

# **HHS Public Access**

Soc Work Public Health. Author manuscript; available in PMC 2020 November 27.

Published in final edited form as:

Author manuscript

Soc Work Public Health. 2019; 34(8): 686–700. doi:10.1080/19371918.2019.1695035.

# Cumulative Dis/Advantage and Health Pattern in Late Life: A Comparison between Genders and Welfare State Regimes

# Peiyi Lu<sup>a</sup>, Mack Shelley<sup>b</sup>

<sup>a</sup>Gerontology Program, Iowa State University, Ames, Iowa, USA

<sup>b</sup>Statistics, and School of Education, University Professor of Political Science, Iowa State University, Ames, Iowa, USA

# Abstract

This study provides a cross-national perspective to apply Cumulative Dis/Advantage (CDA) in explaining health inequality between developing and developed countries in the context of Welfare State Theory. Cross-sectional data from the international Health Retirement Study (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. Regression models were fitted to examine the moderation roles of country and gender. Results indicated older Chinese and Mexican 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. There is no evidence of a widening gap in health status between genders in late life. CDA explains the increasing gaps of functional ability across age groups between countries. General health and mental health, may however, depend more on individuals' intrinsic capacity and human agency.

# Keywords

Cumulative dis/advantage; welfare state theory; health retirement study; cross-national study

# 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

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethical consideration

Not applicable.

Supplemental data for this article can be accessed here.

**CONTACT** Mack Shelley mshelley@iastate.edu Department of Political Science, Iowa State University, 509 Ross Hall, 527 Farm House Lane, Ames, Iowa 50011.

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

Originating 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).

Based on the role of family, market, and state in providing benefits and welfare, Welfare State Theory divided 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, Bambra, Joyce, & Dahl, 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, the life course perspective, the broader theory within which CDA is nested, has been used to explain health inequality in generous welfare arrangement regimes (Mackenbach, 2012). Thus, the

Based on the CDA and Welfare State theories, this article assumes that the welfare state not only frames the social and economic status of individuals, but also mediates individuals' health via government transfer payments and healthcare resources distribution (Levecque, Van Rossem, De Boyser, Van de Velde, & Bracke, 2011). That is, individuals and families are restricted by the resources and opportunities provided by their surrounding environment; and the institutional or structural context shapes 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 pattern across different age groups between countries. Some studies have showed strong evidence regarding health inequality between countries. For example, Sousa et al. (2014) found lower physical performance among older adults in Colombia, Brazil, and Albania than their Canadian counterparts even after adjusting for early childhood adversity. Cullati, Rousseaux, Gabadinho, Courvoisier, and Burton-Jeangros (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 pattern in late life nor include comparisons to Asian countries.

Differential interpersonal health status in different countries could be explained partially by the societal environments in which the individuals are embedded, i.e., the welfare states' different regimes. For examples, McDonough, Worts, Booker, McMunn, and Sacker (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 better-resourced welfare state residents should enjoy optimal health trajectory, 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, following the dissimilarity selection strategy in comparative research (Lijphart, 1975). Table 1 shows comparable health-related statistics in the four countries retrieved from the World Health Statistics Yearbook (WHO, 2014)<sup>1</sup>. All

<sup>&</sup>lt;sup>1</sup>. The data we used concerned older adults in England. However, we were not able to retrieve relevant health statistics for England from the WHO yearbook. Thus, we used the health statistics of the UK as the proxy variable for similar characteristics in England.

Soc Work Public Health. Author manuscript; available in PMC 2020 November 27.

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, O'Donnell, van Doorslaer, and Van Ourti (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 were 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.

#### Socioeconomic status and health

A substantial amount of literature has studied the relationship between SES and health over individuals' life span. In particular, much 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 later life, 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 levels was found in many health dimensions, including physical function (Leopold & Engelhartdt, 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 females in their early life. The unequal role of females in marriage, employment, and caregiving shapes women's health outcomes in middle and late life (McDonough et al., 2015). However, there is insufficient

research 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 the health pattern 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 and early adversity with an individual's health trajectory. The role of gender is under-explored (Corna, 2013; Pavalko & Caputo, 2013). Second, many studies were concerned with a unidimensional health indictor, such as physical health or cognitive function (e.g., Leopold & Engelhartdt, 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 strives to compare age differences in health outcomes in late life in China, the U.S., Mexico, and England. Driven by both CDA and Welfare State theories, we hypothesize 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 age groups, health inequality would become greater in later life as the disadvantages accumulate. We also explore gender differences in the applicability of CDA and expand the comparison to four dimensions of health indicators: self-reported health, depressive symptoms, functional ability, and memory. Considering the social roles imposed on females, we hypothesize that women will experience more health inequality with age compared to their male 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.

#### Method

#### Data

Harmonized data from the international family of Health and Retirement Study (HRS) were used. HRS is one of the most popular large-scale surveys focusing on the health and financial conditions of older adults in the U.S. The international family studies are the sister studies of HRS that are conducted in various counties around the world using similar questionnaires. 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 Aging (ELSA). There were 21,134 respondents in China, 37,495 respondents in the U.S., 21,369 respondents in Mexico, and 17,980 respondents in England.

#### Measures

#### 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 without partner. Education was recoded as a binary variable: higher education (tertiary) and relatively lower education (secondary and below).<sup>2</sup> 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 measured 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 body weight (unit: kilograms) divided by the square of body height (unit: meters). Another three variables addressed whether the older adult was involved in certain 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 coded 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, Reistetter, & Wong, 2016). The range of CESD was 0 (no) to 1 (severe), with higher values indicating more severe depressive symptoms.

<sup>&</sup>lt;sup>2.</sup>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. Thus we recategorized education into two levels by combining "Less than lower secondary education" and "Upper secondary" into "0 = relatively lower education" and recoding "Tertiary education" into "1 = higher education."

Soc Work Public Health. Author manuscript; available in PMC 2020 November 27.

Functional ability was measured by asking if respondents had difficulties performing certain types of 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, we used the average score for each respondent 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.

**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. The individual-level weights in the four surveys were not comparable, so all analyzes were unweighted. Residual plots were examined to check the assumptions underlying the validity of least-squares regression models. Plots indicated that assumptions were met generally, although the lack of strict normality was acceptable considering the large sample sizes in this study.

The original version of CESD included four-category response options for each item (0 =rarely or none of the time; 1 = some of the time; 3 = much of the time; 4 = most or all the time). However, the harmonized dataset used a dichotomy that collapsed the categories (0 =no; 1 = yes) in coding the CESD items. To validate that the analysis results would not be affected by using a brief form of CESD (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993), we performed the analysis using the original version and the brief version of CESD in the CHARLS dataset, separately. Furthermore, previous studies have treated the CESD score as count data (e.g., Cacioppo et al., 2006) or continuous variable (e.g., Lei, Sun, Strauss, Zhang, & Zhao, 2014). To verify that the analysis results would not be affected by treating the CESD score differently, we fitted the model using an ordinary least squares (OLS) linear regression model and a negative binomial model, separately. Results are shown in the supplemental Tables 1 and 2 in the appendix. For both models of males and females, compared to results in the OLS linear model using the binary response, the OLS model using the four-category frequency response scale achieved very similar results in terms of the signs and magnitudes of coefficient estimates, and in terms of model fitting. The negative binomial model results also achieved results that were similar to those from the OLS model regarding the signs of predictors although the magnitudes of parameter estimates and of model fitting criteria were not comparable between the models. Thus, we verified that the analysis results were not affected by the structure of the response options for the CESD items and the type of variable. For the sake of simplicity and consistency, we chose the

dichotomous response version of CESD in the four countries and fit the OLS linear regression model.

Finally, to illustrate further the moderating role of country and gender in the relationship between age and health, least squares means of age groups within countries controlling other predictors consistent were plotted. All analyses were performed in R software using the packages "psych," "car," "MASS," and "Ismeans." Plots were generated using Microsoft Excel 2010.

# Results

#### **Descriptive characteristics**

Table 2 shows descriptive statistics and frequency results for the variables employed in this analysis. More females than males 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 pyramidshaped. For the U.S. and England, the percentages of 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. Fewer than 10% of older adults had higher education in China and Mexico; while 39.82% of Americans and 24.19% of English had attained higher education. The national differences in education attainment were statistically significant ( $\chi^2$ = 13,455, p < .001); the percentage of respondents attaining higher education was significantly greater in developed countries than in developing countries. The median purchasing power was above \$30,000 among both American and British respondents, while for Chinese and Mexican respondents were \$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 < .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 ( $kg/m^2 = 25 \sim 30$ ). The mean BMI among Chinese respondents (23.86) was significantly lower and fell into the normal range. About 30–50% of respondents in each county 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 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 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 cross-national differences in the four health outcomes were statistically significant (p < .001).

#### **Regression model results**

Most regression coefficients were significant except for marital status, household size, and household income in the functional ability model for males; marital status in functional ability model for females; and BMI in the depressive symptom model for males. The coefficient of household income was significant but the size was small. Detailed results can be seen in the OLS linear model using binary response in CESD in CHARLS in supplemental Tables 1 and 2. Generally, the positive predictors consistently significant across all models were being partnered, attaining higher education, smaller household size, engaging in physical exercise, having smaller BMI, and not using tobacco; these were associated with better self-reported health, less depressive symptoms, higher functional ability, and better memory. Table 3 shows the ANOVA results of the moderation role of country and overall model results. All models were significant (p < .001) and explained about 15 ~ 32% of variance of the dependent variable after adjusting for model complexity. The interaction term of country and age group was statistically significant (p < .05).

#### Moderation role of country and gender

Figures 1–4 illustrate the comparison of four health outcomes across various age groups. The over-lapping 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 (Figures 1 and 2), 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 (Figures 3 and 4), 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 group 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 2). In other words, the health gaps between developing and developed countries were widening in the pattern of functional ability, but not for the other three health conditions. Women in the four countries had poorer health than their male counterparts except for memory status. However, there were no indications that the health gaps between genders were accelerating as age groups became older.

# Discussion

This study examined age-varying differences in four health outcomes and the moderation role of gender and country. Descriptive analysis indicated there were great cross-national differences in the respondents' social and financial status; 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 demonstrated the disadvantaged SES of people living in developing countries, which was consistent with the literature review and macro-level health statistics.

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 while a bigger household was not. The results implied the relative 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/partnership 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 common sense. The idea that avoiding risky 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 2), optimizing BMI would benefit most respondents' health in late life. However, this study did not find a consistent 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 massive 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 (Table 2), which should raise the concerns of public health practitioners.

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 we did not consider cohort and period effects (WHO, 2015, p. 44), but the general health and mental health of older adults are positive. The differential age-varying pattern in four health outcomes implied the flexibility and potential enhancement 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 our hypothesis that people living in resourceless areas should have cumulative health risk. This 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. Referring to Table 2, 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 while the functions of U.S. and England maintained high levels (Figure 3), which supported the hypothesis driven by CDA and Welfare State theories. 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 in transferring benefits through a larger public sector and publically-funded healthcare system than 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 (Figures 1, 2, & 4). 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 et al., 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.

Women in the four countries had poorer health than their male 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 females, which mainly was attributed to unequal roles assignment by patriarchal or traditional society. Despite women reporting poorer health than men, they live longer than men (De Medeiros, 2016). In this case, females 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.

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 disadvantaged 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 reformation of welfare regimes and resource provision is needed.

There are some limitations in this study. First, we were not able to use longitudinal HRSseries data due to the unavailability of harmonized datasets across all four countries when the data were retrieved. The cross-national design limited our ability to observe individuals' health trajectory across the life span, but we were able to approximate the relationship using age-varying paths. Second, health measurement in the HRS-series depended heavily on selfreport, 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, we tried to include the country-level measure of healthcare resources in predicting individuals' health but did not find significant relationships. Thus, we excluded those in the regression model for the sake of parsimony in model estimation. Future studies may consider employing more valid health resource indicators and estimate multilevel models. Finally, because this study focused on only two developing and two developed countries, the comparison results are difficult to generalize 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, we compared the age-varying pattern of older adults on four dimensions of health. This study contributed to the empirical evidence and discussion of the applicability of combining CDA and Welfare State theories in a macro-level international comparison study. 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 in functional ability. Females in all four countries had poorer health than their male counterparts except for memory status. There was no sign of a widening health gap between genders across the age groups.

We conclude that CDA explains the increasing gaps of functional ability across age groups between countries. However, other health status characteristics, including general health and mental health, may 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.

#### **Supplementary Material**

Refer to Web version on PubMed Central for supplementary material.

### Acknowledgments

The Gateway to Global Aging Data project is developed by Center for Economic and Social Research (CESR) at University of Southern California. It is funded by National Institute on Aging, National Institutes of Health (R01 AG030153, RC2 AG036619, R03 AG043052, R24 AG048024). For more information, please refer to www.g2aging.org.

This analysis uses data or information from the Harmonized CHARLS dataset and Codebook, Version B.4 as of February 2017 developed by the Gateway to Global Aging Data. The development of the Harmonized CHARLS was funded by the National Institute on Aging (R01 AG030153, RC2 AG036619, R03 AG043052).

This analysis uses information and programming codes from the Harmonized MHAS programming codes and Codebook, Version A developed by the Gateway to Global Aging Data in collaboration with the MHAS research team. The development of the Harmonized MHAS was funded by the National Institute on Aging (R01 AG030153, RC2 AG036619, R03 AG043052). The Harmonized MHAS data files and documentation are public use and available at www.MHASweb.org. The MHAS (Mexican Health and Aging Study) receives support from the National Institutes of Health/National Institute on Aging (R01 AG018016).

This analysis uses data or information from the Harmonized ELSA dataset and Codebook, Version D as of March 2016 developed by the Gateway to Global Aging Data. The development of the Harmonized ELSA was funded by the National Institute on Aging (R01 AG030153, RC2 AG036619, 1R03AG043052). For more information, please refer to www.g2aging.org.

# 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. doi: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. doi:10.1136/jech.2007.070292 [PubMed: 18768570]
- Cacioppo JT, Hughes ME, Waite LJ, Hawkley LC, & Thisted RA (2006). Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses. Psychology and Aging, 21(1), 140. doi:10.1037/0882-7974.21.1.140 [PubMed: 16594799]
- 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. doi:10.1177/0003122409359165 [PubMed: 20379373]
- Corna LM (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. doi:10.1016/ j.alcr.2013.01.002 [PubMed: 24796266]
- Cullati S, Rousseaux E, Gabadinho A, Courvoisier DS, & 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. doi:10.1016/j.alcr.2013.11.002 [PubMed: 24796875]

- 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. doi: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. Illinois, Chicago: Policy Press.
- Díaz-Venegas C, Reistetter TA, & Wong R (2016). Differences in the progression of disability: A US– Mexico comparison. The Journals of Gerontology: Series B, 73(5), 913–922.
- Eikemo TA, 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 [PubMed: 18927186]
- Esping-Andersen G (2013). The three worlds of welfare capitalism. Cambridge, UK: John Wiley & Sons.
- Ferraro KF, & Shippee TP (2009). Aging and cumulative inequality: How does inequality get under the skin? The Gerontologist, 49(3), 333–343. doi:10.1093/geront/gnp034 [PubMed: 19377044]
- Gao Q, Yang S, & Li S (2013). The Chinese welfare state in transition: 1988–2007. Journal of Social Policy, 42(4), 743–762. doi:10.1017/S0047279413000329
- Hatch SL (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. doi:10.1093/geronb/60.Special\_Issue\_2.S130
- Kahn JR, & Pearlin LI (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 [PubMed: 16583773]
- Kohout FJ, Berkman LF, Evans DA, & 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 [PubMed: 10125443]
- Kurtz MJ (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 JH, Kim J, Kim S-H, Na DL, Cheong H-K, ... Kim YG (2010). Systematic review of health behavioral risks and cognitive health in older adults. International Psychogeriatrics, 22(2), 174–187. doi:10.1017/S1041610209991189 [PubMed: 19883522]
- Lei X, Sun X, Strauss J, Zhang P, & Zhao Y (2014). Depressive symptoms and SES among the midaged and elderly in China: Evidence from the China health and retirement longitudinal study national baseline. Social Science Medicine, 120, 224–232. doi:10.1016/j.socscimed.2014.09.028 [PubMed: 25261616]
- 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. doi:10.1177/0022146516645926 [PubMed: 27284078]
- Leopold L, & Engelhartdt 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. doi:10.1007/s00038-013-0453-6 [PubMed: 22918517]
- 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 [PubMed: 21498774]
- Lijphart A (1975). II. The comparable-cases strategy in comparative research. Comparative Political Studies, 8(2), 158–177. doi:10.1177/001041407500800203
- Mackenbach JP (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 [PubMed: 22475407]
- 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. doi:10.1016/j.alcr.2015.05.004
- Mirowsky J, & Ross CE (2008). Education and self-rated health: Cumulative advantage and its rising importance. Research on Aging, 30(1), 93–122. doi:10.1177/0164027507309649

- Pavalko EK, & Caputo J (2013). Social inequality and health across the life course. American Behavioral Scientist, 57 (8), 1040–1056. doi:10.1177/0002764213487344
- Penedo FJ, & Dahn JR (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 [PubMed: 16639173]
- Room R, Babor T, & Rehm J (2005). Alcohol and public health. The Lancet, 365(9458), 519–530. doi:10.1016/S0140-6736(05)17870-2
- Schone BS, & Weinick RM (1998). Health-related behaviors and the benefits of marriage for elderly persons. The Gerontologist, 38(5), 618–627. doi:10.1093/geront/38.5.618 [PubMed: 9803650]
- Sousa ACPDA, Guerra RO, Thanh Tu M, Phillips SP, Guralnik JM, & Zunzunegui M-V (2014). Lifecourse adversity and physical performance across countries among men and women aged 65– 74. PloS One, 9(8), e102299–e102299. doi:10.1371/journal.pone.0102299
- Theou O, Brothers TD, Rockwood MR, 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. doi:10.1093/ageing/aft010 [PubMed: 23443511]
- 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. doi:10.1177/0952872002012003394
- Turrell G, Lynch JW, Kaplan GA, Everson SA, Helkala E-L, Kauhanen J, & Salonen JT (2002). Socioeconomic position across the lifecourse and cognitive function in late middle age. The Journals of Gerontology: Series B, 57(1), S43–S51. doi: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. doi:10.1016/j.socscimed.2009.10.020 [PubMed: 19897296]
- Walsemann KM, Geronimus AT, & Gee GC (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. doi:10.1177/0164027507311149
- WHO. (2014). World health statistics yearbook: Part II global health indicators. Retrieved from https:// www.who.int/gho/publications/world\_health\_statistics/en/
- WHO. (2015). World report on ageing and health. Retrieved from https://www.who.int/ageing/ publications/world-report-2015/en/

Lu and Shelley

Page 16



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

Lu and Shelley



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

Lu and Shelley

Page 18



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

Lu and Shelley

Page 19



Gender and cross-national comparison on memory across age groups.

#### Table 1.

Comparison of health resources in four countries in 2012–2013.

	China	U.S.	Mexico	UK
Health service coverage (%)				
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
health system (per 10,000 population)				
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
Health expenditure				
total expenditure on health as % of GDP	5.4	17	6.1	9.3
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/

#### Table 2.

Descriptive and frequency analysis results of respondents in four countries.

	China	U.S.	Mexico	England	test statistics (sig.)	
Sociodemographic information						
Gender- male $N(\%)$	10,148 (48.03)	16,424 (43.81)	9300 (43.52)	8163 (45.40)	X <sup>2</sup> = 119.92 (***)	
Age group $N(\%)$					$X^2 = 7881.80 (***)$	
<50	4409 (24.93)	835 (4.06)	1464 (9.35)	341 (3.22)		
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)		
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 $N(\%)$	16,211 (87.11)	12,868 (62.61)	10,941 (69.59)	7594 (71.66)	$X^2 = 3084.8 (***)$	
Education N-higher education (%)	521 (2.47)	14,923 (39.82)	2061 (9.70)	2048 (24.19)	X <sup>2</sup> = 13,455 (***)	
Household income median (skewness)	5142.86 (31.28)	39,125.64 (10.17)	2303.70 (38.24)	32,625.43 (12.85)	F=1802 (***)	
Household size median (skewness)	3 (1.06)	2 (2.07)	2 (1.90)	2 (-0.81)	F= 3817(***)	
Health and behavior covariates						
BMI mean (SD)	23.86 (3.83)	28.50 (6.23)	27.49 (5.01)	28.29 (5.26)	F=2241 (***)	
Physical exercise yes $N(\%)$	2122 (34.86)	9115 (44.49)	5675 (39.30)	4138 (39.05)	X <sup>2</sup> = 231.36 (***)	
Alcohol use $N(\%)$					X <sup>2</sup> = 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	10,105 (55.04)	9534 (46.52)	12,147 (77.63)	1177 (13.45)		
Tobacco use $N(\%)$					X <sup>2</sup> = 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	10,610 (71.03)	8972 (43.90)	9957 (63.35)	3950 (37.87)		
Dependent variables						
Self-reported health mean (SD)	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(SD)	0.35 (0.18)	0.48 (0.17)	0.58 (0.19)	0.53 (0.19)	F=4371 (***)	

Note: when the distribution of the variable is skewed, we used median and skewness to describe the distribution. The last column shows the significance test results of difference between means (F tests) or proportions ( $X^2$  tests).

#### Table 3.

Analysis of variances (ANOVA) table of model results.

	Model 1 (Se Hea	elf-reported lth)	Model 2 (l symp	Depressive toms)	Model 3 (Functional Ability)		Model 4 (Memory)	
Variables	Female	Male	Female	Male	Female	Male	Female	Male
Sample size ( <i>n</i> )	21,990	16,214	21,281	15,570	12,617	10,920	21,226	15,489
	F-stat (sig.)	F-stat (sig.)	F-stat (sig.)	F-stat (sig.)	F-stat (sig.)	F-stat (sig.)	F-stat (sig.)	F-stat (sig.)
age groups	14.95 (***)	14.19 (***)	10.94 (***)	7.20 (***)	195.78 (***)	130.40 (***)	252.75 (***)	252.38 (***)
Country	664.54 (***)	273.75 (***)	484.23 (***)	269.73 (***)	338.25 (***)	138.45 (***)	1855.73 (***)	831.99 (***)
agegroup:country	3.32 (***)	1.70 (*)	4.19 (***)	6.94 (***)	20.95 (***)	20.37 (***)	11.91 (***)	5.12 (***)
<i>F</i> -statistic (sig.) overall model	223.6 (***)	120.4 (***)	119 (***)	72.14 (***)	118.5 (***)	70.48 (***)	241.4 (***)	146.1 (***)
Adjusted $R^2$	0.2929	0.2315	0.1850	0.1574	0.2756	0.2063	0.3167	0.2771

Note:s.r means standard errors.

 $p^* < 0.05$ 

\*\* p<0.01

\*\*\* p < 0.001