Socioeconomic Gradients of Cardiovascular Risk Factors in China and India

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Background

- **Economic development and rapid population aging have lead to a transition of disease profile to predominantly chronic medical conditions in both China and India**

- **Cardiovascular disease (CVD) is now the leading cause of death**
  - **41% of all deaths in China**
  - **>25% of all deaths in India**

Background

- **Socioeconomic status (SES) is a known determinant for development of CVD and related mortality**

- **SES-CVD associations are less well studied and may be more complicated in developing countries due to**
  - **Lack of high quality data**
  - **Confounding by access to the health care system and underdiagnosis of disease**

Background

- **Meta-analysis data have shown that SES-hypertension associations in rural populations of low- and middle-income countries may vary by geographical regions**
  - **Positive association in South Asia**
  - **Inverse association in East Asia**
- **Possible reasons**
  - **Different stages of socioeconomic development**
  - **East Asian populations may be further advanced along the epidemiological transition than are South Asian populations**

Objective

- **To examine and compare the relationships between SES and CVD risk factors in China and India**

Methods

- **Data**

  - **The China Health and Retirement Longitudinal Study (CHARLS), national baseline wave, which was fielded in 2011-2012**

  - **The Longitudinal Aging Study in India (LASI) pilot study, fielded in 2010**

  - **Both CHARLS and LASI are conceptually harmonized to the U.S. Health and Retirement Study (HRS)**

CHARLS

- **A longitudinal national survey representative of the middle-aged and elderly population (45+ years) in China**

- **Baseline wave interviewed 17,708 respondents from 10,257 households**

- **Our analysis included 9,947 participants who had complete data from interview, physical examination, and bioassays**

LASI Pilot Study

- **A longitudinal survey representative of persons at least 45 years of age in India**

- **To capture regional variations, LASI pilot study included two northern states (Punjab and Rajasthan) and two southern states (Karnataka and Kerala)**

- **The overall demographic characteristics of LASI pilot samples were similar to the general population of India**

- **Our analysis included 1,460 participants who had complete data from interview, physical examination, and bioassays**

Measures

- **Socioeconomic status**
  - **Education attainment**
    - **Illiterate**
    - **Literate but less than elementary education**
    - **Completing elementary school**
    - **Junior high school or above**
  - **Per capita household expenditure**
    - **To allow cross-country comparison, this measure was converted to US dollars and adjusted by purchasing power parities (PPP)**

Measures

- **Cardiovascular risk factors**
  - **Waist circumference**
    - **High risk is defined as > 102 cm in men or > 88 cm in women**
  - **Body mass index**
    - **High risk is defined as >= 30 kg/m^2**
  - **Hypertension**
    - **Self reported physician diagnosis**
    - **Taking medication for hypertension**
    - **Systolic blood pressure >=140 mmHg or diastolic blood pressure >=90 mmHg on physical examination**

Measures

- **Cardiovascular risk factors (cont.)**
  - **C-reactive protein levels**
    - **On plasma specimens from CHARLS participants**
    - **On dried blood spot specimens from LASI participants**
- **Demographic and other characteristics**
  - **Age**
  - **Gender**
  - **Living in rural versus urban areas**
  - **Caste (LASI only)**

Statistical Analysis

- **Summarize gender-specific descriptive statistics**
  - **Accounting for survey design and sample weights**
- **Chi-square test to determine statistical significance for the differences between genders within each country, and between two countries within same gender**
- **Gender-specific multivariate regression analyses to examine the associations between SES and cardiovascular risk factors**
  - **Adjustment for potential clustering effect**
  - **Log transformation of per capita expenditure in U.S. dollars after adjustment for purchasing power parities**
  - **For LASI analysis, we also included caste**

Distribution of sociodemographic characteristics by gender and study

	LASI		CHARLS	
	Men	Women	Men	Women
N	709	751	4623	5324
Age, mean (SD), years	58.2 (10.5)	57.8 (11.2)	60.5 (10.1) [+]	59.6 (10.1) [*+]
% living in rural area	75.3	70.7 [*]	66.3 [+]	64.2 [+]
Education categories, %				
Illiterate	41.0	55.2 [*]	13.8 [+]	43.8 [*+]
Literate	11.7	10.6	20.9 [+]	17.3 [*+]
Elementary school	14.7	11.9	27.5 [+]	17.8 [*+]
Junior high +	32.6	22.3 [*]	37.8 [+]	21.2 [*]
Per capita expenditure in USD and adjusted for PPP	1669	1732	2351	2416

* P<0.05 for testing gender difference within country
+ p<0.05 for testing country difference within same gender
PPP = purchasing power parities

Distribution of cardiovascular risk factors by gender and study

	LASI		CHARLS	
	Men	Women	Men	Women
N	709	751	4623	5324
% high risk waist circumference	28.7	50.1 *	5.5 +	39.3 *+
% high risk body mass index	2.4	8.2 *	2.9	6.1 *+
% Hypertension				
Self-reported diagnosis	14.1	19.6 *	23.8 +	26.4 *+
Taking medications	10.8	16.5 *	18.4 +	20.9 *+
High blood pressure measurement	42.0	43.6	30.5 +	32.7 +
Total	49.4	55.3	40.4 +	43.1 *
% C-reactive protein > 3 mg/L	17.2	13.9	19.4	17.5 *+

* P<0.05 for testing gender difference within country
+ p<0.05 for testing country difference within same gender

Gender-specific multivariate logistic regression analysis of the association between sociodemographic characteristics and high-risk waist circumference, by study

	LASI		CHARLS	
	Men	Women	Men	Women
Age (ref: 45 – 59 years)				
60 – 74 years	0.85 (0.43-1.71)	0.97 (0.68-1.38)	0.83 (0.59-1.16)	**1.25 (1.07-1.46)**
75 + years	1.15 (0.29-4.65)	1.20 (0.41-3.53)	0.88 (0.47-1.65)	1.18 (0.87-1.59)
Rural residency (ref: urban)	0.62 (0.22-1.70)	**0.46 (0.23-0.95)**	**0.40 (0.25-0.63)**	**0.65 (0.53-0.81)**
Education (ref: illiterate)				
Literate	**3.09 (1.31-7.29)**	1.14 (0.41-3.22)	0.80 (0.46-1.40)	1.10 (0.90-1.35)
Elementary school	2.10 (0.61-7.28)	**2.31 (1.11-4.80)**	1.08 (0.63-1.85)	0.86 (0.69-1.06)
Junior high +	**4.65 (2.10-10.32)**	**2.93 (1.42-6.06)**	0.99 (0.56-1.68)	**0.77 (0.61-0.96)**
Per capita expenditure in USD and adjusted for PPP (log scale)	1.09 (0.74-1.61)	**1.51 (1.13-2.02)**	1.19 (0.99-1.43)	1.06 (0.97-1.16)

* Data are presented as odds ratio (95% CI). State dummy and caste variables are included in LASI models and county dummy variables are included in the CHARLS models. PPP = purchasing power parities

Gender-specific multivariate logistic regression analysis of the association between sociodemographic characteristics and high-risk body mass index, by study

	LASI		CHARLS	
	Men	Women	Men	Women
Age (ref: 45 – 59 years)				
60 – 74 years	3.64 (0.86-15.39)	1.67 (0.70-3.98)	**0.58 (0.36-0.91)**	0.85 (0.63-1.15)
75 + years	1.15 (0.10-13.80)	0.72 (0.11-4.84)	**0.10 (0.01-0.77)**	0.57 (0.26-1.23)
Rural residency (ref: urban)	0.70 (0.19-2.53)	0.65 (0.40-1.07)	**0.47 (0.26-0.86)**	0.69 (0.44-1.07)
Education (ref: illiterate)				
Literate	1.88 (0.14-24.48)	2.08 (0.57-7.57)	0.83 (0.32-2.16)	0.85 (0.58-1.26)
Elementary school	**5.20 (1.09-24.79)**	1.76 (0.54-5.69)	1.30 (0.56-3.00)	0.74 (0.50-1.10)
Junior high +	1.74 (0.43-7.01)	**2.81 (1.08-7.31)**	1.01 (0.46-2.18)	**0.65 (0.43-1.00)**
Per capita expenditure in USD and adjusted for PPP (log scale)	1.72 (0.94-3.14)	**1.57 (1.11-2.24)**	1.15 (0.89-1.50)	1.05 (0.90-1.22)

* Data are presented as odds ratio (95% CI). State dummy and caste variables are included in LASI models and county dummy variables are included in the CHARLS models. PPP = purchasing power parities

Gender-specific multivariate logistic regression analysis of the association between sociodemographic characteristics and hypertension based on self report or examination, by study

	LASI		CHARLS	
	Men	Women	Men	Women
Age (ref: 45 – 59 years)				
60 – 74 years	**2.85 (1.84-4.41)**	**2.33 (1.41-3.86)**	**2.06 (1.76-2.43)**	**2.40 (2.04-2.82)**
75 + years	**4.70 (1.88-11.74)**	1.74 (0.88-3.41)	**3.13 (2.32-4.21)**	**4.89 (3.61-6.64)**
Rural residency (ref: urban)	1.23 (0.71-2.14)	0.72 (0.49-1.05)	**0.67 (0.54-0.85)**	**0.79 (0.64-0.98)**
Education (ref: illiterate)				
Literate	2.45 (0.83-7.22)	**2.57 (1.39-4.78)**	1.02 (0.78-1.33)	**0.81 (0.66-0.99)**
Elementary school	2.15 (0.94-4.94)	1.45 (0.76-2.76)	1.15 (0.89-1.49)	**0.77 (0.61-0.96)**
Junior high +	**2.17 (1.04-4.51)**	**2.07 (1.14-3.78)**	1.01 (0.78-1.31)	**0.66 (0.51-0.83)**
Per capita expenditure in USD and adjusted for PPP (log scale)	0.91 (0.71-1.18)	1.10 (0.89-1.37)	1.03 (0.94-1.13)	0.97 (0.89-1.06)

* Data are presented as odds ratio (95% CI). State dummy and caste variables are included in LASI models and county dummy variables are included in the CHARLS models. PPP = purchasing power parities

Other Results

- **CRP levels were lower among Chinese men with higher education**

- **No significant associations between CRP levels and education among Chinese women or Indian men or women**

- **No significant associations between CRP levels and per capita expenditure**

Discussion

- **High education attainment may have multiple and possibly opposing effect on cardiovascular risk factors in developing countries**
  - **Increase availability of high-energy and processed food**
  - **Sedentary lifestyle**
  - **Increase in health awareness**
  - **Better access to the health care system**
  - **Improved chronic disease management**
- **Therefore, the direction of education-CVD association may not be fixed, but subjective to unique context in time and societies**

Discussion

- **Strengths**
  - **Harmonized SES and health indicators**
  - **Objective biological measurements, in addition to self-reported information**
- **Limitations**
  - **A cross-sectional analysis**
  - **Misclassification of hypertension in a small number of cases**

Conclusions

- **SES is associated with cardiovascular risk factors in both China and India**

- **However, the relationship varies across these two countries**

- **This complexity may suggest different underlying causal pathways linking SES to CVD**

- **Relative impact of these causal pathways may be related to different stages of socioeconomic development**

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