Old and Wise: Assessing the link between cognition and overall wellbeing in later life

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Abstract

Cognitive health reflects mental capacities which are important contributor of overall wellbeing in old age. In this study, we assess the association between cognitive ability with multidimensional wellbeing measures such as WHO-QoL scale, functional health, general health, among older adults in aged 50+. Cross-country analysis is performed using the WHO-SAGE and SHARE data for Low and Middle and High-Income Countries. To understand the composite effect of cognition on overall wellbeing, we made a cognitive index combining four variables: verbal fluency, verbal recall, digit span forward and digit span backward. Regression results indicate that higher cognitive ability is associated with lower risks of reporting poor self-rated health, 1+ADL and 1+IADL limitations. Higher cognitive ability is positively associated with quality of life score and physical function measures across countries. Improving cognitive abilities across the life course are important to improve the overall wellbeing in later life.

Background

"Cognitive health—the ability to clearly think, learn, and remember—is an important component of brain health" Cognitive ability reflects mental capacities which are important determinant of overall wellbeing in old age. In emerging literature, memory and executive function are recognized as a key indicator under the domain of cognitive; one of the five functional domains of Intrinsic Capacity as part of the WHO framework of health ageing metrics (de Carvalho et al., 2017). WHO defines Intrinsic Capacity (IC) as "the measure of all the physical and mental capacities that an individual can draw on at any point in time" (WHO 2016). Lower cognitive ability is linked with higher risk of all-cause of mortality (Gottfredson and Deary, 2004; Batty, Deary and Zaninotto, 2016). On the other hand, better cognitive ability is linked with better physical and mental health outcomes (Jokela et al., 2010; Shimada et al.,

2016; Ahmed, Kesavayuth and Zikos, 2018) and avoiding risky health behaviours (Batty et al., 2007).

The rising share of the older population is a global phenomenon which will impact almost all aspects of society. By 2050, one in five people will be 60 years or older, totalling 2 billion people worldwide. Maintaining health and wellbeing across the life course are important to attain healthy ageing (WHO, 2015). Understanding the determinants of wellbeing is important to improve the understanding of the growing older population, thereby policies can be suggested to improve the quality of ageing. The aim of this study is to assess the association between cognitive ability, overall and specific dimensions of multidimensional wellbeing measures such as WHO-Quality of Life scale, CASP index of quality of life and well-being, WHO-DAS, 1+ADL, 1+IADL, gait speed and general health among older adults in aged 50+.

Materials and Methods

WHO-SAGE

We use data from the WHO's Study on Global Ageing and Adult Health (SAGE). SAGE is a nationally representative household health survey conducted in six countries: China, Ghana, India, Mexico, the Russian Federation and South Africa. This analysis focussed on sample of older adults aged 50 years and above. The analysis was carried out using the nationally representative sample with the total sample of 30155 older adults in age 50+. Details on sampling and the methodology are available in Kowal et al, 2012. SAGE is nationally representative and cohort study conducted in six countries; India, China, Ghana, Mexico, Russia and South Africa during 2007-10. The aim of the SAGE was to fulfil the data gaps to understand the health and wellbeing of the growing aging population in six low and - countries. SAGE measures are comparable with other studies from high-income countries such as the Health and Retirement Study (HRS), the Survey of Health, Ageing and Retirement in Europe (SHARE). SAGE collects data on self-reported as well as biomarkers data on different domains of health, wellbeing and anthropometric indicators.

SHARE

The Survey of Health, Ageing and Retirement in Europe is a multidisciplinary and cross-national panel database of micro data on health, socioeconomic status as well as social and family networks of more than 45,000 individuals aged 50 or above. A total of five waves has been conducted; the first wave was conducted in 2004, wave 2nd in 2006-07, wave 3rd in 2008-

09, wave 4th in 2010-11 and 5th in 2012-13. The survey covers many nations in the European regions and also covering a wide range of indicators including health variables (e.g. self-reported health, health conditions, physical and cognitive functioning, health behaviours, use of health care facilities), biomarkers (e.g. Grip strength, body mass index, peak flow), psychological variables (e.g. Psychological health, well-being, life satisfaction), economic variables (current work activity, job characteristics, opportunities to work past retirement age, sources and composition of current income, wealth and consumption, housing, education), and social support variables (e.g. Assistance within families, transfers of incomes and assets, social networks, volunteer activities). In this study, we used the SHARE wave 2 data.

Definition and Variable Construction

Predictor Variable

Cognitive functioning

To understand the composite effect of cognition we made a cognitive index combining four variables: verbal fluency, verbal recall, digit span forward and digit span backward.

Different cognition tests and procedure used in the survey are;

> **Verbal recall:** Interviewer read out a list of 10 commonly used words to the respondents and asked them to repeat again in some time.
>
> **Digit span (forward and backward):** Participants were read a series of digits and asked to immediately repeat them back. In the backward test, the person must repeat the numbers in reverse order. These tests measure concentration, attention, and immediate memory.
>
> **Verbal fluency:** Participants were asked to produce as many animal names as possible in one-minute time span. This test assessed retrieval of information from semantic memory.

The composite index was derived using Principal Components Analysis (PCA), a mathematical tool which helps in creating a composite index using uncorrelated components, where each component captures the largest possible variation in the original variables. Selected raw scores for cognitive tasks were bundled into three domains (digit span, memory and executive functioning) to yield compound cognitive scores. This was done to condense the number of

cognitive variables while refining the robustness of the underlying cognitive construct. We followed two steps to make a cognitive index:

Step 1: All four variables were in different scales. So first, we standardized these variables. A standardized variable (sometimes called a z-score or a standard score) is a variable that has been rescaled to have a mean of zero and a standard deviation of one. Each case's value on the standardized variable designates its difference from the mean of the primary variable in some standard deviations (of the original variable).

Step 2: PCA is a multivariate statistical technique used for extracting from a set of variables those few orthogonal linear combinations that capture the common information most successfully. Further, this index comprises both values, positive and negative. So we converted this index into a 0–100 scale which facilitates easier interpretation of the data. Higher scores indicate better cognitive abilities.

Dependent variables

Self-Rated Health (SRH)

This study used self-rated health as one of the outcome variables. In SAGE, self-rated health was assessed on a five-point scale with the following question: In general, how would you rate your health today? The response categories were: 'very good', 'good', 'moderate', 'bad' and 'very bad'. In the analysis, 'bad' and 'very bad' health categories were combined to represent poor self-rated health.

Activities of Daily Living (1+ADL) and Instrumental Activities of Daily Living (1+IADL)

Self-rated functional health was assessed through a set of questions based on the Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADL). In SAGE and SHARE surveys data collected on ADLs and IADLs based on self- reports about particular activities in the last 30 days on a five-point scale ranging from none to extreme difficulty. In this study, severe and extreme difficulties were combined. The ADLs include sitting, walking, standing-up, standing, climbing, crouching, picking up, eating, dressing, using the toilet, moving around in home, transferring and concentrating for about 10 minutes. The IADLs include using public transport, carrying out household responsibilities, joining community functions and getting out of the household.

WHODAS score

The 12-item version of WHODAS 2.0 encompasses all six domains of the full version: cognition, mobility, self-care, getting along, life activities and participation in society. Its psychometric properties in older people from low and middle income countries have been validated previously. WHODAS score ranges from 0 (no disability) to 100 (full disability).

Quality of Life Index (WHO-QoL)

We used the quality of life questionnaire (S-QoL 30) from the WHO-SAGE data set, which was a particular, self-administered and multidimensional QoL questionnaire designed for people. It included 30 items describing five dimensions: physical health (PHY), psychological health (PSY), level of independence (IND), social relation (SOC) and environment (ENV). It also included a total score (Index). The five dimensions and the Index score ranged from 0 to 100; higher scores indicated better quality of life.

Quality of life (QoL)

The CASP-12v.1 is a short version of the original scale (CASP-19) and was developed specifically for SHARE. Each of its 12 items is answered using a four-point Likert-type scale, and the total score, which ranges between 12 and 48, higher score indicating better quality of life.

Gait speed

Mobility of the study participants was assessed in 4-meter timed walk. The respondents were requested to walk in normal pace. The speed of walk measured in m/sec. In the analysis, we divided walking speed into two categories: less than or equal to 0.4 m/sec as normal walking speed and more than 0.4 m/sec as slow walking speed.

Covariates

Age, place of residence[urban/rural], marital status [currently married/otherwise], years of education [0-4 years of education, 6-9 years of education and 10+ years], wealth quintile [poorest, poorer, middle, richer, richest], Multi-morbidity.

Statistical Analysis

We generated country or region-specific cognitive quintile to examine the association of cognitive abilities with various outcomes- poor self-rated health, 1+ADL, 1+IADL, gait speed, WHO-DAS, WHO-QoL, CASP. Logistic regression was used to examine the association of cognitive quintile with poor self-rated health, gait speed, 1+adl and iadl. The multivariate linear

regression model was adopted to assess the linkages of cognitive abilities with functional health (WHO-DAS), quality of life adjusting for selected socio-demographic and health risk factors.

Preliminary findings

Table 1 shows descriptive statistics of the study population. Of the total sample of 30155 older adults in all six countries, China has proportionately a higher sample size of 40 percent. The mean age of older adults in Southern Europe was higher (65.8 years) and was lower in India (61.3 years). In Mexico, Russia, and South Africa, Continental Europe and Southern Europe, the share of older women participants are much higher than older men. The mean quality of life and cognition score was higher in Russia, whereas older adults in India had higher prevalence of 1+ADL (52 %) and 1+IADL (26.9 %). 22 % of the student population in India and 21.5% in Russia reported poor self-rated health. The proportion who had normal walking speed was higher in China.

Results from regression analysis on the association of cognitive quintile with self-rated health, WHO-DAS, 1+adl, 1+iadl, quality of life are shown in **table 2**. The results are adjusted for age, residence, gender, schooling, wealth quintile, multimorbidity and height. Older adults in lowest cognitive quintile were 2.80 times more likely to report poor health in India compared to older adults highest cognitive quintile. Similar findings are evident from other countries too; older adults in China, Ghana, Russia and South Africa and Europe had poor general health with lower cognitive ability. The pattern is similar with functional health indicators such as gait speed, 1+adl, iadl and WHO-DAS that lowest cognitive quintile is positively associated higher likelihood of disabilities across countries six countries. Higher cognitive ability is positively associated with quality of life.

Table 3 shows the regression results from SHARE data indicates similar findings that higher cognitive ability is associated with lower likelihood of poor SRH, 1+ADL and 1+IADL across regions. Further, older adults in lowest cognitive quintile had lower quality of life score (CASP) as compared to highest cognitive quintile.

Summary and Conclusion

The implication of global ageing is expected to affect every individual in the society. However, a growing body of literature argues that older population are assets as they can contribute and take part in the society. Maintaining wellbeing and delaying onset of disabilities will further reduce the burden of the individual and the economy, thereby an individual can contribute more to the society. The role of cognitive function is important which enable the individual to function independently, thereby reducing the burden of ageing. Maintaining higher cognitive ability is one of the important components of healthy ageing (WHO, 2015). This study examined the impact of cognitive ability on health and wellbeing measures across low, middle and high-income countries.

Results revealed a significant and strong association between cognitive ability and self-rated health, activities of daily living, instrumental activities of daily living, WHO-DAS, quality of life and gait speed. This association is consistent and stronger across different indicators in India, China, Ghana, Russia and South Africa and Europe. The results of this study strongly highlight the role of higher cognitive ability in later life is important determining overall wellbeing.

Table 1 Characteristics of the study population, WHO-SAGE and SHARE

Survey	WHO-SAGE						SHARE (Northern Europe)	SHARE (Continental Europe)	SHARE (Southern Europe)
Country/region	India	China	Ghana	Mexico	Russia	South Africa	Denmark, Ireland and Sweden	Austria, Germany, Netherlands, France, Switzerland, Belgium, Israel, Czech Republic and Poland	Spain, Italy and Greece
Year of survey	2007/10	2007/10	2007/10	2007/10	2007/10	2007/10	2006/07	2006/07	2006/07
Sample size	6,560	13,106	4,305	2,301	3,763	3,836	6,432	21,585	8,606
Mean age	61.5	62.6	64.4	63	63.9	61.6	65	65	65.8
Mean years of schooling	3.7	5.6	4.2	5	11.1	6	11.8	11.3	7.8
% Female	49	50.2	47.6	53.2	61.1	56	52.7	54.8	54.4
Mean cognition	38.2	50.9	44	43.6	53.2	45	43.24	31.63	39.19
Poor SRH (%)	22.4	21.2	17.1	17	23.1	17.5	7.3	13.6	13
1+ADL (%)	52	12.8	40.2	34.4	23.5	34.8	10.23	11.38	12.71
1+IADL (%)	26.9	3.4	17.8	8.2	10.8	13.6	15.34	19.3	17.62
WHO-DAS score	27.5	8.9	21.9	14.6	17.9	19.9	-	-	-
% Gait speed (normal)	20.5	50	16.3	26.3	18.4	20.4	-	-	-
Quality of life (WHO)	49.5	52.6	45.8	53.4	50.5	47.8	-	-	-
CASP score	-	-	-	-	-	-	39.2	34.11	37.26

Table 2 Multivariable regression results on the association of cognitive ability with general health, functional ability, quality of life and in six countries

	Quintile 1 (Ref=Quintile 4)	Quintile 2 (Ref=Quintile4)	Quintile 3 (Ref=Quintile 4)		
	OR [95% CI]	OR [95% CI]	OR [95% CI]	Pseudo R^2	n
Self-rated health					
India	2.80***(2.18,3.58)	1.90***(1.50,2.42)	1.45***(1.14,1.84)	0.1034	6003
China	1.80***(1.52,2.12)	1.34***(1.14,1.57)	1.12 (.95,1.31)	0.1201	11550
Ghana	1.61***(1.16,2.25)	1.36*(.99, 1.88)	1.38**(1.01,1.89)	0.0749	3706
Mexico	1.26 (.75,2.13)	1.20(.73,1.97)	1.50*(.94,2.39)	0.0736	1768
Russia	2.44***(1.74,3.40)	1.96***(1.41,2.71)	1.38*(.99,1.94)	0.1947	2630
South Africa	2.53***(1.68,3.82)	1.49(.99,2.24)	1.03(.67,1.59)	0.1083	2333
Pooled	2.00***(1.79,2.23)	1.49***(1.34,1.65)	1.24***(1.11,1.38)	0.1104	27990
1+ADL					
India	1.97***(1.62,2.38)	1.56***(1.31,1.86)	1.28***(1.08,1.51)	0.1475	6003
China	2.69***(2.14,3.37)	1.59***(1.27,2.00)	1.27**(1.00,1.61)	0.1626	11545
Ghana	1.28**(1.00,1.64)	1.12(.88, 1.41)	1.24*(.99,1.55)	0.148	3707
Mexico	1.23(.88,1.72)	1.01(.74,1.37)	1.00(.74,1.36)	0.1224	1768
Russia	1.78***(1.29, 2.45)	1.31*(.95,1.79)	1.16(.85,1.60)	0.2195	2633
South Africa	1.69***(1.25,2.29)	1.41**(1.06,1.88)	1.03(.77,1.38)	0.0707	2334
Pooled	1.89***(1.71,2.09)	1.37***(1.24,1.51)	1.20***(1.09,1.32)	0.2236	27990
1+IADL					
India	1.77***(1.42,2.20)	1.37***(1.11,1.69)	1.13(.92,1.40)	0.1347	6003
China	3.52***(2.26,5.49)	1.82***(1.16,2.86)	1.15(.70,1.87)	0.1778	11540
Ghana	1.71***(1.22,2.41)	1.33*(.95,1.87)	1.17(.84,1.64)	0.1396	3706
Mexico	1.53(.90,2.61)	1.05(.62,1.79)	1.22(.72,2.06)	0.1224	1766
Russia	3.37***(2.11, 5.37)	1.91***(1.19,3.08)	1.48(.90,2.45)	0.2109	2628
South Africa	1.43*(.94,2.18)	0.87(.57,1.33)	0.71(.46,1.11)	0.0821	2334
Pooled	2.06***(1.79,2.37)	1.36***(1.18,1.57)	1.13*(.98,1.31)	0.2134	27977
Walking speed (normal)					
India	0.66***(.52,.84)	0.81*(.66,1.00)	0.88(.73,1.07)	0.074	6003
China	0.69***(.60,.78)	0.84***(.75,.94)	0.89**(.80,.99)	0.0857	11563
Ghana	0.97 (.72,1.29)	0.76*(.57,.99)	0.92(.71,1.18)	0.074	3707
Mexico	0.57***(.38,.86)	0.58***(.40,.83)	0.75*(.54,1.05)	0.1153	1768
Russia	0.62**(.43,.91)	0.51***(.36,.71)	0.63***(.47,.85)	0.0879	2633

South Africa	0.33***(.23,.46)	0.39***(.28,.52)	0.48***(.36,.64)	0.064	2336
Pooled	0.63***(.57,.69)	0.73***(.67,.79)	0.82***(.76,.89)	0.1489	28010
WHO-DAS				Adjusted R^2	
	β [95% CI]	β [95% CI]	β [95% CI]		
India	6.62***(5.25,8.00)	3.74***(2.46,5.01)	1.31**(.12,2.51)	0.2805	6003
China	5.63***(5.01,6.25)	1.97***(1.41,2.53)	0.59**(.05,1.13)	0.2782	11538
Ghana	10.41***(8.76,12.06)	5.33***(3.79,6.88)	3.83***(2.35,5.31)	0.2659	3707
Mexico	4.41***(2.13, 6.68)	-0.30(-2.38,1.77)	-.01(-2.02,1.99)	0.1771	1768
Russia	8.55***(6.98,10.13)	4.32***(2.87,5.76)	1.74**(.35, 3.12)	0.4085	2633
South Africa	8.5***(6.30,10.7)	5.23***(3.18,7.27)	2.08**(.08,4.08)	0.151	2336
Pooled	7.05***(6.52,7.57)	3.20***(2.72,3.69)	1.39***(.92, 1.85)	0.381	27985
Quality of Life (QoL)					
India	-3.55***(-4.44,-2.66)	-2.30***(-3.12,-1.47)	-1.72***(-2.49, -.95)	0.2441	6003
China	-3.81***(-4.52,-3.10)	-1.66***(-2.31,-1.01)	-0.54*(-1.16,.06)	0.1457	11563
Ghana	-6.02***(-7.20,-4.84)	-3.76***(-4.87,-2.66)	-2.52***(-3.58,-1.46)	0.1975	3707
Mexico	-2.05***(-3.45,-.65)	-1.34**(-2.61, -.06)	-0.86(-2.09,.37)	0.1304	1768
Russia	-4.37***(-5.70,-3.04)	-2.14***(-3.36,-.92)	-.72(-1.89,.44)	0.2386	2633
South Africa	-4.80***(-6.25,-3.36)	-2.41***(-3.75,-1.07)	-1.59**(-2.90,-.28)	0.2102	2336
Pooled	-4.02***(-4.45,-3.59)	-2.07***(-2.46,-1.67)	-1.12***(-1.50,-.75)	0.2029	28010

Q=quintile, CI: Confidence Interval *** Significant at p < .001, ** Significant at p < .005, * Significant at p < .01, All regression models were adjusted for age, sex, place of residence, marital status, years of education, wealth quintile, height and multi-morbidity

Table 3 Multivariable regression results on the association of cognitive ability with general health, functional ability, quality of life in Europe, SHARE

	Quintile 1 (Ref=Quintile 4)	Quintile 2 (Ref=Q4)	Quintile 3 (Ref=Q4)		
	OR [95% CI]	OR [95% CI]	OR [95% CI]	Pseudo R^2	n
Poor Self-rated health					
Northern Europe	2.80***(1.94, 4.03)	1.79***(1.25, 2.58)	1.04(.70,1.54)	0.1056	6119
Southern Europe	2.75***(2.07,3.64)	1.54***(1.16,2.06)	1.16(.85,1.57)	0.1607	8041
Continental Europe	4.50***(3.82,5.30)	1.98***(1.68, 2.34)	1.36***(1.14,1.63)	0.1653	20263
Pooled	3.84***(3.37,4.39)	1.87***(1.11, 1.48)	1.28***(1.11,1.48)	0.1608	34423
1+ADL					
Northern Europe	3.09***(2.25,4.25)	1.51**(1.09, 2.10)	0.87(.60, 1.24)	0.137	6119
Southern Europe	3.13***(2.26,4.36)	1.63***(1.16,2.29)	1.45**(1.02,2.06)	0.1861	8037
Continental Europe	3.14***(2.66,3.70)	1.64***(1.38,1.94)	1.17*(.97,1.40)	0.1579	20258
Pooled	3.13***(2.74,3.57)	1.61***(1.41,1.85)	1.16**(1.00,1.34)	0.1593	34414
1+IADL					
Northern Europe	3.05***(2.34,3.98)	1.54***(1.17,2.02)	0.78(.57,1.05)	0.1842	6119
Southern Europe	2.35***(1.87,2.94)	1.50***(1.19,1.88)	1.16(.91,1.47)	0.2077	8037
Continental Europe	3.08***(2.70,3.52)	1.55***(1.35,1.77)	1.14*(.99,1.31)	0.1818	20258
Pooled	2.92***(2.63,3.24)	1.55***(1.40,1.73)	1.10*(.98,1.23)	0.1876	34414
Quality of Life (CASP)	β [95% CI]	β [95% CI]	β [95% CI]	Adjusted R^2	
Northern Europe	-1.93***(-2.33,-1.54)	-.58***(-.94,-.22)	-0.29(-.64,.05)	0.0848	5902
Southern Europe	-2.97***(-3.37,-2.58)	-1.83***(-2.19,-1.46)	-1.01***(-1.36,-.66)	0.1925	7831
Continental Europe	-4.11***(-4.37,-3.84)	-1.95***(-2.19,-1.71)	-1.01***(-1.24,-.78)	0.1579	18865
Pooled	-3.50***(-3.69,-3.31)	-1.74***(-1.91,-1.56)	-.91***(-1.08,-.74)	0.2176	32598

Q=quintile, CI: Confidence Interval *** Significant at p < .001, ** Significant at p < .005, * Significant at p < .01, All regression models were adjusted for age, sex, marital status, years of education, and multi-morbidity

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