

Preplanned Studies

Early-Life Circumstances and Cross-Country Disparities in Cognition Among Older Populations — China, the US, and the EU, 2008–2018

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Summary

What is already known about this topic?

Many health challenges have emerged due to rapid population aging, including declined cognitive ability among older adults.

What is added by this report?

Childhood circumstances have significant and lasting impacts on cognition in old age. This study compared cognition data from China with both the United States (U.S.) and the European Union (EU) during 2008–2018, finding that childhood circumstances could respectively explain 65.4% [95% confidence interval (CI): 59.4%, 71.4%] (China *vs.* the U.S.) and 38.2% (95% CI: 35.1%, 41.2%) (China *vs.* the EU) of the overall differences in cognition among older adults. Family socioeconomic status explained the largest share of differences among all considered childhood circumstances.

What are the implications for public health practice?

Large disparities in cognition should be addressed by mitigating childhood disadvantages.

With accelerated aging across the globe (1), it is critical to improving health in older populations (2), including aspects relating to cognitive ability (3). Growing scientific evidence found associations between childhood circumstances and cognition in old age (4–6). However, it has yet to be discovered to what extent childhood circumstances may explain cross-country disparities in cognition in older populations, especially between countries in different stages of development. This study applied the Oaxaca-Blinder decomposition to a validated measure of cognition in harmonized global aging surveys to explore the contributions of childhood circumstances to cross-country differences in cognition. Our results demonstrated a large share of cross-country differences in cognition among older adults being explained by childhood circumstances. Specifically, childhood

disadvantages contributed 65.4% to the China-US difference in cognition, while childhood disadvantages contributed 38.2% to the China-EU difference in cognition. In both cases, family socioeconomic status explained the largest share of cross-country differences in cognition. The large gap in the cognition of older adults across these countries and their risk factors in childhood stress the urgency of mitigating childhood disadvantages to achieve more equitable, healthy aging.

This study used three Health and Retirement Study (HRS)-family surveys: the China Health and Retirement Longitudinal Study (CHARLS); the U.S. HRS; and the Survey of Health, Aging, and Retirement in Europe (SHARE). In the past three decades, the U.S. National Institutes of Health and HRS-family survey teams in each country have collected and harmonized data for aging populations to offer an opportunity for cross-national comparisons (7–8). Our analysis was restricted to individuals aged 60 years and older, with no proxy respondents. We matched CHARLS Life History Survey 2014 (9,846 respondents) with CHARLS core survey 2018 (11,096 respondents); HRS Life History Mail Survey 2015/2017 (8,579 respondents) with HRS core survey 2016 (7,744 respondents); and SHARELIFE 2008/2017 (30,706 respondents) with SHARE core survey 2017 (27,173 respondents). For the three HRS-family surveys, the earliest and latest years in which cognition data were collected for this analysis were 2008 and 2018, respectively. To make the cognitive assessments most comparable across China, the U.S., and the EU, we measured cognitive ability using the validated Mini-Mental State Examination (MMSE). Our cognitive score included the typical dimensions and items across the three HRS-family surveys, ranging from 0 to 29. The larger the value, the better the cognitive ability. Considering salient differences in the distribution of cognitive scores between China and the U.S. and between China and the EU, standardized cognitive scores were measured. Z-scores were determined to facilitate cross-country comparisons,

using the combined mean and standard deviation of cognition scores in all three HRS-family surveys. We used the Oaxaca-Blinder decomposition to estimate the extent to which various childhood circumstances were explained in the cognitive abilities of older adults across countries (9). Originally proposed in 1973, the Oaxaca-Blinder decomposition offered a regression-based approach to attributing cross-country differences in cognition of older adults to differences in childhood circumstances (composition effect) *versus* differences in the effects of these circumstances (association effect) (10). A package *iop* in STATA (version 16.0, Stata Corp, College Station, U.S.) was used to perform the

analyses (9).

We measured cognitive abilities among older populations in China, the U.S., and the EU, all of which exhibited rapid aging processes, though at different stages of development. While the cognitive scores of older adults in the U.S. and EU are relatively similar in level and distribution, Figure 1 displays the large differences with their Chinese counterparts who tended to have lower cognitive scores. As shown in Table 1, Chinese older adults in the sample also tended to receive lower education (on average 4.5 years, *versus* 12.0 years in the U.S. and 11.2 years in the EU). Education has been recognized as a profound,

TABLE 1. Summary statistics for older adults — China, the US, and the EU, 2008–2018.

Variables	Country	Obs	Mean	S.D.	Min	Max	Variable description
Cognition	CN	8,819	8.9	6.8	0	28	Continuous: include orientation, episodic memory, and calculating ability; possible values 0–29
	US	6,106	16.5	4.5	1	29	
	EU	18,540	17.5	4.3	0	29	
Standardized cognition score	CN	8,819	-1.0	1.1	-2.4	2.1	Measured in Z-scores, using mean and standard deviation of cognition scores in all three HRS-family surveys combined
	US	6,106	0.2	0.7	-2.2	2.2	
	EU	18,540	0.4	0.7	-2.4	2.2	
Male	CN	8,819	0.5	0.5	/	/	Dummy: males were assigned 1, females were assigned 0
	US	6,106	0.4	0.5	/	/	
	EU	18,540	0.4	0.5	/	/	
Age	CN	8,819	69.3	7.1	60	102	Continuous: selected samples aged ≥60 years
	US	6,106	76.1	7.2	60	100	
	EU	18,540	72.6	7.5	60	100	
Years of education	CN	8,819	4.5	4.0	0	16	Continuous: years of education the respondents received
	US	6,472	12.0	4.5	0	17	
	EU	15,709	11.2	4.2	0	25	
War or famine experiences	CN	8,819	0.2	0.4	/	/	Dummy: experienced World War II, the Anti-Japanese War or famine in childhood assigned 1; 0 otherwise
	US	6,106	0.0	0.1	/	/	
	EU	18,540	0.0	0.2	/	/	
Family SES in childhood							
Father: no school	CN	8,819	0.6	0.5	/	/	Dummy: fathers did not attend school were assigned 1; 0 otherwise
	US	6,106	0.0	0.2	/	/	
	EU	18,540	0.0	0.2	/	/	
Father: below primary school	CN	8,819	0.2	0.4	/	/	Dummy: fathers did not finish primary school were assigned 1; 0 otherwise
	US	6,106	0.1	0.2	/	/	
	EU	18,540	0.1	0.2	/	/	
Father: primary school	CN	8,819	0.1	0.3	/	/	Dummy: fathers finished primary school were assigned 1; 0 otherwise
	US	6,106	0.1	0.4	/	/	
	EU	18,540	0.4	0.5	/	/	
Father: secondary school	CN	8,819	0.1	0.2	/	/	Dummy: fathers finished secondary school were assigned 1; 0 otherwise
	US	6,106	0.6	0.5	/	/	
	EU	18,540	0.2	0.4	/	/	

TABLE 1. (Continued)

Variables	Country	Obs	Mean	S.D.	Min	Max	Variable description
Father: university and above	CN	8,819	0.0	0.1	/	/	Dummy: fathers attended university or above were assigned 1; 0 otherwise
	US	6,106	0.2	0.4	/	/	
	EU	18,540	0.3	0.5	/	/	
Mother: no school	CN	8,819	0.9	0.3	/	/	Dummy: mothers did not attend school were assigned 1; 0 otherwise
	US	6,106	0.0	0.2	/	/	
	EU	18,540	0.0	0.1	/	/	
Mother: below primary school	CN	8,819	0.0	0.2	/	/	Dummy: mothers did not finish primary school were assigned 1; 0 otherwise
	US	6,106	0.0	0.3	/	/	
	EU	18,540	0.1	0.3	/	/	
Mother: primary school	CN	8,819	0.0	0.1	/	/	Dummy: mothers finished primary school were assigned 1; 0 otherwise
	US	6,106	0.1	0.3	/	/	
	EU	18,540	0.5	0.5	/	/	
Mother: secondary school	CN	8,819	0.0	0.1	/	/	Dummy: mothers finished secondary school were assigned 1; 0 otherwise
	US	6,106	0.7	0.5	/	/	
	EU	18,540	0.2	0.4	/	/	
Mother: university and above	CN	8,819	0.0	0.03	/	/	Dummy: mothers attended university or above were assigned 1; 0 otherwise
	US	6,106	0.1	0.3	/	/	
	EU	18,540	0.2	0.4	/	/	
Parental health							
Father: alive	CN	8,819	0.1	0.2	/	/	Dummy: fathers still alive assigned 1; 0 otherwise
	US	6,106	0.0	0.1	/	/	
	EU	18,540	0.0	0.1	/	/	
Father: lower lifespan than average	CN	8,819	0.4	0.5	/	/	Dummy: fathers died at below-average lifespan assigned 1; 0 otherwise
	US	6,106	0.4	0.5	/	/	
	EU	18,540	0.5	0.5	/	/	
Father: higher lifespan than average	CN	8,819	0.4	0.5	/	/	Dummy: fathers died at above-average lifespan assigned 1; 0 otherwise
	US	6,106	0.5	0.5	/	/	
	EU	18,540	0.4	0.5	/	/	
Mother: alive	CN	8,819	0.1	0.4	/	/	Dummy: mothers still alive assigned 1; 0 otherwise
	US	6,106	0.1	0.3	/	/	
	EU	18,540	0.1	0.3	/	/	
Mother: lower lifespan than average	CN	8,819	0.4	0.5	/	/	Dummy: mothers died at below-average lifespan assigned 1; 0 otherwise
	US	6,106	0.4	0.5	/	/	
	EU	18,540	0.4	0.5	/	/	
Mother: higher lifespan than average	CN	8,819	0.3	0.5	/	/	Dummy: mothers died at above-average lifespan assigned 1; 0 otherwise
	US	6,106	0.5	0.5	/	/	
	EU	18,540	0.4	0.5	/	/	
Childhood health	CN	8,819	2.7	1.0	1	5	Continuous: possible values 1–5, higher indicate poorer self-rated health in childhood
	US	6,106	1.7	0.9	1	5	
	EU	18,540	2.3	1.1	1	5	
Child abuse	CN	8,819	0.3	0.4	/	/	Dummy: beaten by parents during childhood were assigned 1; 0 otherwise
	US	6,106	0.1	0.2	/	/	
	EU	18,540	0.3	0.4	/	/	

Note: This table presents summary statistics for cognitive assessments, demographic, and childhood circumstance variables. The 10th, 25th, 50th, 75th, 90th percentiles of cognitive score (for CN) are 0, 3, 8, 14, 18, respectively.

Abbreviation: CN=China; US=the United States; EU=the European Union; SD=standard deviation; SES=socioeconomic status; HRS=Health and Retirement Study.

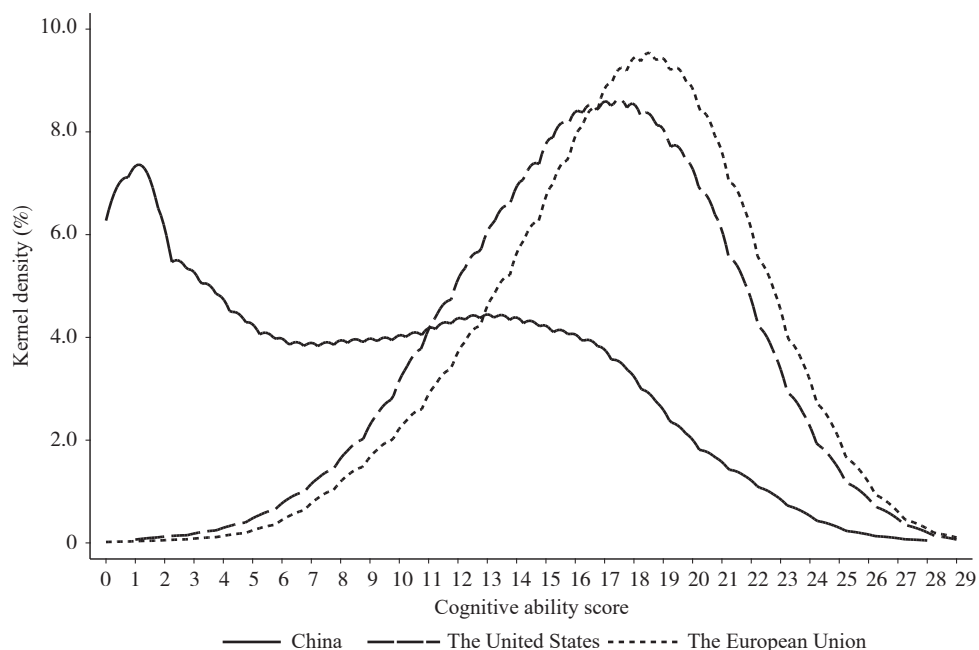


FIGURE 1. Distributions of cognitive score for older adults — China, the United States, and the European Union, 2008–2018.

Notes: The kernel density plots represent the distributions of assessed cognitive ability for older adults in China, the US, and the EU. This figure is plotted using raw cognitive assessment data without accounting for differences in education across the countries. The MMSE score was calculated based on common items in three dimensions in the CHARLS, HRS and SHARE surveys. Specifically, the cognitive ability score ranges from 0 to 29, and the larger the value, the better the cognitive ability. The three dimensions included functions of orientation to time and attention, episodic memory, and computational ability. There were 4 points for orientation function, i.e., correct answers to the year, month, day, and day of the week; 20 points for episodic memory, i.e., 10 points for immediate memory and 10 points for delayed memory; and 5 points for computational ability, i.e., subtracting 7 from 100 for five consecutive times, and the number of correct answers is the computational ability score.

Abbreviation: MMSE=Mini-mental State Examination; CHARLS=China Health and Retirement Longitudinal Study; HRS=Health and Retirement Study; SHARE=the Survey of Health, Aging, and Retirement in Europe.

protective factor of cognitive ability (11).

In addition to the gaps in educational attainment, a key predictor of cognitive disparities for older populations, other economic and social development aspects may also widen the cross-country cognitive disparities. To better understand these economic and social conditions at an individual level, we considered the role of various childhood circumstances of our study subjects before completing their education. Table 1 shows the summary statistics, a significantly higher proportion of Chinese older adults experienced war or famine compared to those in the U.S. and the EU. Five levels of schooling were created across China, the U.S., and the EU to indicate parental educational attainment to harmonize parental educational data for comparison. There were significant cross-country differences in parental education. Specifically, for older Chinese adults above age 60, about 60% of their fathers and 90% of their mothers received no formal education. By contrast, only 3% of fathers and 3% of

mothers of older U.S. adults received no formal education. Similar differences existed when comparing other childhood circumstances, including parental and individual health. Chinese and European older adults experienced more abuse in childhood than their U.S. counterparts. Childhood circumstance variables in Table 1 were defined according to the literature (12).

Using the three HRS-family surveys and the Oaxaca-Blinder decomposition based on the standardized cognitive scores (Z-scores), Table 2 further illustrates the differences in cognition of the elderly and the contribution of childhood circumstances: 1) Chinese older persons had significantly lower assessed cognition (8.9 out of a total score of 29) than their U.S. and EU counterparts, respectively, at 16.5 and 17.5 (Table 1); 2) comparing China to the U.S. and the EU, overall childhood circumstances respectively explained 65.4% [95% confidence interval (CI): 59.4%, 71.4%] and 38.2% (95% CI: 35.1%, 41.2%) of the China-US and China-

TABLE 2. Differences in cognitive score between countries explained by childhood circumstances.

Item	CN and US				CN and EU			
	Overall gap	Explained gap	Explained proportion (%)	95% confidence interval (%)	Overall gap	Explained gap	Explained proportion (%)	95% confidence interval (%)
Difference (standardized score of cognitive score)	1.2	0.80	65.40	(59.4, 71.4)	1.4	0.50	38.20	(35.1, 41.2)
War / famine experiences		0.02	1.30	(0.7, 1.9)		0.02	1.60	(1.3, 2.0)
Parental health		0.04	3.50	(2.6, 4.4)		0.01	0.60	(0.2, 1.0)
Father: alive		-0.00	-0.07	(-0.4, 0.2)		-0.00	-0.20	(-0.4, -0.01)
Father: < average lifespan		-0.00	-0.20	(-0.4, -0.09)		-0.00	-0.20	(-0.3, -0.09)
Mother: alive		-0.01	-1.10	(-1.0, -0.6)		-0.01	-0.70	(-0.9, -0.6)
Mother: < average lifespan		0.00	0.01	(-0.04, 0.06)		-0.00	-0.07	(-0.1, 0.007)
Family SES		0.70	57.60	(51.8, 63.4)		0.50	35.00	(31.9, 38.0)
Father: < primary school		-0.30	-3.80	(-4.4, -3.1)		-0.03	-2.50	(-3.1, -1.9)
Father: primary school		0.10	0.90	(0.6, 1.2)		0.05	3.70	(2.8, 4.5)
Father: secondary school		1.40	18.40	(15.4, 21.5)		0.05	3.70	(3.2, 4.3)
Father: college and above		0.50	5.90	(4.9, 6.9)		0.10	8.20	(7.2, 9.3)
Mother: < primary school		0.02	0.20	(0.02, 0.4)		0.00	0.20	(-0.003, 0.3)
Mother: primary school		0.20	2.40	(1.7, 3.1)		0.10	9.20	(7.7, 10.7)
Mother: secondary school		2.00	26.80	(21.7, 31.8)		0.09	6.60	(5.8, 7.4)
Mother: college and above		0.50	6.80	(5.6, 8.0)		0.08	5.90	(5.2, 6.5)
Childhood health		0.30	4.40	(3.2, 5.6)		0.01	1.00	(0.8, 1.3)
Child abuse		-0.10	-1.40	(-2.1, -0.7)		-0.00	-0.04	(-0.08, 0.0007)

Notes: The reference group for parental health is "Father (Mother): Higher lifespan than average", and the reference group for family SES in childhood is "Father (Mother): No school".

Abbreviation: CN=China, US=the United States; EU=the European Union; SES=Socioeconomic Status.

EU disparities in cognitive ability; 3) various childhood circumstances significantly contributed to cross-country differences in the cognitive ability of older adults. Of the childhood circumstances considered, family socioeconomic status, measured by parental educational attainment, contributed the largest — 57.6% (95% CI: 51.8%, 63.4%) to the China-US difference and 34.9% (95% CI: 31.9%, 38.0%) to the China-EU difference in cognitive ability. Of the other factors, individual health, parental health, and war or famine experiences respectively explained 4.4% (95% CI: 3.2%, 5.6%), 3.5% (95% CI: 2.6%, 4.4%), and 1.3% (95% CI: 0.7%, 1.9%) of the China-US difference, while war or famine experiences, individual health, and parental health explained 1.6% (95% CI: 1.3%, 2.0%), 1.0% (95% CI: 0.8%, 1.3%), and 0.6% (95% CI: 0.2%, 1.0%) of the China-EU difference.

DISCUSSION

Using harmonized data from HRS-family surveys

conducted in China (CHARLS), the U.S. (HRS), and the European Union (SHARE), this study examined cross-country disparities in the cognitive ability of older adults, with a focus on the influences of childhood circumstances. The three countries were chosen due to their high levels of population aging but different stages of socioeconomic development, which provided a clear basis for comparisons. We found that childhood circumstances explained large shares of differences in the cognitive ability of older persons across countries. Further decomposing these cross-country disparities, we specifically showed that the contributions of childhood circumstances amounted to 65.4% of the China-US and 38.2% of the China-EU differences in cognitive ability in older age, respectively.

Among all domains considered, we identified that family socioeconomic status was the most significant contributor to these differences. Striving for parental educational equity may compensate for cognitive disparities resulting from other childhood

disadvantages. Although modest, parental health status during childhood also contributed to disparities in cognitive ability. Relative to mothers' lifespan, fathers' lifespan was much more statistically significant but only slightly larger in terms of the size of cross-country differences. In addition to indicating inherited health endowments from parents, men's health explained slightly more as they often constituted the primary labor force and were expected to bring in substantial resources for their families. Therefore, long-term cognitive ability may be influenced more by the health status of their fathers. Other childhood circumstances, including war or famine experiences and individual health, also had statistically significant but modest contributions.

Overall, our main finding of childhood circumstances contributing substantially to the cross-country disparities in the cognitive ability of older populations highlights the value of taking a life-course perspective to study health inequalities. In the meantime, the economic theory of equality of opportunity calls for public policies to offer more equitable childhood circumstances and compensate for those who had adverse childhood circumstances to improve cognitive health in older age. These policies can potentially narrow the differences between developing and developed countries that promote global health equity.

This study had some limitations. First, while we used a comprehensive and harmonized MMSE for cross-country comparisons, the lack of clinical diagnosis data prevented us from directly assessing the link between childhood circumstances and cognitive impairment using validated clinical criteria. Second, the self-reported childhood circumstances data can be subject to recall error. Third, considering the nature of cross-country comparisons, we included early life circumstance indicators that are more consistent across the three surveys, which indicate a lower bound, and therefore a conservative estimate.

Conflicts of interest: No conflicts of interest.

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