected by their surrounding environment (Sallis et al., 2015). Accordingly, the couples' health conditions or behaviors are shaped by the circumstances of their policy environments, which is also the key point of the shared resource hypothesis. For the four countries addressed in this study, socioeconomic differences also existed (Adler & Newman, 2002), which might further contribute to the differential applicability of the shared resource hypothesis. With a base of fewer existing resources, older couples in China and Mexico might be more likely to experience more stress from the vicissitudes of reality while also being less able to obtain medical treatment.

Based on these findings, some implications for clinical practitioners and policy makers are provided. First, the spousal effect was evident in this study, highlighting the necessity of

couple-centered intervention. Designing programs or delivering services aiming at older couples could achieve a positive synergistic effect. Second, general physical health was the most robust predictor of depressive symptoms concordance within couples, suggesting that clinical professionals should pay more attention to the spousal effect on their clients' mental health. Physical health should be the primary consideration when clients present depressive symptoms. From the policy advocacy level, the limited applicability of the shared resource hypothesis may be attributed to the under-resourced condition encountered by older couples. Therefore, healthcare policymakers should be aware of the contextual effects of socioeconomic status and resource allocation on individuals' health and may resolve the problem from its roots by improving the national level of economic and healthcare resources. Policy efforts should be directed to enhance the accessibility of psychological counselling service to low-income older couples.

This study comes with limitations. First, the development of measures in this study was limited primarily by the unavailability of many items across the datasets of all four countries, although best efforts were made to retrieve existing information to construct the indicators. Even though items were available in some countries, the measurement methods were incomparable, making it inappropriate to include them in the model. However, such unavailable or incomparable items may be important to test the shared resource hypothesis. Future researchers could conduct their own cross-national investigations using a well-developed and comprehensive scale. In addition, this study was not able to measure some characteristics of the marriage, such as the length and quality of marriage, as covariates. Future research may consider adding these important marital measures to explore how they associate with health concordance. Second, the comparison encompasses only four countries. International family data using the HRS collection

include many countries that may be considered for comparison in future studies, although even with the four countries used in this study the number of variables that are available and measured in the same manner for all countries is quite limited.

Third, this study focused on testing the shared resource hypothesis, but it was not possible to assess the predictive validity of the assortative mating and affective contagion theories. This should not be taken to imply that the shared resource hypothesis was superior to these other two theories or deny their ability to explain depressive symptoms concordance. Future research may focus on comparing the applicability of these different theories. Finally, this study explored the applicability of the shared resource hypothesis in explaining only depressive symptoms concordance using cross-sectional data. Future study could expand the discussion of concordance using other health dimensions such as physical health, health behavior, utilization, and other mental health measures such as anxiety or stress. Also, future studies can utilize longitudinal data to explore the dynamics of health concordance between couples over time. The findings of this study focused on heterosexual couples, which may not be generalized to homosexual couples.

Conclusion

This study tested the applicability of the shared resource hypothesis in explaining depressive symptoms concordance within couples by exploring its cross-national variations in four countries. The analysis has contributed to expanding knowledge about the spousal effect on older adults' depressive symptoms and the theoretical explanation about why spouses depress each other. Results indicated that older adults' depressive symptoms were related to both his/her own and his/her spouse's social and physical health status. The shared resource hypothesis was more applicable to depressive symptoms concordance within older couples in the U.S. and England. Couple-centered intervention is suggested for clinical practice, and the spousal effect

should be considered in attempting to resolve the negative consequences of depressive symptoms concordance. The applicability of the shared resource hypothesis was weak in Chinese and Mexican contexts, probably attributed to resource scarcity for older couples. These findings lead to the suggestion that policymakers address the contextual effects of socioeconomic status and provide more opportunities for low-income couples to obtain psychological counseling. Efforts by clinical professionals and policymakers should note that spouses could depress each other partly because they share the same environment and resources.

References

- Aboderin, I. (2004). Modernisation and ageing theory revisited: Current explanations of recent developing world and historical Western shifts in material family support for older people. *Ageing & Society*, 24(1), 29-50. <https://doi.org/10.1017/S0144686X03001521>
- Adler, N. E., & Newman, K. (2002). Socioeconomic disparities in health: pathways and policies. *Health Affairs*, 21(2), 60-76. <https://doi.org/10.1377/hlthaff.21.2.60>
- Butterworth, P., & Rodgers, B. (2006). Concordance in the mental health of spouses: analysis of a large national household panel survey. *Psychological Medicine*, 36(5), 685-697. <https://doi.org/10.1017/S0033291705006677>
- Carman, K. L., Dardess, P., Maurer, M., Sofaer, S., Adams, K., Bechtel, C., & Sweeney, J. (2013). Patient and family engagement: a framework for understanding the elements and developing interventions and policies. *Health Affairs*, 32(2), 223-231. <https://doi.org/10.1377/hlthaff.2012.1133>
- Cook, W. L., & Kenny, D. A. (2005). The actor-partner interdependence model: A model of bidirectional effects in developmental studies. *International Journal of Behavioral Development*, 29(2), 101-109. <https://doi.org/10.1080/01650250444000405>
- De Medeiros, K. (2016). *The short guide to aging and gerontology*. Bristol, UK: Policy Press.
- Di Castelnuovo, A., Quacquarello, G., Donati, M. B., De Gaetano, G., & Iacoviello, L. (2008). Spousal concordance for major coronary risk factors: a systematic review and meta-analysis. *American Journal of Epidemiology*, 169(1), 1-8. <https://doi.org/10.1093/aje/kwn234>
- Díaz-Venegas, C., Reistetter, T. A., & Wong, R. (2016). Differences in the progression of disability: A US-Mexico comparison. *The Journals of Gerontology: Series B*, 73(5), 913-922. DOI: 10.1093/geronb/gbw082

- Dufouil, C., & Alperovitch, A. (2000). Couple similarities for cognitive functions and psychological health. *Journal of Clinical Epidemiology*, *53*(6), 589-593. doi: 10.1016/s0895-4356(99)00189-4
- Enders, C. K. (2001a). The impact of nonnormality on full information maximum-likelihood estimation for structural equation models with missing data. *Psychological Methods*, *6*(4), 352. <https://doi.org/10.1037/1082-989X.6.4.352>
- Enders, C. K. (2001b). The performance of the full information maximum likelihood estimator in multiple regression models with missing data. *Educational and Psychological Measurement*, *61*(5), 713-740. doi 10.1177/00131640121971482
- Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, *8*(3), 430-457. https://doi.org/10.1207/S15328007SEM0803_5
- Ferrer, R. L., Palmer, R., & Burge, S. (2005). The family contribution to health status: a population-level estimate. *The Annals of Family Medicine*, *3*(2), 102-108. DOI: 10.1370/afm.266
- Fiske, A., Wetherell, J. L., & Gatz, M. (2009). Depression in older adults. *Annual Review of Clinical Psychology*, *5*, 363-389. <https://doi.org/10.1146/annurev.clinpsy.032408.153621>
- Grant, J. D., Heath, A. C., Bucholz, K. K., Madden, P. A., Agrawal, A., Statham, D. J., & Martin, N. G. (2007). Spousal concordance for alcohol dependence: evidence for assortative mating or spousal interaction effects? *Alcoholism: Clinical and Experimental Research*, *31*(5), 717-728. doi: 10.1111/j.1530-0277.2007.00356.x
- Hasler, B. P., & Troxel, W. M. (2010). Couples' nighttime sleep efficiency and concordance: Evidence for bidirectional associations with daytime relationship functioning. *Psychosomatic Medicine*, *72*(8), 794. doi: 10.1097/PSY.0b013e3181ecd08a
- Homish, G. G., & Leonard, K. E. (2008). Spousal influence on general health behaviors in a community sample. *American Journal of Health Behavior*, *32*(6), 754-763. doi: 10.5555/ajhb.2008.32.6.754
- Huijts, T., Monden, C. W., & Kraaykamp, G. (2009). Education, educational heterogamy, and self-assessed health in Europe: a multilevel study of spousal effects in 29 European countries. *European Sociological Review*, *26*(3), 261-276. <https://doi.org/10.1093/esr/jcp019>
- Jackson, J. S. (2002). Conceptual and methodological linkages in cross-cultural groups and cross-national aging research. *Journal of Social Issues*, *58*(4), 825-835. <https://doi.org/10.1111/1540-4560.00292>
- Jurj, A. L., Wen, W., Li, H.-L., Zheng, W., Yang, G., Xiang, Y.-B., Yu-Tang, G., & Shu, X.-O. (2006). Spousal correlations for lifestyle factors and selected diseases in Chinese couples. *Annals of Epidemiology*, *16*(4), 285-291. DOI: 10.1016/j.annepidem.2005.07.060

- Kendler, K. S., Lönn, S. L., Salvatore, J., Sundquist, J., & Sundquist, K. (2018). The origin of spousal resemblance for alcohol use disorder. *JAMA Psychiatry*, *75*(3), 280-286. doi:10.1001/jamapsychiatry.2017.4457
- Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). Analyzing mixed independent variables: Chapter 7: The actor-partner interdependence model. *Dyadic data analysis*. New York: Guilford Press.
- Kiecolt-Glaser, J. K., & Wilson, S. J. (2017). Lovesick: How couples' relationships influence health. *Annual Review of Clinical Psychology*, *13*, 421-443. doi: 10.1146/annurev-clinpsy-032816-045111
- Lee, S., Martire, L. M., Damaske, S. A., Mogle, J. A., Zhaoyang, R., Almeida, D. M., & Buxton, O. M. (2018). Covariation in couples' nightly sleep and gender differences. *Sleep Health*, *4*(2), 201-208. DOI: 10.1016/j.sleh.2017.10.009
- Lijphart, A. (1975). II. The comparable-cases strategy in comparative research. *Comparative Political Studies*, *8*(2), 158-177. <https://doi.org/10.1177/001041407500800203>
- Machado, M. P. A., Opaleye, D. C., Pereira, T. V., Padilla, I., Noto, A. R., Prince, M., & Ferri, C. P. (2017). Alcohol and tobacco consumption concordance and its correlates in older couples in Latin America. *Geriatrics & Gerontology International*, *17*(11), 1849-1857. <https://doi.org/10.1111/ggi.12974>
- Meyler, D., Stimpson, J. P., & Peek, M. K. (2007). Health concordance within couples: a systematic review. *Social Science & Medicine*, *64*(11), 2297-2310. doi: 10.1016/j.socscimed.2007.02.007.
- Monden, C. (2007). Partners in health? Exploring resemblance in health between partners in married and cohabiting couples. *Sociology of Health & Illness*, *29*(3), 391-411. DOI:10.1111/J.1467-9566.2007.01003.X
- Nordsletten, A. E., Larsson, H., Crowley, J. J., Almqvist, C., Lichtenstein, P., & Mataix-Cols, D. (2016). Patterns of nonrandom mating within and across 11 major psychiatric disorders. *JAMA Psychiatry*, *73*(4), 354-361. DOI: 10.1001/jamapsychiatry.2015.3192
- Roberts, M. E., Banse, R., Ebbeler, C., & Ferketich, A. K. (2017). Spousal concordance in the use of alternative tobacco products: A multi-country investigation. *Drug & Alcohol Dependence*, *171*, 16-19. DOI: 10.1016/j.drugalcdep.2016.11.017
- Ross, C. E., Mirowsky, J., & Goldsteen, K. (1990). The impact of the family on health: The decade in review. *Journal of Marriage and Family*, *52*(4), 1059. doi 10.2307/353319
- Rosseel, Y., Oberski, D., Byrnes, J., Vanbrabant, L., Savalei, V., Merkle, E Hallquist M, Rhemtulla M, Katsikatsou M, Barendse M, Chow M. (2017). Package 'lavaan'. Retrieved June, 17, 2017.

- Ruthig, J. C., Trisko, J., & Stewart, T. L. (2012). The Impact of Spouse's Health and Well-Being on Own Well-Being: A Dyadic Study of Older Married Couples. *Journal of Social and Clinical Psychology, 31*(5), 508-529. DOI: 10.1521/jscp.2012.31.5.508
- Sallis, J. F., Owen, N., & Fisher, E. (2015). Ecological models of health behavior. *Health behavior: Theory, research, and practice*, Chapter 20, pp 465-486, New York: Wiley.
- Siegel, M. J., Bradley, E. H., Gallo, W. T., & Kasl, S. V. (2004). The effect of spousal mental and physical health on husbands' and wives' depressive symptoms, among older adults: longitudinal evidence from the health and retirement survey. *Journal of Aging and Health, 16*(3), 398-425. doi: 10.1177/0898264304264208.
- Smith, K. R., & Zick, C. D. (1994). Linked lives, dependent demise? Survival analysis of husbands and wives. *Demography, 31*(1), 81-93. doi 10.2307/2061909
- Stimpson, J. P., Masel, M. C., Rudkin, L., & Peek, M. K. (2006). Shared health behaviors among older Mexican American spouses. *American Journal of Health Behavior, 30*(5), 495-502. doi: 10.5555/ajhb.2006.30.5.495.
- Stimpson, J. P., Peek, M. K., & Markides, K. S. (2006). Depression and mental health among older Mexican American spouses. *Aging & Mental Health, 10*(4), 386-393. <https://doi.org/10.1080/13607860500410060>
- Townsend, A. L., Miller, B., & Guo, S. (2001). Depressive symptomatology in middle-aged and older married couples: A dyadic analysis. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 56*(6), S352-S364. doi: 10.1093/geronb/56.6.s352
- Treur, J. L., Vink, J. M., Boomsma, D. I., & Middeldorp, C. M. (2015). Spousal resemblance for smoking: Underlying mechanisms and effects of cohort and age. *Drug & Alcohol Dependence, 153*, 221-228. <https://doi.org/10.1016/j.drugalcdep.2015.05.018>
- Uchida, Y., Kitayama, S., Mesquita, B., Reyes, J. A. S., & Morling, B. (2008). Is perceived emotional support beneficial? Well-being and health in independent and interdependent cultures. *Personality and Social Psychology Bulletin, 34*(6), 741-754. doi: 10.1177/0146167208315157
- Waite, L. J. (1995). Does marriage matter? *Demography, 32*(4), 483-507. doi 10.2307/2061670
- Walker, R. B., & Luszcz, M. A. (2009). The health and relationship dynamics of late-life couples: A systematic review of the literature. *Ageing & Society, 29*(3), 455-480. <https://doi.org/10.1017/S0144686X08007903>
- Wang, Z., Ji, W., Song, Y., Li, J., Shen, Y., Zheng, H., & Ding, Y. (2017). Spousal concordance for hypertension: A meta-analysis of observational studies. *The Journal of Clinical Hypertension, 19*(11), 1088-1095. DOI: 10.1111/jch.13084

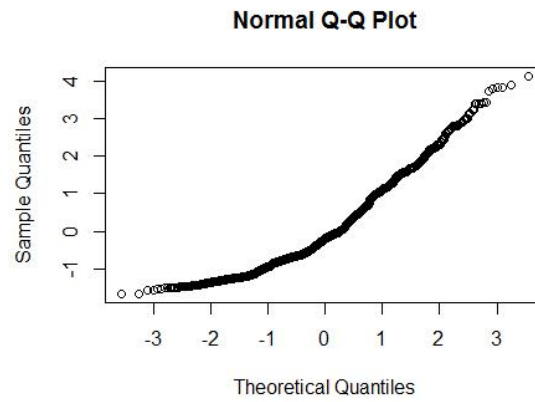
Wilson, S. E. (2002). The health capital of families: an investigation of the inter-spousal correlation in health status. *Social Science & Medicine*, 55(7), 1157-1172. doi: 10.1016/s0277-9536(01)00253-2

Xu, A., & Xia, Y. (2014). The changes in mainland Chinese families during the social transition: a critical analysis. *Journal of Comparative Family Studies*, 45(1), 31-53. DOI: 10.3138/jcfs.45.1.31

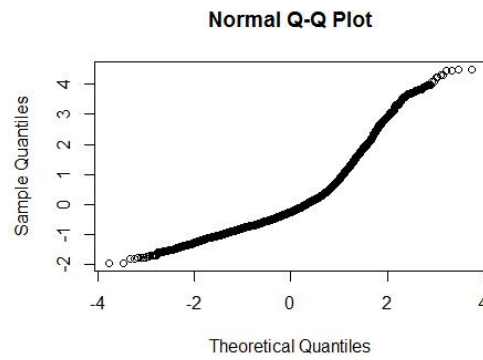
Appendices 2: Supplemental tables and figures

Supplemental Table 6 Linear regression models of depression concordance predicted by couple-level measures

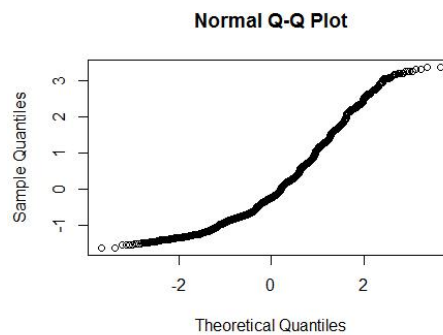
	China	US	Mexico	England
Intercept	76.36***	56.68***	53.60**	24.80
Average age between couples	-0.80**	-0.81***	-0.25	0.54
Average Self-rated health between couples	13.00***	30.59***	15.51***	22.84***
Number of living children	0.43	0.74	1.35**	-2.83*
Household income				
5,001~7,000	10.13*	-38.38*	5.46	-99.13*
7,001~10,000	-4.90	-17.19	9.00	-89.22
10,001~20,000	-4.84	-11.73	7.43	-68.42**
>=20,001	-8.93	-18.16	-6.33	-48.09*
Education attainment of couples	11.61*	-2.06	-1.49	-5.17*
Number of people are working	-0.47	-4.64**	0.01	-1.41
Number of pensions the couples have	-0.05	-0.88	-3.20	-3.17
Number of medical insurance policies the couples have	1.37	-0.94	-1.36	-2.41
<i>p</i> -value	<0.001	<0.001	<0.001	<0.001
Adjusted R^2	0.026	0.119	0.020	0.102



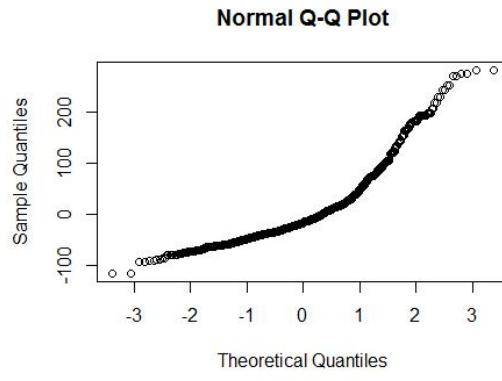
Supplemental Figure 1 Q-Q plot for studentized residuals of linear regression for China



Supplemental Figure 2 Q-Q plot for studentized residuals of linear regression for US



Supplemental Figure 3 Q-Q plot for studentized residuals of linear regression for Mexico



Supplemental Figure 4 Q-Q plot for studentized residuals of linear regression for England

CHAPTER 4. DIS/ADVANTAGE AND HEALTH IN LATE LIFE: A COMPARISON BETWEEN FOUR COUNTRIES

Peiyi Lu

Graduate Student in Gerontology Program, Iowa State University

Mack Shelley

University Professor, Department of Political Science, Statistics, School of Education, Iowa State University

Modified from a manuscript published in *Social Work in Public Health*

Abstract

Cumulative Dis/Advantage (CDA) theory concerns how societal structure influences the individual's developmental and health process across the life span, but few studies have applied CDA in the international setting with gender comparisons. This study provides a cross-national perspective to apply CDA in explaining health inequality between developing and developed countries in the context of welfare state theory. Cross-sectional harmonized data from the international Health Retirement Study-series (United States, China, Mexico, and England) in 2013-2014 were used ($N=97,978$). Four health indicators were included: self-reported health, depressive symptoms, functional ability, and memory. Sociodemographic information and health behaviors were used as covariates. Regression models were fitted to examine the moderation roles of country and gender in the relationship between age and health. Older Chinese and Mexican respondents had poorer health status than their British and American counterparts consistently except for Mexicans' memory. Cumulative health gaps between developing and developed countries existed only for functional ability. Women in all four countries had poorer health than their men counterparts except for memory. There is no evidence of a widening gap in health status between genders in late life. CDA explains only the increasing gaps of functional

ability across age groups between developing and developed countries. Health inequality between countries could be attributed to the limited availability of healthcare resources and different welfare regimes. However, general health and mental health depend more on individuals' intrinsic capacity and human agency.

Introduction

Cumulative Dis/Advantage (CDA) theory is a commonly used theory in social gerontology research and has been widely applied to research on heterogeneity and inequality issues among older adults (Dannefer, 2003, 2018). Yet, research efforts have been inadequate in exploring the applicability of CDA to studies of health disparities across the life span in the international setting and across gender (Corna, 2013; Pavalko & Caputo, 2013). Welfare state theory is another popular theory applicable to explaining how the structural design of political regimes shapes individuals' social and health status via the availability and accessibility of resources and opportunities (Corna, 2013). This study explores the relationships of age and various health indicators among older adults living in four countries (China, the United States [U.S.], Mexico, and England) across their late life span, assesses gender differences, and discusses how the systemic health resource disparities between developing and developed countries may influence individuals' health status by applying both CDA and welfare state theories. Results contribute to the CDA-related research by adding evidence about cross-national and between-gender comparisons, and address the feasibility of exploring macro-level processes of CDA by combining it with welfare state theory.

Theories: CDA and Welfare State

Originated from the perspective of structural-functionalism in sociology, CDA was developed to explain how inequality between various demographic groups is generated across their life span (Dannefer, 2003). The reason could be at the individual level, such as

disadvantaged socioeconomic status (SES) and adverse experiences in childhood. The adversity in early life subsequently changes people's perception of the past and the present, diminishes their intrinsic capacity, and consequently determines individuals' trajectories in late life (Ferraro & Shippee, 2009). CDA also emphasizes the influence of societal environment on individuals. Systemic factors such as neighborhood context and social disparities due to demographic and developmental processes also play a decisive role and contribute to interpersonal heterogeneity in late life (Dannefer, 2003; Ferraro & Shippee, 2009). However, some protective factors such as human agency, sense of control or mastery, social support, and resource mobilization can counteract the cumulative adversity (Ferraro & Shippee, 2009; Hatch, 2005). Currently, most CDA application research is concerned with health and income inequality between various population groups (Dannefer, 2003; Ferraro & Shippee, 2009), but most of these applications have been focused on individual-level factors, especially early childhood adversity (Dannefer, 2018). Disentangling the relationship between CDA and health beyond the individual level remains a major need to determine how systemic inequalities interact with individual health (Dannefer, 2018).

Welfare state theory is a popular theory in social welfare research. Based on the role of family, market, and state in providing benefits and welfare, the theory divides countries into three regimes: liberal, social democratic, and corporatist (Corna, 2013; Esping-Andersen, 2013). As the theory developed, the division of welfare regimes derived more types (Arts & Gelissen, 2002). Welfare state theory has been commonly used in comparative research and more recently applied to explain the health inequality between countries (Bambra et al., 2009; Eikemo et al., 2008; Mackenbach, 2012). It is argued that the health inequality between different demographic groups is partly attributed to their unequal accessibility to both material and immaterial resources

(Mackenbach, 2012). Therefore, welfare state theory and CDA share the same theoretical focus about how people are shaped by societal context. In fact, life course perspective has been used to explain health inequality in generous welfare arrangement regimes (Mackenbach, 2012). Thus, the combination of two theories could help direct this study to explore the health inequality between developing and developed countries.

Based on the CDA and welfare state theories, this article assumes that the welfare state not only frames the economic status of individuals, but also mediates individuals' health via government transfer payments and healthcare resources distribution (Levecque et al., 2011). That is, individuals and families are restricted by the resources and opportunities provided by their surrounding environment; and the institutional or structural context shape their health status across the life span (Corna, 2013). Logically, individuals living in developing and developed countries would demonstrate health inequality across their life span because of the cumulative gaps in accessibility to social and healthcare resources.

Cross-National Comparison in Health Patterns

Despite previous studies that have explored the relationship between macro-level country characteristics and individuals' health (e.g., Theou et al., 2013), few studies have compared health patterns across different age groups between countries. Some studies have showed strong evidence regarding health inequality between countries. For example, Sousa et al. (2014) illustrated lower physical performance among older adults in Colombia, Brazil, and Albania than their Canadian counterparts even after adjusting for early childhood adversity. Cullati et al.'s (2014) systematic review implied a heterogeneous effect of gender in the health trajectories between European and North American countries. However, the above-mentioned studies did not explore health patterns in late life nor included comparisons to Asian countries.

Differential interpersonal health status in different countries could be explained partially by the societal environments in which individuals are embedded (i.e., the welfare states' different regimes). For examples, McDonough et al. (2015) found that welfare systems contributed to explaining the cumulative health disparities in middle-aged women's health trajectory in the U.S. and Great Britain. Tsakloglou and Papadopoulos (2002) also indicated that the differential relationship between social exclusion and cumulative disadvantages in Europe depends on the country and whether it had rudimentary or liberal welfare regimes. Together, the CDA and welfare state theories suggest that in a more equalized and resourceful welfare state residents should enjoy optimal health trajectories, with their physical function remaining high across the majority of their life span and not declining rapidly until the very end of life (World Health Organization [WHO], 2015).

The present study compares two developing countries and two developed countries. The four countries were chosen primarily based on their different extent of economic development and geographic location across the globe (Lijphart, 1975). Table 13 shows comparable health-related statistics in the four countries retrieved from the World Health Statistics Yearbook (WHO, 2014). All four countries had high coverage rates in basic health service, especially in vaccination of infants. However, the two developed countries had much greater density in health facilities and professionals compared to the two developing countries. The U.S. and United Kingdom (UK) also had higher amount of health expenditure than China and Mexico. In the context of such great differences in resource availability, this study hypothesizes that there would be health inequality between developing and developed countries.

Previous studies have indicated that the applicability of CDA was mixed in different countries. Leopold (2016) and van Kippersluis et al. (2010) suggested their findings of the

relationship between SES and health trajectory in the Netherlands and Sweden were consistent with those in the U.S., extending the applicability of CDA in egalitarian North European countries. Another study, however, suggested opposite findings in the relationship between SES and health disparities among Chinese compared to American respondents (Chen, Yang, & Liu, 2010). The inapplicability of CDA in China could be attributed to the unique sociopolitical setting in that country, such as lifestyle choices, being in an early stage of an epidemiology transition, and power of the state (Chen et al., 2010). The inconsistent indications from these studies may arise because the results are from a single-country context without conducting cross-national comparisons using data measured by the same instruments and collected in the same period, which reduced the comparability of their results.

Table 13 Comparison of Health Resources in Four Countries in 2012-2013

	China	U.S.	Mexico	UK
<i>Health service coverage (%)</i>				
contraceptive prevalence	85	76	71	84
immunization coverage among 1 year-olds (measles)	99	92	99	93
immunization coverage among 1 year-olds (DTP3)	99	95	99	97
case-detection rate for all forms of tuberculosis	89	87	75	88
smear-positive tuberculosis treatment-success rate	95	84	80	80
<i>health system (per 10,000 population)</i>				
Physicians	14.6	24.5	21	27.9
Psychiatrists	0.1	0.8	0.2	1.5
hospital beds	38	29	15	29
psychiatric beds	1.4	3.4	0.4	5
radiotherapy units per million	1.1	12.4	0.5	5
<i>Health expenditure</i>				
total expenditure on health as % of GDP	5.4	17	6.1	9.3

Table 13 continued

	China	U.S.	Mexico	UK
total government expenditure on health as % of total expenditure on health	56	47	51.8	84
private expenditure on health as % of total expenditure on health	44	53	48.2	16
general government expenditure on health as % of total government expenditure	12.5	20	15.8	16.2
out-of-pocket expenditure as % of private expenditure on health	78	22.4	91.5	56.4
private prepaid plans as % of private expenditure on health	7	63.7	8.5	17.1
per capita total expenditure on health at average exchange rate	322	8845	618	3595
per capita total expenditure on health	578	8845	1062	3235
per capita government expenditure on health at average exchange rate	180	4153	320	3019
per capita government expenditure on health	323	4153	550	2716

Source: World Health Statistics Yearbook: https://www.who.int/gho/publications/world_health_statistics/en/

Socioeconomic Status and Health

A substantial amount of literature has studied the relationship between SES and health over individuals' life span. In particular, many of the extant research has discussed how early childhood adversity, education, wealth, and ethnicity interacted with people's health and development. Adversity in early life experience or childhood with scarce resources (e.g., parents' lower SES, educational disadvantages in youth) was associated with worse health outcomes. The correlated health outcomes included poorer physical and cognitive function, among other deficits (e.g., Walsemann, Geronimus, & Gee, 2008). However, protective factors, such as upward mobility in adulthood, could alleviate the cumulative adverse effect (Turrell et al., 2002).

Among various SES indicators, education and income have been studied most extensively. Previous studies have consistently found widening health disparities between groups with higher education/income and with lower education/income (e.g., Walsemann et al., 2008). The divergence of health between age groups with different education/income was found in many health dimensions, including physical function (Leopold & Engelhardt, 2013), mental health (Kahn & Pearlin, 2006), and cognitive function (Turrell et al., 2002), implying the rising importance of education attainment in late life (Mirowsky & Ross, 2008).

The role of gender is scarcer in CDA empirical research (Corna, 2013; Pavalko & Caputo, 2013). McDonough et al. (2015) suggested the gendered division of labor and marriage in current societal context could bring more disadvantages to women throughout their life. The unequal role of women in marriage, employment, and caregiving shapes women's health outcomes in middle and late life (McDonough et al., 2015). However, there is insufficient research in comparing gender differences in health across the life span (Pavalko & Caputo, 2013). To fill the research gap, this study explores the interaction effect of gender in health patterns across age groups in late life.

Research Objectives

Based on the literature review, there are several gaps in existing research. First, most studies were focused on the relationship of education, income/wealth, race, and early adversity with an individual's health trajectory. The role of gender is ambiguous and under-explored (Corna, 2013; Pavalko & Caputo, 2013). Second, many studies were concerned with a unidimensional health indicator, such as physical health or cognitive function (e.g., Leopold & Engelhardt, 2013). There is room to compare the different dimensions of health. Third, most previous studies were conducted either in a single country or focused primarily on Western

countries (e.g., Levecque et al., 2011). There is also inadequate discussion of how the macro-level environment shapes individual health in different welfare state regimes.

This study strived to compare age differences of health outcomes in late life in China, the U.S., Mexico, and England. Driven by both CDA and welfare state theories, it is hypothesized that with few resources and unequal accessibility, disadvantages may accumulate during an individual's life span and generate greater interindividual disparities in late life. In other words, when comparing health patterns across different age groups, health inequality would become greater in later life as the disadvantages accumulate. The study also explored gender differences in the applicability of CDA and expanded the comparison to four dimensions of health indicators: self-reported health, depressive symptoms, functional ability, and memory. Considering the social roles imposed on women, it is hypothesized that women will experience more health inequality with age compared to their men counterparts. Results could expand the empirical research of CDA by adding cross-national and gender comparisons and contribute to the utility of combining CDA and welfare state theories to explain national variations in health inequality.

Methods

Data

Harmonized data from the international family of Health and Retirement Study (HRS) datasets were used. Harmonized datasets were provided by the Program on Global Aging, Health, and Policy at the University of Southern California. The program, also known as Gateway to Global Aging Data, harmonized the coding of HRS-series studies across nations and survey waves, to facilitate cross-national comparative study. Two developing countries (China and Mexico) and two developed countries (U.S. and England) were chosen based on their extent of economic development and their locations in different continents.

At the time the authors retrieved the data in January 2019, the longitudinal harmonized datasets for these four countries were not available. Thus, the latest cross-sectional data for 2013-2014 were used. Data came from the RAND HRS, the China Health and Retirement Longitudinal Study (CHARLS), the Mexican Health and Aging Study (MHAS), and the English Longitudinal Study on Ageing (ELSA). There were 18,612 respondents in China, 20,544 respondents in the U.S., 13,704 respondents in Mexico, and 10,601 respondents in England. This study used completely de-identified secondary dataset, so Institutional Review Board approval was not required.

Measures

Table 14 shows the variables used in this study.

Sociodemographic Information

Gender, age, education, marital status, household income, and household size were included as sociodemographic information. Gender had two levels: female and male. Age was recoded as an ordinal variable with 5-year intervals. Marital status had two levels: married/long-term partnered and with partner. Education was recoded as a binary variable: higher education (tertiary) and relatively lower education (secondary and below). Household income was continuous; to make this variable comparable across countries it was transformed into purchasing power based on the US dollar in 2013. Household size measures the number of people living in the household.

Health and Behavior Indicators

Four health-related indicators were used as covariates in this study. Body Mass Index (BMI) was derived from the body weight (unit: kg) divided by the square of the body height (unit: cm). Another three variables addressed whether older adults were involved in some types of health behaviors. Respondents were asked if they did vigorous physical exercise such as

aerobics, running, or bicycling regularly. Substance use historical and current statuses were also included. Respondents were asked if they used cigarettes/alcohol ever and/or now. Based on their answers, respondents were categorized into the categories of never user, former user, and current user of tobacco and alcohol, separately.

Outcome Variables

There were four outcome variables in this study: general health, depressive symptoms, functional ability, and memory. General health was measured by a single item ranging from poor=1 to excellent=5 and was treated as a continuous variable for the convenience of analysis. Depressive symptom was measured by the Center for Epidemiologic Studies Depression (CESD) Scale. There were different numbers of CESD items in the four countries' questionnaires; to make the variable comparable across countries, the average score implied from previous studies was employed (e.g., Díaz-Venegas et al., 2016). The range of CESD was 0 (no) to 1 (severe), with higher values indicating more severe depressive symptoms.

Functional ability was measured by asking if respondents had difficulties performing some physical activity (e.g., walk several blocks, jog one mile, and sit for two hours). There were 9 items in CHARLS, 10 items in ELSA, and 12 items in MHAS and HRS. Similarly, the average score for each respondent was used to make the scores comparable across countries, with values ranging from 0 (many difficulties) to 1 (no difficulties) and higher values indicating better functional ability. Memory was measured by the extent to which a respondent could recall a list of immediate and delayed words. There were 16 items in MHAS but 20 items in the other three harmonized datasets. Average scores were computed; memory scores ranged from 0 (poor) to 1 (excellent), with higher values indicating better cognitive condition.

Table 14 Variables used in this study

	Type	Coding	Remarks
<i>Demographic variable</i>			
Country	4-level categorical	China; US, Mexico; England	
Age group	8-level categorical	1) <50 2) 51~55 3) 56~60 4) 61~65 5) 66~70 6) 71~75 7) 76~80 8) >80	
Gender	Binary	0=female; 1=male	
Education	Binary	0=lower education; 1=higher education	The education measure in the harmonized dataset used the simplified version of 1997 International Standard Classification of Education (ISCED-97) codes: 1=Less than lower secondary education, 2=Upper secondary and vocational training, and 3=Tertiary education. Education was re-categorized into two levels: higher education (tertiary) and relatively lower education (secondary and below.
Marital status	binary	0=without partner; 1= with partner	<ul style="list-style-type: none"> with partner (“married”, “partnered”) without partner: (“married, spouse absent,” “separated,” “divorced,” “separated/divorced,” “widowed,” and “never married”)
Household income	continuous		Transformed into purchasing power to make it comparable across countries
Household size	continuous	number of people living in the household	
<i>Health behavior covariate</i>			
BMI	continuous	body weight (unit: kg) divided by the square of the body height (unit: cm)	
Physical exercise	binary	0=no; 1=yes	
Smoking status	3-level categorical	never user; former user; current user	Recoded from the history and current status of smoking behavior

Table 14 continued

	Type	Coding	Remarks
Drinking status	3-level categorical	never user; former user; current user	Recoded from the history and current status of drinking behavior
<i>Dependent variable</i>			
Self-reported health	continuous	1=excellent; 2=very good; 3=good; 4=fair; 5=poor	This variable is technically an ordinal variable. For the convenience of analysis, self-reported health was treated as a continuous variable. Treating it as a continuous or an ordinal variable only slightly changed the degree of freedom in the model but did not affect the key findings of this study.
Depressive symptoms	continuous	average score of CESD scores, ranging from 0 to 1	Higher value means more depressive symptoms, which is a worse mental health outcome.
Functional ability	continuous	average score ranging from 0 to 1	It was measured by asking if respondents had difficulties performing some physical activity (e.g., walk several blocks, jog one mile, sit for two hours). There were 9 items in CHARLS, 10 items in ELSA, and 12 items in MHAS and HRS.
Memory	continuous	average score ranging from 0 to 1	It was measured by the extent to which a respondent could recall a list of immediate and delayed words. There were 16 items in MHAS but 20 items in the other three harmonized datasets.

Analytical Strategy

Descriptive analysis was conducted to explicate the characteristics of respondents in the four countries. Chi-square and analysis of variance (ANOVA) tests were performed to ascertain if there were significant cross-national differences in descriptive characteristics. Linear regression models were estimated for the four health outcome variables separately. For further gender comparison, the national samples were split based on respondents' sex; and the models were estimated separately. Age groups by country interaction terms were entered into the model to examine their potential moderating roles. It is also possible to fit the regression model with a three way interaction term (i.e., sex*country*age group). Regardless of the statistical method

used in the study, however, key findings such as the pattern of gender- and country-based comparisons should be similar. The individual-level weights in the four surveys were not comparable, so all analyses were unweighted. To illustrate further the moderating role of the country and gender in the relationship between age and health, least square means of age groups within countries were plotted.

Residual plots were examined to check the assumptions underlying the validity of least-squares regression models. As the Supplemental Figures demonstrate, model assumptions were met generally, especially regarding self-reported health (Supplemental Figure 5) and memory (Supplemental Figure 8). The QQ-plots for the models of depressive symptoms (Supplemental Figure 6) and functional ability (Supplemental Figure 7) did not exhibit straight lines, implying the lack of strict normality. However, these results may be acceptable considering the large sample sizes employed in this study.

Another option was to consider the CESD and functional ability measures as count variables because they were essentially counting the amount of depressive symptoms or mobility limitation items. Negative binomial models were used to further remedy the over-dispersion issue. To examine if violating the residual normality assumption in the linear regression severely reduced model robustness, results were compared between the linear regression and negative binomial models. The interpretation of model coefficients is not directly comparable, so the plots were compared using the mean/predicted values estimated from the two models, separately. Supplemental figures show the predicted depressive symptoms (Supplemental Figure 9) and functional ability (Supplemental Figure 10) across age groups estimated by the negative binomial models. Compared to the plots of least squares means estimated by linear regression in the Results section, the trends were very similar. Therefore, the same conclusions can be derived for

depressive symptoms and functional ability using the linear regression and negative binomial models. This study presents the linear regression results to facilitate interpretation because the other two health indicators also used linear regression model results.

All analyses were performed in R using the packages “psych,” “car,” and “lsmeans.” Plots were generated using Microsoft Excel 2010 and “ggplot2.”

Results

Descriptive Characteristics

Table 15 shows the descriptive statistics and frequency results. More women than men responded in each country. A higher proportion of Chinese respondents were aged below 65 due to the relatively low age eligibility in the CHARLS study. The distribution of Mexican respondents was approximately pyramid-shaped. For the U.S. and England, the percentages of older respondents aged above 75 (> 10%) were higher than in China and Mexico. Most (> 60%) respondents were married or long-term partnered in all four countries. In addition, fewer than 10% of older adults had higher education in China and Mexico; 39.82% of Americans and 24.19% of English had attained higher education. The national differences in education attainment were statistically significant ($\chi^2 = 13455, p < 0.001$); the percentage of respondents attaining higher education was significantly greater in developed countries than in developing countries. The median household income was above \$30,000 among both American and British respondents when for Chinese and Mexican respondents it was \$5,142.86 and \$2,303.70, respectively. ANOVA results indicated incomes in the U.S. and England were significantly higher than in China and Mexico ($F = 1802, p < 0.001$). Finally, most Chinese respondents reported three people in their household while most respondents in the other three countries reported two people.

Regarding health-related covariates, the means of BMI in the U.S., Mexico, and England were above 27.0, in the range of overweight ($\text{kg}/\text{m}^2=25-30$). The mean BMI among Chinese respondents (23.86) was significantly lower and fell into the normal range. About 30-50% of respondents in each country reported that they performed physical exercises regularly. The percentage of current alcohol use was highest in England (64.37%), followed by the U.S. and China (both > 34%). About 10-20% of respondents were current tobacco users in each country.

The means of self-reported health in the U.S. (3.10) and England (3.18) were significantly higher than in China (2.17) and Mexico (2.34). The median CESD scores in China and Mexico (> 0.3) were also higher than in the U.S. and England (both 0.12). The majority of respondents in each of the four countries reported very high functional ability (median > 0.9). The means of memory functioning were significantly higher in Mexico (0.58) and England (0.53) than in the U.S. (0.48) and China (0.35). ANOVA results indicated the national differences in four health outcomes were statistically significant ($p < 0.001$).

Table 15 Descriptive and frequency analysis results of respondents in four countries

	China	U.S.	Mexico	England	sig.
<i>Sociodemographic information</i>					
Gender- male <i>N</i> (%)	10148 (48.03)	16424 (43.81)	9300 (43.52)	8163 (45.40)	$\chi^2 = 119.92$ (***)
Age group <i>N</i> (%)					
<50	4409 (24.93)	835 (4.06)	1464 (9.35)	341 (3.22)	$\chi^2 =$ 7881.80
51~55	2944 (16.65)	2891 (14.07)	2409 (15.38)	1054 (9.94)	(***)
56~60	3509 (19.85)	3602 (17.52)	2408 (15.37)	1960 (18.49)	
61~65	2608 (14.75)	2987 (14.53)	2750 (17.56)	2025 (19.10)	
66~70	1750 (9.90)	2180 (10.61)	2409 (15.38)	1683 (15.88)	
71~75	1210 (6.84)	2973 (14.46)	1676 (10.70)	1353 (12.76)	

Table 15 continued

	China	U.S.	Mexico	England	sig.
76~80	734 (4.15)	2285 (11.12)	1287 (8.22)	1069 (10.08)	
>80	518 (2.93)	2801 (13.63)	1261 (8.05)	1116 (10.53)	
Marital Status-partnered <i>N</i> (%)	16211 (87.11)	12868 (62.61)	10941 (69.59)	7594 (71.66)	$\chi^2 = 3084.8$ (***)
Education N- higher education (%)	521 (2.47)	14923 (39.82)	2061 (9.70)	2048 (24.19)	$\chi^2 = 13455$ (***)
Household income median (skewness)	5142.86 (31.28)	39125.64 (10.17)	2303.70 (38.24)	32625.43 (12.85)	$F = 1802$ (***)
Household size median (skewness)	3 (1.06)	2 (2.07)	2 (1.90)	2 (-0.81)	$F = 3817$ (***)
<i>Health and behaviour covariates</i>					
BMI mean (<i>SD</i>)	23.86 (3.83)	28.50 (6.23)	27.49 (5.01)	28.29 (5.26)	$F = 2241$ (***)
Physical exercise yes <i>N</i> (%)	2122 (34.86)	9115 (44.49)	5675 (39.30)	4138 (39.05)	$\chi^2 = 231.36$ (***)
Alcohol use <i>N</i> (%)					$\chi^2 = 9841.3$ (***)
current user	6321 (34.43)	7509 (36.64)	2427 (15.51)	5634 (64.37)	
former user	1934 (10.53)	3435 (16.85)	1074 (6.86)	1942 (22.19)	
never user	10105 (55.04)	9534 (46.52)	12147 (77.63)	1177 (13.45)	
Tobacco use <i>N</i> (%)					$\chi^2 = 6745.7$ (***)
current user	2968 (19.87)	2972 (14.54)	1876 (11.94)	1316 (12.62)	
former user	1359 (9.10)	8492 (41.55)	3884 (24.71)	5165 (49.52)	
never user	10610 (71.03)	8972 (43.90)	9957 (63.35)	3950 (37.87)	
<i>Dependent variables</i>					
Self-reported health mean (<i>SD</i>)	2.17 (0.93)	3.10 (1.10)	2.34 (0.85)	3.18 (1.12)	$F = 2241$ (***)
CESD score median(skewness)	0.40 (0.43)	0.12 (1.51)	0.33 (0.54)	0.12 (1.65)	$F = 3061$ (***)
Functional ability median (skewness)	0.89 (-1.07)	0.92 (-1.20)	0.92 (-0.76)	1.00 (-1.89)	$F = 1202$ (***)
Memory mean(<i>SD</i>)	0.35 (0.18)	0.48 (0.17)	0.58 (0.19)	0.53 (0.19)	$F = 4371$ (***)

Note: The last column shows the significance test results of difference between means (F tests) or proportions (χ^2 tests). *** $p < 0.001$

Table 16 continued

Variables	Model 1		Model 2		Model 3		Model 4	
	(Self-reported Health)		(Depressive symptoms)		(Functional Ability)		(Memory)	
	Female	Male	Female	Male	Female	Male	Female	Male
<i>F</i> (sig.)	223.6	120.4	119	72.14	118.5	70.48	241.4	146.1
overall model	(***)	(***)	(***)	(***)	(***)	(***)	(***)	(***)
Adjusted <i>R</i> ²	0.2929	0.2315	0.1850	0.1574	0.2756	0.2063	0.3167	0.277
								1

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Model results of covariates such as health behavior measures were not shown.

Moderation Role of Country and Gender

Figures 9-12 illustrate the comparison of four health outcomes across various age groups. The overlapping lines between countries and genders indicate interaction effects. The scores for self-reported health and CESD fluctuated slightly across most age groups but maintained within a certain range (Figure 9 and Figure 10), meaning there were no great age group differences in self-reported health and depressive symptoms. However, the score of functional ability and memory decreased as age groups became older (Figure 11 and Figure 12), implying the older respondents reported lower physical and cognitive functions than their younger counterparts.

Cross-national comparison indicated older Chinese and Mexican respondents had poorer health status than their British and American counterparts consistently except for memory in the Mexican data. For the health pattern of functional ability, the age groups difference became greater as the age groups got older for Mexico and China while the lines of the U.S. and England maintained high levels (Figure 10). In other words, the health gaps between developing and developed countries were widening in the pattern of functional ability, but remained consistent in the other three health conditions. Women in the four countries had poorer health than their men

counterparts except for memory status. However, there were no indications that the health gaps between genders were accelerating as age groups became older.

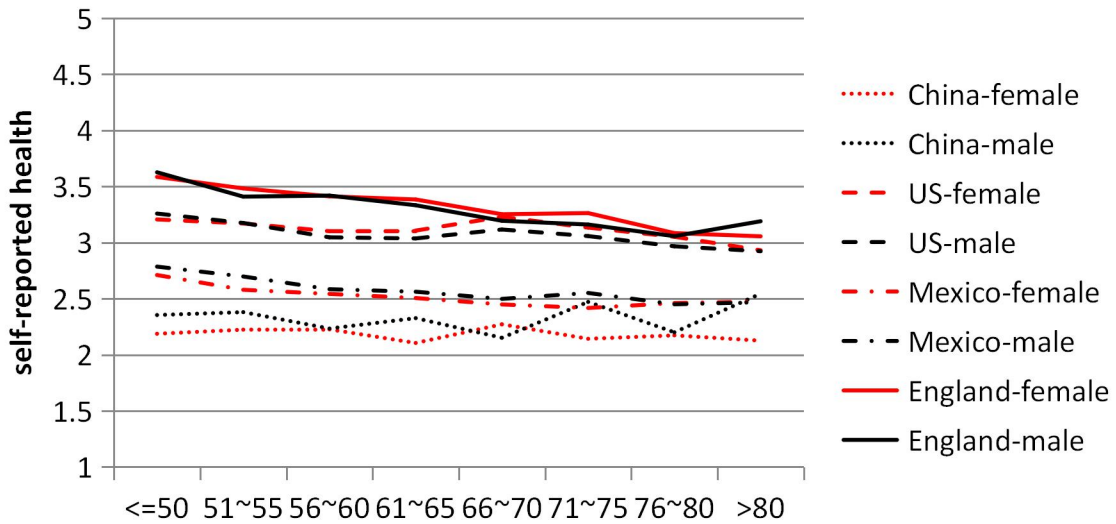


Figure 9 Gender and cross-national comparison on self-reported health across age groups

Note: Higher score indicates better general self-evaluated health.

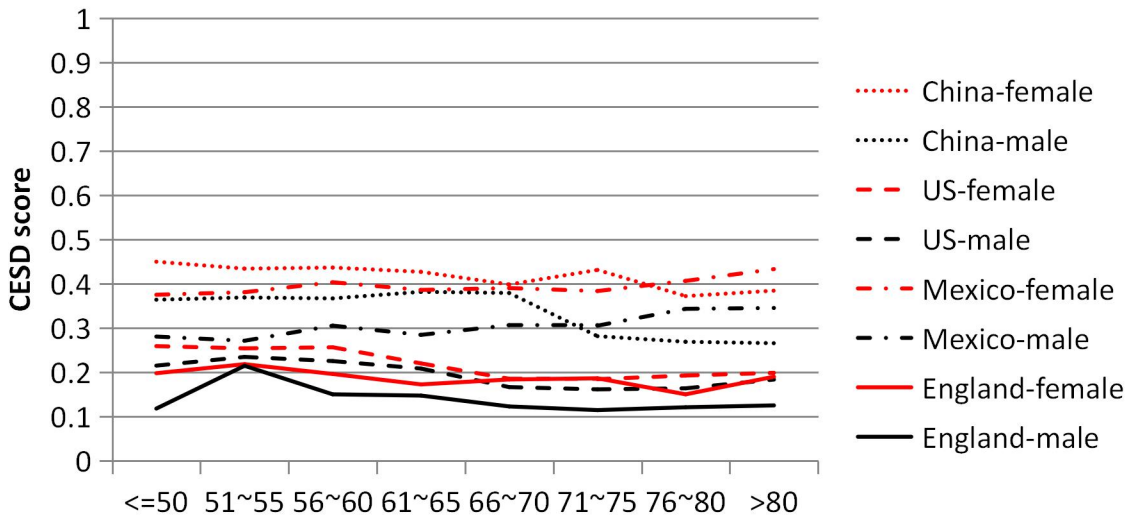


Figure 10 Gender and cross-national comparison on CESD score (depressive symptoms) across age groups.

Note: Higher CESD score indicates higher levels of depressive symptoms.

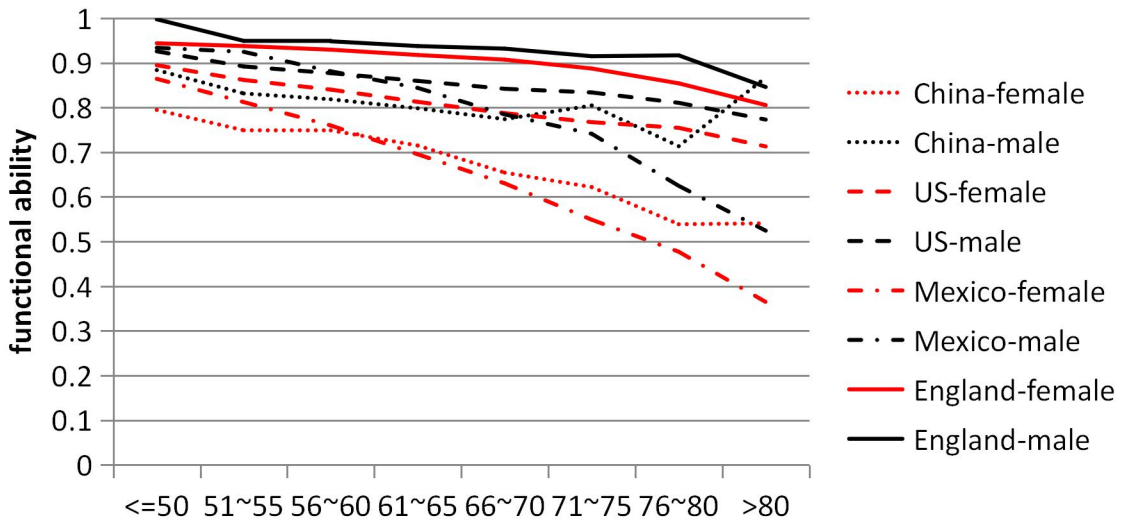


Figure 11 Gender and cross-national comparison on functional ability across age groups

Note. Higher score indicates a higher level of functional ability.

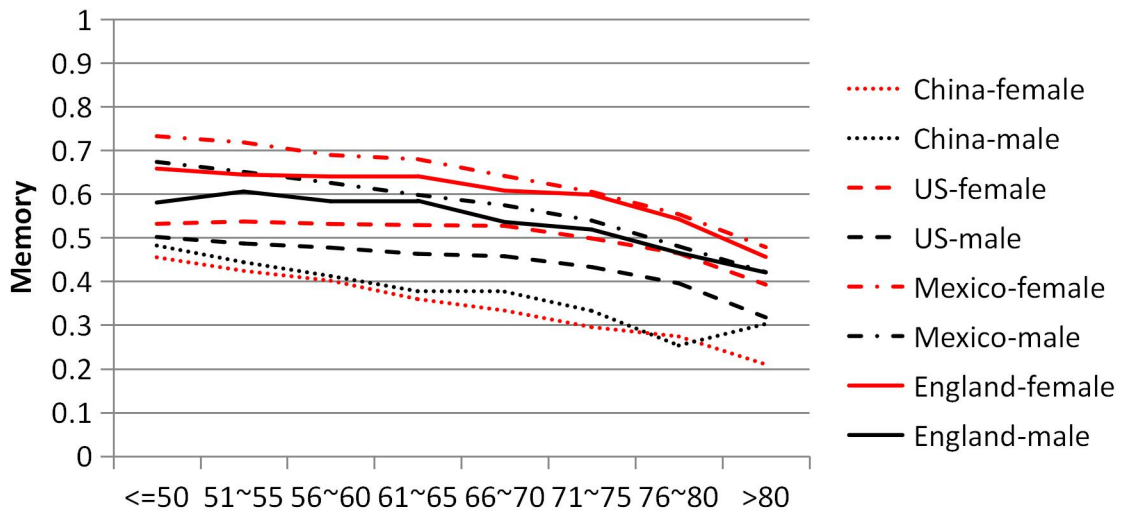


Figure 12 Gender and cross-national comparison on memory functioning across age groups

Note: Higher score indicates a higher level of memory.

Discussion

This study examined age-varying differences in four health outcomes and presented the moderation role of gender and country. First of all, descriptive analysis indicated there were great cross-national differences in the respondents' social and financial status. In particular, Chinese and Mexican respondents were less likely to attain higher education and reported less household income than their American and British counterparts. The descriptive findings implied the disadvantaged SES of people living in developing countries, which was consistent with the macro-level health statistics and research assumption.

Regression model results indicated the relationships between SES indicators and health outcomes were mixed. A positive association of higher education attainment with better health was shown, consistent with most previous studies (e.g., Leopold, 2016; Mirowsky & Ross, 2008). However, the association of income with health was minimal although significant, which could be because the regression model used unstandardized coefficients. One dollar of purchasing power change would not be able to link to great changes in health. Being partnered was associated with better health when a larger household was not. The results imply the importance of a partner rather than adult children or other family members to support older adults' health. Partner is the primary source of support and intimacy to older adults, and the health benefits of marriage continue in later life (Schone & Weinick, 1998).

Engaging in physical exercise, having smaller BMI, and not using tobacco were associated with better health, consistent with literature. The idea that avoiding risky health behavior, including sedentary lifestyle and tobacco consumption, can promote people's health has been well acknowledged in previous studies (e.g., Penedo & Dahn, 2005). Also, considering over half of the respondents in the U.S., Mexico, and England were overweight (Table 15), optimizing BMI would benefit most respondents' health in late life. However, this study did not

find a consistent pattern of the relationship between alcohol consumption and health, which might be attributed to failure to include key covariates. The survey asked only the presence of alcohol consumption but did not measure its frequency, volume, and intensity. There was no doubt that excessive alcohol consumption was associated with negative health outcomes (Room, Babor, & Rehm 2005). The percentage of current alcohol users was very high among British, American, and Chinese older respondents, which should raise the concerns of public health practitioners. However, this study examined only the status of alcohol use and did not concern the volume of alcohol assumption. Future studies should explore in-depth the health effects of alcohol consumption volume rather than the presence/absence of drinking.

Generally, older age groups reported lower functional ability and memory than younger groups; but there were no great age group differences in self-reported health and depressive symptoms. In other words, only cognitive and physical functions fit the declining trajectory in the WHO report if cohort and period effects are not considered (WHO, 2015, p. 44), but general and mental health of older adults were stable. The differential age-varying pattern in four health outcomes implied the flexibility and potential of older adults' self-perception and well-being. General health and mental health depend more on individuals' intrinsic capacity and human agency. Thus, health professionals may want to maximize the resilience of older adults' mental capacity to further stimulate the promotion of older adults' physical and cognitive functions. In the process of aging, timely intervention is needed to alter the age-related declining pattern and help older adults recover at the very early stage of physical and cognitive impairment (WHO, 2015).

Cross-national comparisons showed there was health discrepancy between older adults living in developing and developed countries except for the memory of Mexican respondents.

The cross-national variation partially supported the hypothesis that people living in resourceless areas should have cumulative health risk. The finding was also consistent with the health inequality between countries found in previous studies (e.g., Sousa et al., 2014; WHO, 2015). However, cognitive function in Mexico was an exception even after adjusting for SES, which might be related to the relatively better condition of Mexicans' health behaviors. Of the four countries, Mexico reported the second highest rate of physical exercise and lowest rate of smoking and drinking behaviors, which may consequently reduce the risk of cognition decline (Lee et al., 2010). However, the risks/benefits of health behaviors on other health dimensions are less explicit and less conclusive.

Applicability of CDA and welfare state theories was confounded in different health outcomes. In the pattern of functional ability, the difference between older age groups and younger groups increased for Mexico and China when the functions of U.S. and England maintained high levels (Figure 11), which supported the hypothesis driven by CDA and welfare state. However, the cumulative health gaps between developing and developed countries existed only in the pattern of functional ability but not the other three health indicators. In other words, these three health domains might demonstrate resilience, which indicated the potential for improvement through intervention. In addition, the health of British respondents was always better than that of Americans. Although the U.S. had higher health expenditures than the UK, this finding could be related to the different welfare regimes in the two countries. Based on the clustering of Esping-Andersen (2013), both the U.S. and UK were within the "liberal" type of welfare regime. However, McDonough et al. (2015) suggested the role of government was bigger in the UK. The UK was more egalitarian-structured in transferring benefits through a larger public sector and a publicly-funded healthcare system when compared to the U.S.

Compared to the two developed countries, China and Mexico had fewer resources, but their gaps in health pattern with the U.S. and UK did not widen with age for most health outcomes. This result could be attributed to the recent reformation of their welfare regimes. Traditionally, welfare state theory analyzed only the eighteen developed Organization for Economic Cooperation and Development (OECD) countries and did not include developing countries (Esping-Andersen, 2013). Researchers have developed new types of welfare regimes and added the analysis of developing countries. Gao, Yang, and Li (2013) suggested the social benefit system in urban China resembled developed countries' because of its comprehensive and generous welfare coverage; but the rural system remained a minimal welfare state as in a developing country. Nevertheless, China is evolving to expand and integrate the welfare system in rural and urban areas (Gao, Yang, & Li, 2013).

Similar to China, Mexico is also expanding welfare coverage, which mainly is focused on applying means-test based programs targeting the very poor. The Mexican regime was suggested to be between corporatist and universal systems (Kurtz, 2002). With wider welfare coverage, Mexican and Chinese older adults may face less accumulative disadvantaged health status. However, it is difficult to explain the paradox of Hispanic health outcomes being better later in life. It is similar to the inconclusive scientific mystery of gender difference in health – women usually outlive men, but they generally reported poorer health than men across their life span (De Medeiros, 2016). Hispanics may live longer than non-Hispanic White people, but they often confront more socioeconomic hardship, stress, and health risk (Boen & Hummer, 2019). There is no conclusive explanation for these health paradoxes. Reasons could be various, such as genetic differences, life styles, dietary habits, etc. (De Medeiros, 2016). Further scientific examinations from multidisciplinary efforts are needed to address these controversies.

Women in the four countries reported poorer health than their men counterparts except for memory; however, there is no sign of an increasing gap between genders as age groups got older. The mixed role of gender illustrated the disadvantaged onset of health status of women, which mainly was attributed to unequal role assignment by patriarchal or traditional society. Despite women reporting poorer health than men, they live longer than men (De Medeiros, 2016). In this case, women may demonstrate more intrinsic capacity and resilience in coping with disadvantaged circumstances. More in-depth research may be needed to explore the gender difference in coping with disadvantaged social status and how that could influence their health trajectories.

This study did not examine period and cohort effects. Period effects could not be addressed because this study only used cross-sectional data. Future studies may consider examining period effects when data are available in the harmonized database. In addition, it will be difficult to look at cohort effects in a cross-national study context. For people born in the same cohort, their life experiences vary across countries. For example, older adults born from 1946 to 1964 after World War II, also known as “baby boomers” in the U.S., had country-specific life experiences. Many American baby boomers experienced economic prosperity and the civil rights movement. However, for most Chinese, those born in the same cohort had a materially and politically difficult childhood because of economic under-development and political turmoil (e.g., famine, Cultural Revolution) while witnessing rapid economic development in their adulthood (the economic opening since 1978). In fact, there is no concept of “baby boomer” in China. In addition, older adults in these different countries embrace different cultural values and attitudes, and thus have varying understandings about their life experiences. This circumstance could further widen the gaps separating people in the same

cohorts residing in various countries. Given that cohorts have such different life experiences and cultural understandings within each country, it may not be appropriate to conduct cross-national cohort analysis.

Some suggestions can be drawn for practitioners and policymakers. First, practitioners should focus on education and partnership when connecting older adults' SES with health. Older people with lower education and without a partner may experience more deleterious effects on their health. Second, health promotion could be achieved by encouraging good health behaviors, especially managing weight and doing physical exercise. Third, policymakers should realize how individual health status is shaped by the macro context. The welfare state regimes determine the delivery and coverage of healthcare and social resources, which subsequently frame the ability of individuals to utilize resources. In the context of resources being unequally distributed and marginally available, the health risk of individuals will accumulate and consequently affect their health in later life. Thus, reform of welfare regimes and resource provision is needed.

There are some limitations in this study. First, it was not possible to use longitudinal HRS data due to the unavailability of harmonized datasets across all four countries at the time of data analysis. The cross-national design limited the ability to observe individuals' health trajectory across the life span, but it was possible to approximate the pattern by plotting the comparison between age groups. Second, health measurement in the HRS-series depended heavily on self-report, which might impair the validity of the measurements. Respondents in different cultural contexts could have different interpretations of the same items of a scale. Thus, the comparison of self-reported health measures might not reflect real differences in older adults' health. Third, including the country-level measure of healthcare resources in predicting individuals' health did not result in any significant relationships. Thus, those variables were excluded from the

regression model for the sake of parsimony. Future studies may consider employing more valid or robust health resource indicators and estimate multilevel models. Finally, because this study focused on only two developing and two developed countries, the comparison results may not be generalizable to other countries due to the unique features of healthcare systems and welfare regimes in each country.

Conclusion

Applying CDA and welfare state theories, this study disentangled the role of gender and country in modifying the relationship between age and health in late life. Using data from China, the U.S., Mexico, and England, the age-varying patterns of older adults were compared on four dimensions of health. This study contributed to the empirical evidence and discussion of the applicability of combining CDA and welfare state theory in a macro-level international comparison study. Results indicated older Chinese and Mexican respondents had poorer health status than their British and U.S. counterparts consistently except for Mexicans' memory. Cumulative health gaps between developing and developed countries existed only in functional ability. Women in all four countries had poorer health than their men counterparts except for memory status. There was no sign of a widening health gap between genders across the life span. The results of this analysis lead to the conclusion that CDA explains only the increasing gaps of functional ability across age groups between countries. However, other health status characteristics, including general health and mental health, depend more on individuals' intrinsic capacity and human agency. Health inequality between countries could be attributed to the limited availability of healthcare resources in developing countries. The cross-national variations in health may also depend on welfare regimes. In general, it should be realized that individuals' health is shaped not only by their intrapersonal characteristics but also by interpersonal differences and societal constraints.

References

- Arts, W., & Gelissen, J. (2002). Three worlds of welfare capitalism or more? A state-of-the-art report. *Journal of European Social Policy*, 12(2), 137-158.
<https://doi.org/10.1177/0952872002012002114>
- Bambra, C., Pope, D., Swami, V., Stanistreet, D., Roskam, A., Kunst, A., & Scott-Samuel, A. (2009). Gender, health inequalities and welfare state regimes: a cross-national study of 13 European countries. *Journal of Epidemiology & Community Health*, 63(1), 38-44.
<http://dx.doi.org/10.1136/jech.2007.070292>
- Boen, C. E., & Hummer, R. A. (2019). Longer—but harder—lives?: the Hispanic health paradox and the social determinants of racial, ethnic, and immigrant–native health disparities from midlife through late life. *Journal of Health and Social Behavior*, 60(4), 434-452.
<https://doi.org/10.1177/0022146519884538>
- Chen, F., Yang, Y., & Liu, G. (2010). Social Change and Socioeconomic Disparities in Health over the Life Course in China: A Cohort Analysis. *American Sociological Review*, 75(1), 126-150. <https://doi.org/10.1177/0003122409359165>
- Corna, L. M. (2013). A life course perspective on socioeconomic inequalities in health: A critical review of conceptual frameworks. *Advances in Life Course Research*, 18(2), 150-159.
<https://doi.org/10.1016/j.alcr.2013.01.002>
- Cullati, S., Rousseaux, E., Gabadinho, A., Courvoisier, D. S., & Burton-Jeangros, C. (2014). Factors of change and cumulative factors in self-rated health trajectories: A systematic review. *Advances in Life Course Research*, 19, 14-27.
<https://doi.org/10.1016/j.alcr.2013.11.002>
- Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B*, 58(6), S327-S337.
<https://doi.org/10.1093/geronb/58.6.S327>
- Dannefer, D. (2018). Systemic and Reflexive: Foundations of Cumulative Dis/Advantage and Life-Course Processes. *The Journals of Gerontology: Series B*, 1-15. doi: 10.1093/geronb/gby118
- De Medeiros, K. (2016). *The short guide to aging and gerontology*. Chicago: Policy Press.
- Díaz-Venegas, C., Reistetter, T. A., & Wong, R. (2016). Differences in the progression of disability: A US–Mexico comparison. *The Journals of Gerontology: Series B*, 73(5), 913-922. DOI: 10.1093/geronb/gbw082
- Eikemo, T. A., Bambra, C., Joyce, K., & Dahl, E. (2008). Welfare state regimes and income-related health inequalities: a comparison of 23 European countries. *The European Journal of Public Health*, 18(6), 593-599. DOI: 10.1093/eurpub/ckn092

- Esping-Andersen, G. (2013). *The three worlds of welfare capitalism*. Cambridge, UK: John Wiley & Sons.
- Ferraro, K. F., & Shippee, T. P. (2009). Aging and cumulative inequality: How does inequality get under the skin? *The Gerontologist*, *49*(3), 333-343. doi: 10.1093/geront/gnp034
- Gao, Q., Yang, S., & Li, S. (2013). The Chinese welfare state in transition: 1988–2007. *Journal of Social Policy*, *42*(4), 743-762. <https://doi.org/10.1017/S0047279413000329>
- Hatch, S. L. (2005). Conceptualizing and identifying cumulative adversity and protective resources: Implications for understanding health inequalities. *The Journals of Gerontology Series B*, *60*(Special_Issue_2), S130-S134. https://doi.org/10.1093/geronb/60.Special_Issue_2.S130
- Kahn, J. R., & Fazio, E. M. (2005). Economic status over the life course and racial disparities in health. *The Journals of Gerontology Series B*, *60*(Special_Issue_2), S76-S84. https://doi.org/10.1093/geronb/60.Special_Issue_2.S76
- Kahn, J. R., & Pearlin, L. I. (2006). Financial Strain over the Life Course and Health among Older Adults. *Journal of Health and Social Behavior*, *47*(1), 17-31. DOI: 10.1177/002214650604700102
- Kurtz, M. J. (2002). Understanding the third world welfare state after neoliberalism: The politics of social provision in Chile and Mexico. *Comparative Politics*, 293-313. doi: 10.2307/4146955
- Lee, Y., Back, J. H., Kim, J., Kim, S.-H., Na, D. L., Cheong, H.-K., . . . Kim, Y. G. (2010). Systematic review of health behavioral risks and cognitive health in older adults. *International Psychogeriatrics*, *22*(2), 174-187. DOI: 10.1017/S1041610209991189
- Leopold, L. (2016). Cumulative Advantage in an Egalitarian Country? Socioeconomic Health Disparities over the Life Course in Sweden. *Journal of Health and Social Behavior*, *57*(2), 257-273. <https://doi.org/10.1177/0022146516645926>
- Leopold, L., & Engelhardt, H. (2013). Education and physical health trajectories in old age. Evidence from the Survey of Health, Ageing and Retirement in Europe (SHARE). *International Journal of Public Health*, *58*(1), 23-31. <http://dx.doi.org/10.1007/s00038-013-0453-6>.
- Levecque, K., Van Rossem, R., De Boyser, K., Van de Velde, S., & Bracke, P. (2011). Economic Hardship and Depression across the Life Course: The Impact of Welfare State Regimes. *Journal of Health and Social Behavior*, *52*(2), 262-276. doi: 10.1177/0022146510394861
- Lijphart, A. (1975). II. The comparable-cases strategy in comparative research. *Comparative Political Studies*, *8*(2), 158-177. <https://doi.org/10.1177/001041407500800203>

- Mackenbach, J. P. (2012). The persistence of health inequalities in modern welfare states: the explanation of a paradox. *Social Science & Medicine*, 75(4), 761-769. DOI: 10.1016/j.socscimed.2012.02.031
- McDonough, P., Worts, D., Booker, C., McMunn, A., & Sacker, A. (2015). Cumulative disadvantage, employment–marriage, and health inequalities among American and British mothers. *Advances in Life Course Research*, 25, 49-66. <https://doi.org/10.1016/j.alcr.2015.05.004>
- Mirowsky, J., & Ross, C. E. (2008). Education and Self-Rated Health: Cumulative Advantage and Its Rising Importance. *Research on Aging*, 30(1), 93-122. <https://doi.org/10.1177/0164027507309649>
- Pavalko, E. K., & Caputo, J. (2013). Social Inequality and Health Across the Life Course. *American Behavioral Scientist*, 57(8), 1040-1056. <https://doi.org/10.1177/0002764213487344>
- Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, 18(2), 189-193. doi: 10.1097/00001504-200503000-00013.
- Room, R., Babor, T., & Rehm, J. (2005). Alcohol and public health. *The Lancet*, 365(9458), 519-530. [https://doi.org/10.1016/S0140-6736\(05\)17870-2](https://doi.org/10.1016/S0140-6736(05)17870-2)
- Schone, B. S., & Weinick, R. M. (1998). Health-related behaviors and the benefits of marriage for elderly persons. *The Gerontologist*, 38(5), 618-627. <https://doi.org/10.1093/geront/38.5.618>
- Sousa, A. C. P. d. A., Guerra, R. O., Thanh Tu, M., Phillips, S. P., Guralnik, J. M., & Zunzunegui, M.-V. (2014). Lifecourse adversity and physical performance across countries among men and women aged 65-74. *PloS One*, 9(8), e102299. <https://doi.org/10.1371/journal.pone.0102299>
- Theou, O., Brothers, T. D., Rockwood, M. R., Haardt, D., Mitnitski, A., & Rockwood, K. (2013). Exploring the relationship between national economic indicators and relative fitness and frailty in middle-aged and older Europeans. *Age and Ageing*, 42(5), 614-619. <https://doi.org/10.1093/ageing/aft010>
- Tsakloglou, P., & Papadopoulos, F. (2002). Aggregate level and determining factors of social exclusion in twelve European countries. *Journal of European Social Policy*, 12(3), 211-225. <https://doi.org/10.1177/0952872002012003394>
- Turrell, G., Lynch, J. W., Kaplan, G. A., Everson, S. A., Helkala, E.-L., Kauhanen, J., & Salonen, J. T. (2002). Socioeconomic position across the lifecourse and cognitive function in late middle age. *The Journals of Gerontology: Series B*, 57(1), S43-S51. <https://doi.org/10.1093/geronb/57.1.S43>

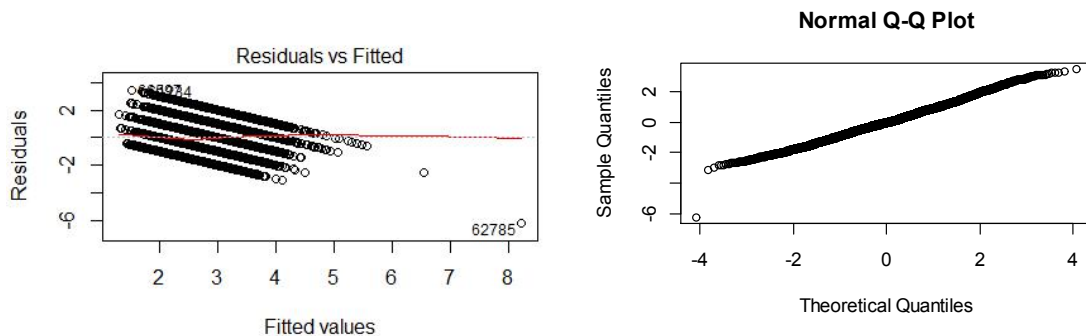
van Kippersluis, H., O'Donnell, O., van Doorslaer, E., & Van Ourti, T. (2010). Socioeconomic differences in health over the life cycle in an Egalitarian country. *Social Science & Medicine*, 70(3), 428-438. <https://doi.org/10.1016/j.socscimed.2009.10.020>

Walsemann, K. M., Geronimus, A. T., & Gee, G. C. (2008). Accumulating disadvantage over the life course: evidence from a longitudinal study investigating the relationship between educational advantage in youth and health in middle age. *Research on Aging*, 30(2), 169-199. <https://doi.org/10.1177/0164027507311149>

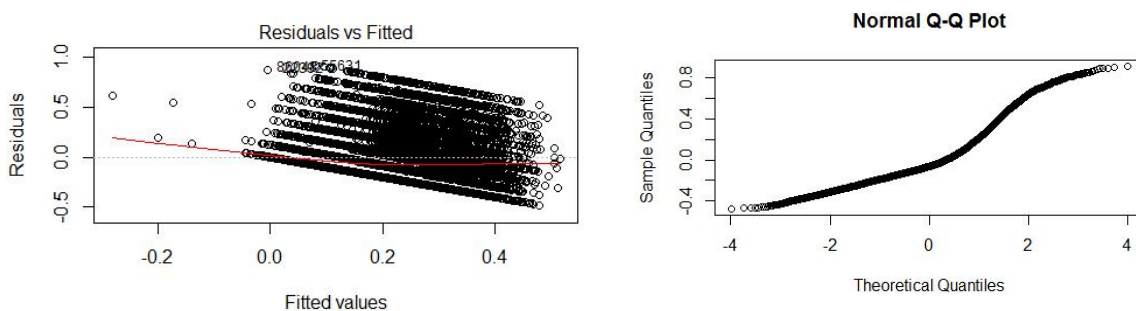
WHO. (2014). World Health Statistics Yearbook: Part II Global health indicators. Retrieved Jan 8, 2019, from https://www.who.int/gho/publications/world_health_statistics/en/

WHO. (2015). World report on ageing and health Retrieved Jan 29, 2019, from <https://www.who.int/ageing/publications/world-report-2015/en/>

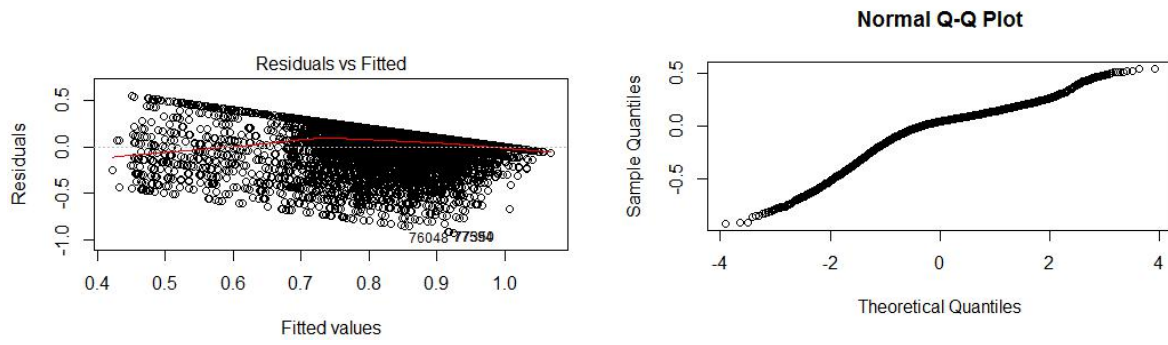
Appendices 3: Supplemental tables and figures



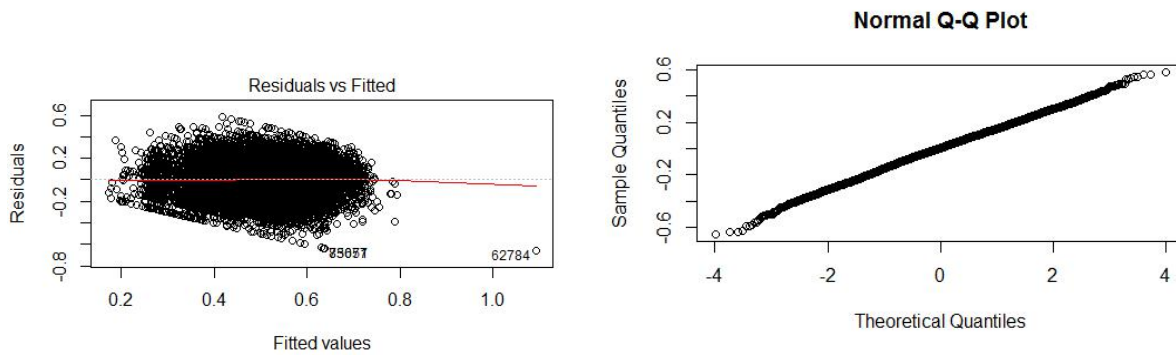
Supplemental Figure 5 Residual plots for linear regression model of males' self-reported health



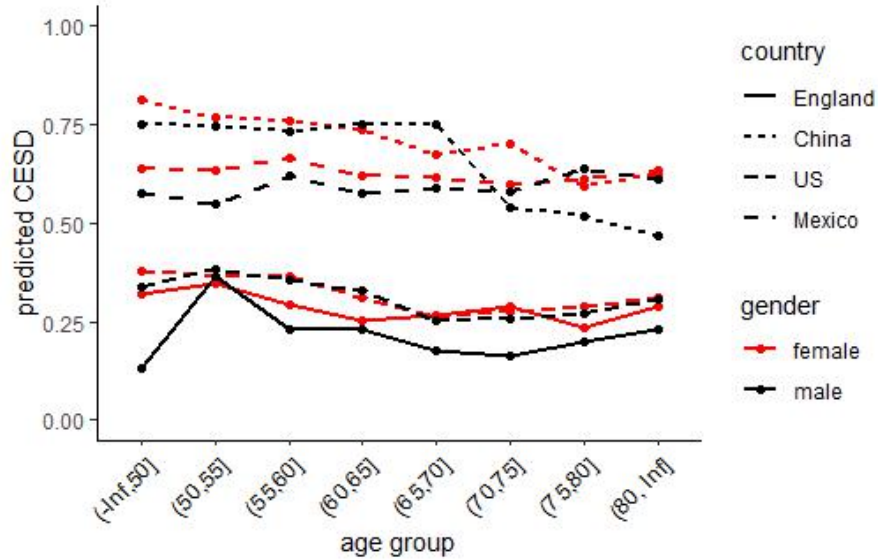
Supplemental Figure 6 Residual plots for linear regression model of males' depressive symptoms



Supplemental Figure 7 Residual plots for linear regression mode of males' functional ability

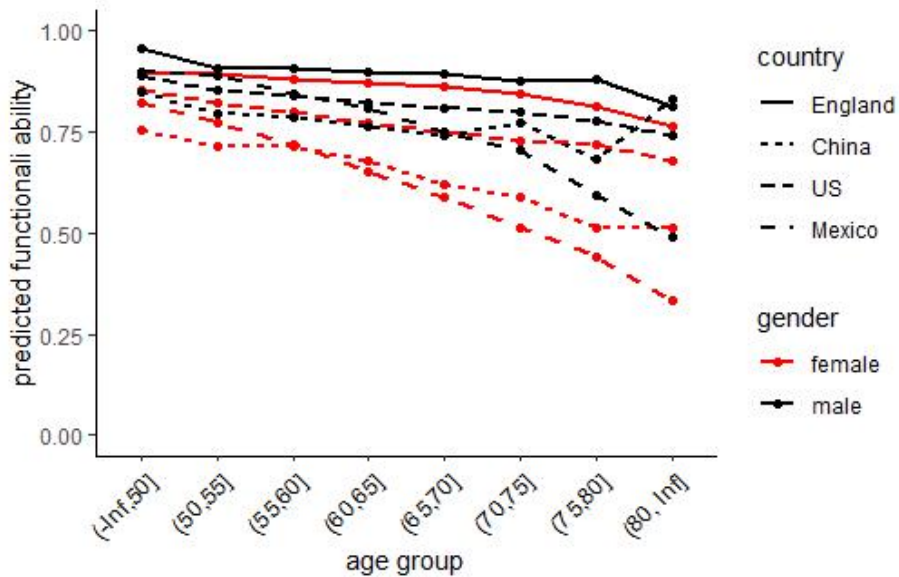


Supplemental Figure 8 Residual plots for linear regression mode of males' memory



Supplemental Figure 9 Gender and cross-national comparison on depressive symptoms across age groups using the negative binomial regression model

Note: The predicted CESD score based on the negative binomial model was adjusted for the covariates in the model. The values are different from the least squares mean of the linear regression model because the covariates were controlled at different values.



Supplemental Figure 10 Gender and cross-national comparison on functional ability across age groups using the Poisson regression model

CHAPTER 5. GENERAL CONCLUSION

Guided by the integrative theoretical framework based on the social ecological model and the life course perspective, this dissertation investigates the social and economic determinants of older adults' health from a cross-national comparison perspective. Specifically, it examines the relationship of social resources with older adults' physical, mental, and cognitive health in China, the United States, England, and Mexico using the Harmonized HRS dataset and its international sister studies. This study has contributed to the empirical evidence of cross-national studies on social determinants of health in gerontological research and expanded knowledge about aging-related experiences in non-Western and developing countries. It also has helped advance the literature on the applicability of aging theories to non-Western contexts. The findings challenged the assumptions that older adults enjoyed sufficient resources in these Anglo-American culture-originated theories and suggested they may not be the case in East Asian and Hispanic cultures. The harmonized dataset and consistent measures with appropriate statistical methods also have provided comparable results and contributed to disentangling some controversial academic arguments. The analysis also has provided some implications for clinical professionals and policy makers to promote healthy aging.

Summary of Findings

Table 17 shows summaries of the three articles in this dissertation. The first article, in Chapter 2, explores the relationship of the status of retirement and types of pensions with depressive symptoms among older adults and examines variation across age groups and countries. Under the assumption that the data are MAR, the FIML approach was used to deal with missing data. Regression models were estimated using SEM. Additional analysis showed that using complete cases and multiple imputation approaches to deal with missing data yield findings

similar to those from the FIML approach. Different scoring methods for the CESD and treating CESD scores as a continuous variable or as count data also achieved similar findings. Results indicated retirement was associated with higher levels of depressive symptoms for the U.S. and with lower levels of depressive symptoms for Mexico and England. Having a public pension was associated with lower levels of depressive symptoms for Mexico and with higher levels of depressive symptoms for the U/S. and China. Having a private pension was associated with lower levels of depressive symptoms for the U.S., China, and England. The cross-national variation in the relationship might be attributed to the availability and accessibility of resources for older adults after retirement, the generosity of their public pensions, the flexibility of private pensions, and the recent pension system reform in each country.

The second article, in Chapter 3, tested the cross-cultural applicability of the shared resource hypothesis in explaining mental health concordance among older couples. Multilevel models and SEM were used to examine the APIM. Both methods achieved similar key findings. Regression was used to test hypotheses using couple-level measures. Results indicated that older adults' depressive symptoms were associated with their own (actor effect) and spouses' (partner effect) social and health status. More household resources (couple effect) were linked to higher health concordance. However, the shared resources hypothesis might be less applicable to Chinese and Mexican older couples but had higher explanatory power among American and British couples. This variation is probably attributed to fewer resources being available to the couples with disadvantaged socioeconomic status in developing countries.

The third project, in Chapter 4, examined health inequalities between genders and countries in the context of cumulative dis/advantage (CDA) and welfare state theories using linear regression models. The residual normality assumption was violated in the models of

depression symptoms and functional ability. However, large sample size justified the choice. Comparison of plots fitted from linear regression and negative binomial models achieved similar health patterns. Results indicated cumulative health gaps between developing and developed countries existed only for functional ability, but not in the three other health dimensions. There is no evidence of a widening gender gap in health status in late life. It is concluded that CDA explains the increasing gaps in functional ability across age groups between countries. However, general health and mental health may depend more on individuals' intrinsic capacity and human agency.

The hierarchical design of this three-article dissertation shows the social and economic determinants of older adults' health from the individual-level (Chapter 2), couple-level (Chapter 3), and macro-level (Chapter 4) perspectives, respectively. Findings from these interconnected articles generally corroborate the person-in-environment perspective and support the research assumptions and hypotheses proposed in Chapter 1. That is, older adults' health is influenced by multilevel factors including micro demographic characteristics, meso household resources, and macro culture/policy contexts across countries.

In addition, the relationship varies because of the unequal resource availability and accessibility in different countries. In particular, older adults in low-resourced developing countries encounter more difficulties in utilizing social and healthcare resources, which may further constrain their health. This is reflected in the disadvantaged socioeconomic status and health conditions of older adults residing in developing countries than those living in developed countries. From the life span perspective, there are also variations. Cumulative disadvantage is observed in certain health dimensions such as functional ability by approximating the between age-group variations. However, it does not apply to all health dimensions.

Table 17 Summaries of the three articles in this dissertation

Chapter	Theories	Statistical Method	Key Findings	Level of Determinant
2	Continuity theory + life course + ecological perspective	Regression model estimated in the Structural Equation Model	<ol style="list-style-type: none"> 1. Retirement was associated with higher levels of depressive symptoms for the U.S. and with lower levels of depressive symptoms for Mexico and England. 2. Public pension was associated with lower levels of depressive symptoms for Mexico and with higher levels of depressive symptoms for the U.S. and China. 3. Private pension was associated with lower levels of depressive symptoms for the U.S., China, and England. 4. No clear age-group variation pattern was found. 	Micro-level (individual)
3	Shared resource hypotheses	Multilevel model + Structural Equation Model	<ol style="list-style-type: none"> 1. Older adults' depressive symptoms were associated with their own (actor effect) and spouses' (partner effect) social and health status. 2. More household resources (couple effect) were linked to higher health concordance. 3. The shared resources hypothesis might be less applicable to Chinese and Mexican older couples but had higher explanatory power among American and British couples. 	Meso-level (family/spouse)
4	Cumulative dis/advantage + welfare state theory	Linear regression model + negative binomial model	<ol style="list-style-type: none"> 1. Cumulative health gaps between developing and developed countries existed only for functional ability, but not in the three other health dimensions. 2. There is no evidence of a widening gender gap in health status in late life. 	Macro-level (country)

Implications

Based on the different relationships of retirement and pension types with older adults' depressive symptoms in Chapter 2, some implications were provided for each country. All countries need to develop education programs to help older citizens plan retirement to avoid financial difficulty after retirement. For China, it may consider providing larger public pensions and continue reforming its pension system for marginalized populations and low-resourced areas. For the U.S., it is recommended to promote bridge employment for certain group and enhance public pension benefits. For Mexico, its older citizens' health will benefit from a reasonable retirement plan, a more flexible market for private pensions, and continued reformation of its pension system. Older adults in England may need reasonable retirement plans and larger public pensions that keep up with inflation.

Suggestions for practice and policy-making can also be derived from the study findings in Chapter 3. First, the necessity of couple-centered intervention is highlighted based on the spousal interdependence in their mental health conditions. Providing mental health support to both spouses simultaneously may have the synergic effect of mitigating their depressive symptoms. Results also underscored the importance of the spousal dyadic perspective in studying older adults' mental health. Second, general physical health was the most robust predictor of depressive symptoms concordance within couples, suggesting that clinical professionals may use physical health as a primary screening indicator to identify older adults with worsening mental health condition. From the policy advocacy level, the limited applicability of the shared resource hypothesis may be attributed to the under-resourced condition encountered by older couples. Therefore, policy efforts should be directed to enhance the accessibility of psychological counseling service to low-income older couples.

There are also some recommendations based on the results in Chapter 4. Practitioners should focus on education and partnership when connecting older adults' SES with health. Older people with less education and without a partner may experience more negative effects on their health. Health promotion programs should focus on encouraging good health behaviors, especially managing weight and doing physical exercise. Policymakers should continue reforming the distribution and delivery of resources with the goal to promote equal accessibility and wide availability.

Putting everything together, this dissertation recommends a person-in-environment perspective for clinical professionals and policy makers to develop interventions to promote healthy aging. That is, when designing intervention programs, they must think about what are the important intrapersonal, interpersonal, and societal factors that influence older adults' health. They can identify the most vulnerable subgroups through their demographic background. They also need to recognize the influence from older adults' spouse, family, and community and leverage such influence to achieve better intervention effects. In all, an integrative and multilevel approach is essential to address older adults' health needs.

Limitations

This dissertation comes with some limitations. As elaborated in Chapter 1, the foremost limitation is the choice of countries. Only four countries were selected for this dissertation due to the difficulties in accessing Harmonized HRS datasets. That context did not fully meet the principle of "similar in most other variables but dissimilar in one particular variable" in the typical comparative politics study. However, the analysis endeavored to control in the statistical models for individual-level demographic variables that are shared in each country's dataset. Nevertheless, this dissertation is not able to rule out other confounding factors at the country level, such as political system. It also cannot determine the exact reasons for the cross-national

difference in the findings. In addition, because of the limited number of countries for comparison, the findings cannot be generalized to many other countries although this research may shed some light on the existence of cross-national variation in socioeconomic determinants of older adults' health.

Second, the relationships among variables found here are only correlational and not casual. Because this dissertation used observational survey data, it could not be definitive about causal relationships. Therefore, these studies reported observed connections or links between variables but could not ascertain the effect mechanism. The discussion tried to cite prior literature to explain the possible effect mechanism; however, the reasoning needs further validation.

Third, many variables relevant to studying the topic at hand were unavailable in the Harmonized HRS dataset for several reasons. It was difficult to harmonize some variables because different definitions or concepts were used in the datasets generated from country-specific surveys. The policy system design is also different in each country; for example, when measuring the dollar value of pensions, the US uses the before-tax amount, England uses the after-tax amount, and China uses the tax-exempt amount. Some measures were just not included in the study designs that produced the datasets, especially for surveys conducted in developing countries. Therefore, the covariates included in this dissertation were simple and straightforward. They could not capture perfectly all elements described in the theoretical framework.

Fourth, because people in these four countries have different living environments and cultural beliefs, older respondents may have different understanding about the health measures employed in the country-specific surveys, especially because the CESD scale is based on Western countries and cultures. It is not sure how much the cross-national difference may be

attributed to different cultural understanding. While culturally-adapted scales are still under development, the national differences in health condition should be interpreted with caution.

Fifth, the available macro-level covariates are quite limited. This dissertation is built on the assumption that developed countries have more social and healthcare resources than developing countries. That assumption is supported by the descriptive characteristics reported in these surveys. However, country-level specific covariates were not included in the statistical models because no measures were available in the current Harmonized HRS dataset. In Chapter 4, an effort was made to include measures derived from the World Health Organization's International Health Yearbook (<https://apps.who.int/iris/handle/10665/86217>), but those were dropped due to their lack of statistical significance. Inability to include such macro-level covariates therefore limited the ability to measure contextual influence in a precise way.

Finally, there are no perfect solutions to the methodological issues raised in this dissertation. Many difficulties were encountered in dealing with the Harmonized HRS dataset, including missing data, different scoring methods for CESD, highly skewed distributions of dependent variables, multicollinearity and lack of normality in the regression models, and trying to balance different methods to answer the research questions. In my original manuscripts, I used only one method to address those concerns without paying much attention to justify my choices. However, in responding to the comments from the committee members at the preliminary oral exam, I have performed many additional analyses to address the methodological issues, cross-examine the results using different methods, and try to justify my choices. Fortunately, most analyses were consistent with the original manuscripts and gave similar findings. In this process, I realized and learned there always are some limitations in one specific method. However, it is

the researcher's responsibility to recognize these limitations and clarify them when presenting the results to the reader. Whenever possible, try different methods and cross-examine the results.

Future Direction

As the Gateway to Global Aging team at USC continues their efforts to provide more waves of harmonized data and add countries that have a similar HRS design, there will be more opportunities to use the longitudinal data to improve the study design and include more countries for cross-national comparison. In the future, researchers will be able to use the longitudinal data to study the dynamic relationship of social resources with older adults' health in different countries. The release of longitudinal data will also help researchers improve studies conducted with those datasets and possibly draw causal relationships in addressing their research questions. As more countries' data are included in the USC's harmonization work, it is foreseeable that researchers will have more options, such as Japan, South Korea, Costa Rica, India, and African countries to be included in comparison studies. Future expansion of the number of countries may enable the findings to be generalized to more areas of research, although including more countries may be limited if the number of variables shared across the larger number of countries will be even fewer.

Thinking broadly, there are also some unsolved questions specific to each article. In Chapter 2, although I have examined the association of presence/absence of retirement and types of pension with depressive symptoms, other aspects of retirement (e.g., timing of retirement, years of retirement, satisfaction with retirement) or pension (e.g., amount of pension, format/delivery of pension, usage of pension) may be worthy of further exploration. In Chapter 3, there remain questions such as the ability of different theories to explain health concordance. Can the shared resource hypothesis apply to concordance in other health dimensions? What role does marital quality or the presence of children play in couples' health concordance? Regarding

Chapter 4, while this dissertation explored age effects, future research could explore cohort and period effects using other datasets. Some health paradoxes, especially the better performance of memory among Mexican older adults, requires further scientific explanation. More research efforts are needed in the future to disentangle these questions growing from this dissertation.

Looking ahead, future studies also may evaluate the feasibility and effectiveness of borrowing experience from high-performing countries to other countries. What are the possible political and cultural barriers that hinder one country learning lessons from another country's experiences to promote healthy aging? How can these foreign-originated experiences be copied/adapted effectively and implemented in the local context? Answering these questions requires an interdisciplinary perspective and collaborative effort from researchers in various disciplines such as gerontology, public health, and public policy. Such scholarly inquiry would be part of my future research agenda.

Appendix 4: IRB exempt memo



Peiyi Lu <peiyilu@iastate.edu>

Human Subjects Research Assessment Results - Not Research - Social Resources, Pension Policy, and Older Adults' Mental, Physical, and Cognitive Health: A Cross-National Comparison between China, England, Mexico, and the United States

1 message

IRBManager on behalf of IRB Administrator <no-reply@iastate.my.irbmanager.com> Wed, Oct 28, 2020 at 7:35 PM

Reply-To: IRB Administrator <IRB@iastate.edu>

To: Peiyi Lu <peiyilu@iastate.edu>, Mack Shelley <mshelley@iastate.edu>

To: Peiyi Lu

Subject: Social Resources, Pension Policy, and Older Adults' Mental, Physical, and Cognitive Health: A Cross-National Comparison between China, England, Mexico, and the United States

Your responses on the Human Subjects Research Assessment form ([Does My Study Require IRB Oversight](#)) indicate that your project does not involve research per the federal regulations (45CFR46.102 and 21CFR56). Accordingly, IRB oversight is not necessary.

Please be aware that this assessment is based on the responses you provided. No individuals from the IRB Office or Committee have reviewed this form or your project plans. The Human Subjects Research Assessment form does not replace an IRB application and this determination was made solely on the information provided within the form. If there is information that was not accounted for when responding to the questions in this form, it could change the determination. We recommend completing a new Human Subjects Research Assessment Form if there are any changes to your project plans.

In addition to this notification, you may click "View as PDF" at the bottom of the Human Subjects Research Assessment form to save a copy of the information you submitted for your records.
