Linking Socioeconomic Inequality, Indoor Air pollution and Cognitive Abilities among older adults in India and China: Evidence from WHO-SAGE

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Introduction

A number of population based studies have suggested that socioeconomic and demographic characteristics are associated with cognitive abilities, with increasing age, lower wealth quintile, female sex and lower education consistently associated with lower cognitive performance (Paul, Riberio and Santos 2010; Millan et al 2009). Cognitive decline is also associated with poor financial status (Xu et al 2014; Wee et al 2012). Socioeconomic inequalities have also been shown to contribute to discrepancies in cognitive abilities.

Air pollution from outdoor and indoor sources negatively affects cognitive function at all ages, though research has only recently focused on older adults (Ailshire & Crimmins, 2014; Clifford, Lang, Chen, Anstey, & Seaton, 2016; Saenz, Wong, & Ailshire, 2018). Exposure to indoor air pollution (IAP) as a major health risk factor in India and China primarily arises from use of solid fuels for cooking and heating, used by more than half of the population. Understanding the social and environmental determinants of cognitive impairment is important to identify modifiable risk factors in order to reduce costs of personal and health care by families and society and to extend the quality of life of older adults.

Being the top two populated countries of the world, India and China are undergoing a rapid demographic and epidemiologic transition. The demographic change is also leading to increase in the share of the elderly population who are vulnerable to various health problems. In both the countries majority of the population is located in rural areas, use solid fuel for cooking purposes, and are exposed to the risk of both acute and long-term ill health from emissions of solid fuel combustion.

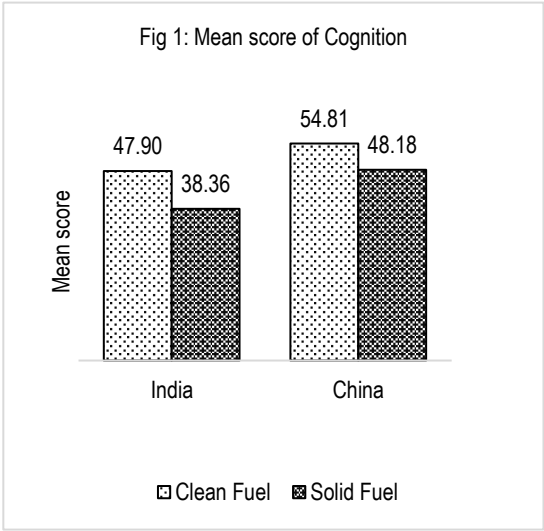
Compared with ambient air pollution, little is known about the mental health status in relation to indoor air pollution from the burning of unprocessed, solid biomass for cooking in India and China. So, in this study an attempt has been made to understand the association between indoor air pollution due to solid fuel use and mental health of older adults in India and China.

Data and Methodology

This study is based on WHO Study on global AGEing and adult health (SAGE)-wave-1 (2007-10) data, covering six LIMIC (low and middle-income countries) including China, Ghana, India, Mexico, Russian Federation and South Africa. The study analyses data on India and China for 50 years and above population.

Chi-Square (χ^2), t-test and ANOVA was used to check the association between independent and dependant variables and to compare means. Multivariable Linear regression model was adopted to assess the association between indoor air pollution and cognition of older adults.

Result and discussion



It is evident from Fig 1 that the older adults living in houses using solid fuels have lower cognitive score in India (38.3 vs 47.9, p< 0.001) and in China (48.1 vs 54.8, p< 0.001). Older adults living in houses without ventilation and separate kitchen also have lower cognitive score as compared with those adults living in houses with ventilation and separate kitchen facility in both India and China. It is clearly visible that mean score of cognition is showing a declining trend with increase in age of adults. Adults in the oldest age group i.e. 70 years and above have lowest score in comparison with the individuals aged 50-59 years in India (36.5 vs 43.2, p<0.001) and China (45.8 vs 55.2, p< 0.001). Furthermore, results show that older women have lower cognition score as compared to men in India (36.2 vs 45.2, p<0.001) and China (50.3 vs 52.4, p< 0.001). It was found that older adults residing in rural areas have lower cognition score in comparison with those living in urban areas of both the countries. However, it was observed lower among Indian older adults living in rural areas (39.1 vs 45.8, p< 0.001).Older adults with higher level of education have better cognitive abilities as compared to those with no or lower education in both the countries. Those with the highest education i.e. college and above have significantly better cognition score in case of India (59.2 vs 33.6, p< 0.001) as well as China (62.1 vs 43.4, p< 0.001). It was also observed that the older adults belonging to highest wealth quintile have better cognition score in comparison with adults from lowest wealth quintile. This holds true for both the countries.

Table 2 illustrates the result of linear regression analysis of cognition by indoor air pollution and other selected background characteristics. The results indicate that in India older adults exposed to solid fuel use have 2.09 lower cognition score than those unexposed older adults. However, in case of China older adults living in households using solid fuels have reported to have 3.2 points lower cognition score in comparison with those using clean fuel. Ventilation was found significantly associated with cognition in China only and the results how that older adults living in households without ventilation are likely to have 2.4 points lower cognition score as compared with older adults living in houses with ventilation facility in China. It was also found that availability of separate kitchen has negative effect on cognition score of older adults in China. The results from the linear regression analysis shows significant association between age and cognition in both the countries. Older adults in the 70 years and above age group are more likely to have lowest cognition score as compared to the 50-59 age group. It can be observed clearly that there is significant decrease in cognition score with the aging. In comparison with men, older women reported to have lower cognition score in both the countries. Education was significantly associated with cognitive performance and it was observed to be increasing with the increase in educational level. Older adults in higher wealth quintile have better cognition score than those in lowest quintile. In India, older adults engaged in high physical activity shows positive association with cognition score and have 3.2 points better cognition score as compared to the reference category. Adjusting for other factors in India older men exposed to solid fuel have reported to have 2.8 lower cognition score while in case of women the result was not statistically significant. On the other hand, in China, in comparison with older men, older women living in households using solid fuels have 3.6 lower cognition score while men reported to have 2.7 lower cognition score.

Conclusion:

Population structure is changing rapidly in India and China, concurrent with expanding economy and social development inequality, which may be associated with cognitive functioning of older adults. In addition, the Indoor Air Pollution has been found associated with socioeconomic conditions and greatly affects cognitive abilities. Hence, understanding the role of socioeconomic factors in determining health of older adults is essential in allocating resources appropriately.

Table 1 Mean score of Cognition by indoor air pollution and selected background characteristics

Exposure Variables	India			China		
	Mean Score	N	p value	Mean Score	N	p value
Cooking fuel						
Clean	47.90	1638		54.81	6845	
Solid	38.36	4622	0.001	48.18	5748	0.001
Ventilation						
Yes	44.87	2448		51.79	12232	
No	38.28	3812	0.001	51.41	361	0.552
Separate Kitchen						
Yes	42.59	4125		51.91	12336	
No	37.50	2135	0.001	45.81	257	0.001
Age						
50-59	43.21	2,866		55.26	5511	
60-69	40.24	2,117		51.87	3779	
70+	36.59	1,277	0.001	45.88	3303	0.001
Sex						
Male	45.23	3195		53.41	5868	
Female	36.29	3065	0.001	50.37	6725	0.001
Place of Residence						
Urban	45.87	1,604		54.70	6019	
Rural	39.13	4,656	0.001	49.11	6574	0.001
Marital status						
Currently Married	42.86	4,687		52.85	10381	
Unmarried	34.89	1,573	0.001	46.78	2212	0.001
Educational Status						
No education	33.65	3,127		43.47	3101	
Primary School	41.70	736		49.67	2310	
Secondary School	46.71	1,529		54.46	5049	
High School	53.78	553		59.01	1581	
College and above	59.23	315	0.001	62.12	552	0.001
Wealth Quintile						
Lowest	34.04	995		45.62	2538	
Low	36.83	1139		49.28	2520	
Middle	39.05	1158		51.66	2547	
Higher	43.08	1357		55.05	2575	
Highest	47.56	1573	0.001	57.77	2352	0.001
Tobacco Smoking						
No	40.70	3,283		51.38	9185	
Yes	41.02	2,977	0.391	52.88	3408	0.001
Drinking Status						
Never	40.53	5259		51.23	8690	
Infrequent Drinker	41.24	463		53.29	2584	
Frequent Drinker	43.64	538	0.001	52.50	1319	0.001
Fruit Intake						
Insufficient	40.87	6,215		51.13	10718	
Sufficient	38.29	45	0.234	55.50	1875	0.001
Vegetable Intake						
Insufficient	40.86	6,136		49.05	3506	
Sufficient	40.20	124	0.614	52.84	9087	0.001
Physical Activity						
Low	37.98	1,867		51.42	5218	
High	42.07	4,393	0.001	52.04	7375	0.004
Total	40.85	6,260		51.78	12593	

Note: ANOVA for more than two groups and t-test for only two groups

Table 2 Results of linear regression analysis of Cognition by indoor air pollution and selected background characteristics.

Exposure Variables	India		China	
	Coeff.	**95% CI**	**Coeff.**	**95% CI**
Cooking fuel				
Clean ®				
Solid	-2.099***	(-3.269 -0.929)	-3.227***	(-3.776 -2.677)
Ventilation				
Yes®				
No	-0.406	(-1.288 0.476)	-2.479***	(-1.372 -3.586)
Separate Kitchen				
Yes®				
No	0.149	(-0.535 0.834)	-1.513**	(-2.819 -0.206)
Age				
50-59®				
60-69	-1.657***	(-2.316 -0.998)	-2.347***	(-2.769 -1.924)
70+	-3.834***	(-4.66 -3.009)	-6.586***	(-7.08 -6.092)
Sex				
Male®				
Female	-4.733***	(-5.466 -4)	-1.489***	(-1.957 -1.02)
Place of Residence				
Urban®				
Rural	-0.727	(-1.557 0.102)	-0.115	(-0.653 0.422)
Marital status				
Currently Married®				
Unmarried	-2.018***	(-2.744 -1.292)	-0.858***	(-1.356 -0.36)
Educational Status				
No education®				
Primary School	5.789***	(4.839 6.738)	3.478***	(2.913 4.043)
Secondary School	8.969***	(8.176 9.762)	6.417***	(5.892 6.942)
High School	14.088***	(12.914 15.261)	9.386***	(8.674 10.099)
College and above	18.214***	(16.706 19.722)	12.644***	(11.641 13.648)
Wealth Quintile				
Lowest ®				
Low	1.8***	(0.826 2.773)	1.041***	(0.479 1.604)
Middle	3.011***	(2.024 3.998)	1.291***	(0.705 1.877)
Higher	4.287***	(3.29 5.284)	3.368***	(2.766 3.969)
Highest	5.445***	(4.387 6.504)	4.306***	(3.65 4.963)
Tobacco Smoking				
No®				
Yes	-0.11	(-0.745 0.518)	-0.004	(-0.499 0.491)
Drinking Status				
Never®				
Infrequent Drinker	-1.772***	(-2.922 -0.621)	0.38	(-0.127 0.887)
Frequent Drinker	-0.71	(-1.78 0.352)	0.211	(-0.395 0.817)
Fruit Intake				
Insufficient®				
Sufficient	-2.75	(-6.396 0.906)	0.803***	(0.289 1.317)
Vegetable Intake				
Insufficient®				
Sufficient	-2.10	(-4.322 0.128)	1.908***	(1.5 2.316)
Physical Activity				
Low®				
High	3.274***	(2.626 3.922)	0.011	(-0.362 0.384)
Constant	37.09		48.12	

*Note: ® reference category, *** p<0.01, ** p <0.05*

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