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Cognitive functioning among poor elderly persons: evidence from Peru

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Abstract

The recent emergence and expansion of non-contributory pension programmes across low- and middle-income countries responds and contributes to a larger attention towards the population of elderly individuals in developing countries. These programmes are intended to reduce poverty in old age by providing monetary transfers in mean-tested schemes. However, little is known about the most salient characteristics of this population, particularly health outcomes and their relationship with socioeconomic demographics. The aim of this paper is to provide evidence about this relationship in the specific case of cognitive functioning. We exploit the baseline sample of the Peru's non-contributory pension programme *Pension 65* and find significant relationships between cognitive functioning and retirement, education, nutrition, ethnicity and sex.

JEL Classification: J14, J24

Keywords: Cognitive functioning, Old-age poverty, Peru

1 Introduction

Elderly individuals with more cognitive impairments are less autonomous and can represent a major public health problem in the context of ageing societies. Cognitive impairment or dementia is associated with lower quality of life and increased disability and higher health expenditure (Bonsang et al. 2012). It has also been shown that having good cognitive functioning in old age is important for people to make better financial decisions and for preventing larger public spending on healthcare for the elderly (Lei et al. 2012; Bonsang et al. 2012; Banks et al. 2015). Furthermore, elderly individuals in rural areas play an important role in passing on traditions, dialects, customs and memories, and therefore, it is also important to have healthy individuals who can contribute to and preserve the social capital of the community.

Due to the generally lower participation in social security and larger credit constraints in developing countries, elderly individuals may face a larger burden than individuals living in developed economies. Elderly individuals in developing countries also tend to keep working at an advanced age or even never retire. To deal with this, many developing countries have implemented non-contributory pension schemes targeted to the elderly poor.[1] However, not much is known about the relationship between cognitive functioning and retirement and other socioeconomic characteristics for this particular population. In this paper, we aim to improve the understanding of the relationship between individuals' socioeconomic characteristics and cognitive functioning among the elderly poor.

In terms of human capital, cognitive functioning may be regarded as a measure of accumulated capital. This capital has a certain depreciation rate which speed can be affected through some cognitive maintenance and repair activities (McFadden 2008). Rohwedder and Willis (2010) have proposed the 'mental retirement' effect, which indicates that individuals not only retire from work but also suffer accelerated cognitive decline due to insufficient cognitive stimulation in retirement (see also Mazzona and Peracchi 2012; Bingley and Martinello 2013; Coe and Zamarro 2011 and Bonsang et al. 2012).

This paper analyses the cognitive functioning of old persons living in poverty and addresses the role of important variables such as education, retirement, ethnicity, objective nutritional status in the short and long term and variables at the community level. For long-term nutritional status, the analysis employs arm span as a proxy for the quality of nutrition acquired in childhood, which positively affects the development of cognitive ability (Case and Paxson 2008; Guven and Lee 2013, 2015). Therefore, our paper follows a large body of recent research documenting the importance of accounting for parental input and schooling at early ages in the formation of cognitive skills (Todd and Wolpin 2003; Cunha et al. 2006; Cunha et al. 2010; Cunha and Heckman 2007, 2008). For short-term nutritional status, the analysis utilizes individuals' haemoglobin levels. Recent evidence suggests that poor nutritional status is associated with an increase in the risk of dementia (Hong et al. 2013). The issue of potential ceiling effects in the measurement of cognitive functioning is also tackled in this study.

For the purposes of the paper, we use Peru's Survey of Health and Wellbeing of the Elderly (ESBAM), which samples elderly individuals living in households officially classified as poor and contains a comprehensive set of biomarkers and socioeconomic variables for the elderly individuals and household information. ESBAM differs from other large-scale surveys examining old age in the sense that this survey has been specially designed to collect information from the population of elderly and poor individuals.

The rest of the paper is organised as follows: in Section 2, we describe the data and in Section 3, we present the methods. The results are reported and discussed in Section 4, and a conclusion is provided in Section 5.

2 Data

2.1 The Survey of Health and Wellbeing of the Elderly

ESBAM (*Encuesta de Salud y Bienestar del Adulto Mayor*) is a unique survey collected by the National Institute of Statistics of Peru (INEI) between November and December 2012. It includes a detailed questionnaire for 65–80-year-old individuals, which includes information about their socioeconomic position, well-being, beliefs and several subjective and objective health variables. ESBAM also contains socioeconomic questions about the household and its members. The information was collected in face-to-face interviews by INEI's interviewers, while the anthropometrical measures, blood samples and arterial pressure measurements were collected by specialised technicians during the fieldwork.

The data was gathered in 12 departments[2] (half of the total in Peru), where the Ministry of Development and Social Inclusion (MIDIS) had already completed the census of socioeconomic variables intended to update its household targeting score system *Sistema de*

Focalización de Hogares (SISFOH). The goal of ESBAM is to serve as a baseline for the programme *Pension 65*, which is the non-contributory pension scheme implemented in Peru at the end of 2011. The population of the survey are 65–80-year-old individuals living in households classified as poor.[3] The sampling selection was probabilistic, independent in each department, stratified in rural/urban areas and carried out in two steps. In the first step, the primary sampling units (PSU) were census units in urban areas and villages in rural areas with at least four households living in poverty and with elderly members. The selection of PSU was made by probability proportional to size (PPS) according to the total number of households. In the second step, four households were randomly drawn from each PSU for interview and two for replacements. The initial sample size comprises 4151 individuals who completed the survey questionnaire themselves. This was reduced to 3884 individuals for our purposes. We dropped 194 individuals with missing information for some variables, 20 individuals whose mother tongue is a foreign language or an unspecified indigenous language and 53 unemployed people.

The sample contains a large number of retirees and working individuals at later ages, which allows us to observe cognitive differentials between working and non-working people in their later years. This is different from data collected in industrialised countries, where cognitive functioning is very difficult to observe in working individuals at advanced ages because most people stop working at statutory retirement ages. In our sample, 1615, 1272 and 997 individuals are 65–69, 70–74 and 75–80 years old, respectively.

2.2 The cognitive score

ESBAM uses a shortened version of the Mini-Mental State Examination (MMSE) (Folstein et al. 1975) to evaluate cognitive functioning. This is similar to the version used in the Survey on Health, Well-Being, and Aging (SABE) implemented during the early 2000s in seven capital cities of Latin America and the Caribbean (Maurer 2010). Given the low literacy rates among elderly Latin American individuals, SABE employed a reduced version of the MMSE in order to minimise the strong bias produced by education on performing the test (Fillenbaum et al. 1988; Herzog and Wallace 1997). This is also relevant for our sample of elderly poor individuals, who report very low levels of education (28.5% are illiterate and only 20.9% have at most completed primary education).

The score for cognitive functioning is computed using five questions. The first question is about *orientation* and asks the day of the week, day of the month, month and year. Each correct answer is given one point. In the second question, the interviewer reads three words that the individual must recall immediately in any order. This question measures *immediate memory recall*. The respondent is asked for these words again later (the fourth question) in order to measure *delayed memory recall*. A point is given for each word correctly answered. The third question is a *command* comprising three actions that the respondent has to complete in order: ‘I will give you a piece of paper. Take this in your right hand, fold it in half with both hands and place it on your legs’. One point is given for each correct action. Lastly, a point is added for respondents who are able to duplicate a picture of two intersecting circles, provided that the circles do not cross more than half way. This measurement (*drawing*) captures the intactness of visual-spatial abilities. The cognitive score is the result of adding up the points obtained for these five questions. Table 1 shows the distribution of points for each type of question.

Table 1 Distribution of cognitive score by question

Cognitive skills question ($N = 3884$)	Correct answers (%)						Mean score
	0	1	2	3	4	Total	
Orientation	2.2	7.2	16.9	30.4	43.2	100.0	3.1
Word memory immediate recall	0.7	1.5	13.6	84.1	–	100.0	2.8
Command following	0.5	3.7	21.2	74.6	–	100.0	2.7
Word memory delayed recall	6.5	10.8	33.5	49.2	–	100.0	2.3
Drawing	12.7	87.3	–	–	–	100.0	0.9
Total							11.7

The total score for cognition can range from 0 to 14 points. Similar to Lei and colleagues (2012; 2014), we also consider two distinct components of cognitive functioning: *episodic memory* and *mental intactness*. The first component is the sum of the two memory scores (0–6 points), and the second is the sum of *orientation*, *command* and *drawing* (0–8 points).

2.3 Variables

The questions concerning retirement and employment status in ESBAM follow conventional questions in household surveys to evaluate whether the individual is working, retired or unemployed.[4] Retirement is introduced in the analysis as a dummy variable. The analysis includes age, age squared and dummies of age, gender, literacy, area (urban or rural) and ethnicity, which is assessed by the mother tongue of the individual (Quechua, Aymara or Spanish). The inclusion of ethnicity is aimed at accounting for cumulative deprivation experienced by indigenous groups in many dimensions, which might affect cognition and go beyond education and health.[5] In addition, we include haemoglobin and arm span measurements as variables assessing short- and long-term nutritional status. Haemoglobin is measured from a blood sample taken from each respondent and corrected for the altitude of the district where the individual lives, in accordance with WHO norms (WHO 2011). This variable controls for the effect of anaemia, which has been linked to an increase in the risk of dementia through low oxygen levels affecting brain functions and damaging neurons, and hence reducing memory and thinking abilities (Hong et al. 2013). Anaemia can affect an important number of the elderly, because old age is associated with diet monotony, less intestinal mobility and lower intake of energy. According to WHO norms, haemoglobin levels should be between approximately 120 and 160 g/L. In our sample, the mean for haemoglobin is 132. 21.6% of respondents have less than 120 g/L, and 5.4% have more than 160 g/L.

Cognitive performance in later age is positively related with nutrition quality acquired in childhood. Case and Paxson (2008) find a strong correlation between height in early life and adulthood and indicate that an adult's height can be a proxy for the quality of nutrition and health in childhood. Guven and Lee (2013, 2015) and Lei and colleagues (2012; 2014) also use respondents' height and find that better nutrition in childhood is positively associated with the development of cognitive ability. Height is not measured in ESBAM, because of well-known limitations concerning this measurement for elderly individuals (for example height loss and difficulty in standing straight). Instead, arm span is used, as this is considered a better measurement for elderly individuals and is highly correlated with height (Kwok and Whitelaw 1991; Kwok et al. 2002; De Lucia et al. 2002).

The analysis also includes variables at the level of the district where the individuals live (the sample comprises individuals living in 422 districts). As stressed in Lei et al. (2014), communities are institutions that can have important effects on their members, particularly on health outcomes. There is a large disparity in the level of socioeconomic development and infrastructure among Peruvian localities, and therefore, it is important to control for this heterogeneity when analysing health outcomes. The variables for the district are taken from the National Institute of Statistics and the 2012 National Registry of Municipalities (*Registro Nacional de Municipalidades*, RENAMU), which is a census of municipalities. We include the altitude of the district's capital and the standard deviation from the district's mean altitude of the altitude of village, as a measurement of elevation and terrain ruggedness, because these are the principal determinants of climate and crop choice in Peru (Dell 2010). With regard to infrastructure, we include the number of social assistance centres, hospitals and social centres for elderly individuals in the district, whether 50% or more of the district's capital households are covered by electricity and water networks and whether the district has a sewage system. Lastly, the official monetary poverty rate for the district in the period 2012–2013 is also included (INEI 2013).

Table 2 shows the summary statistics and unconditional means tests by retirement status for all the variables used in the analysis. Retired individuals have lower cognitive functioning than working individuals and are more likely to be female, older, illiterate, non-indigenous and living in urban areas and have lower levels of haemoglobin and a shorter arm span.

3 Methods

The score for cognitive functioning shows a left-skewed distribution and can range from 0 to 14 points. As indicated in Maurer (2010, 2011)—who also uses a reduced version of the MMSE with 0–19 points in samples of Latin American cities—the score can suffer from ceiling effects because this is right censored for some individuals. We address this issue with a Tobit regression model. This model assumes that the dependent variable is a latent variable C^* censored at $\overline{C}$ (in our case at 14). The data reports $\overline{C}$ when $C^* \geq \overline{C}$, but the Tobit model can account for this issue with the following specification:

$$C^* = \alpha + X\delta + \varepsilon,\ \varepsilon \sim N(0, \sigma)$$
$$C = \begin{cases} C^* \text{ if } C^* < \overline{C} \\ \overline{C} \text{ if } C^* \geq \overline{C} \end{cases}$$

C^* is the latent cognition score, X is a vector of variables at the individual and district level and ε is a normally distributed error term. Vector X includes retirement and other covariates such as short- and long-term nutritional status. The models are estimated by maximum likelihood, the standard errors are robust and clustered at the level of the department and all models include dummy variables for the department of the respondent. Given that ESBAM is a cross-sectional dataset, we cannot control for individual heterogeneity or address the potential reverse causality

Table 2 Summary statistics

Variable	Total		Working	Retired	Diff.[a]	Female	Male	Diff.[a]
	Mean	Std. dev.	Mean	Mean		Mean	Mean	
Cognitive score	11.69	2.04	11.86	11.26	0.60***	11.27	12.02	−0.75***
Memory	5.06	1.15	5.11	4.96	0.15***	5.05	5.07	−0.02
Mental intactness	6.62	1.37	6.75	6.30	0.45***	6.22	6.95	−0.73***
Male (yes = 1)	0.55	0.50	0.66	0.30	0.36***			
Mother tongue Quechua (yes = 1)	0.25	0.43	0.27	0.20	0.07***	0.26	0.24	0.03*
Mother tongue Aymara (yes = 1)	0.05	0.22	0.06	0.02	0.05***	0.05	0.05	−0.01
Age	71.17	4.39	70.70	72.34	−1.64***	71.08	71.24	−0.16
Illiterate (yes = 1)	0.28	0.45	0.24	0.40	−0.16***	0.50	0.11	0.40***
Retired (yes = 1)	0.29	0.45				0.45	0.15	0.30***
Arm span	156.03	10.91	157.55	152.22	5.32***	148.39	162.17	−13.78***
Haemoglobin	132.33	18.22	133.43	129.58	3.85***	127.44	136.27	−8.83***
Urban (yes = 1)	0.38	0.49	0.32	0.53	−0.20***	0.44	0.33	0.11***
Variables at district level:								
Poverty rate (%)	47.14	22.22	47.89	45.25	2.64***	45.73	48.27	−2.54***
Altitude (metres/1000)	2.33	1.31	2.44	2.05	0.39***	2.34	2.32	0.02
Std. dev. of altitude	0.34	0.23	0.35	0.32	0.03***	0.33	0.35	−0.02***
Number of social assistance centres	1.34	1.58	1.24	1.59	−0.35***	1.38	1.30	0.07
Number of hospitals	0.81	1.73	0.68	1.13	−0.46***	0.89	0.74	0.16***
Number of social centres for old age	0.41	1.57	0.31	0.67	−0.36***	0.46	0.38	0.08
Electricity coverage +50% (yes = 1)	0.92	0.27	0.91	0.94	−0.02**	0.92	0.92	0.01
Water coverage +50% (yes = 1)	0.84	0.36	0.84	0.86	−0.02*	0.86	0.83	0.02**
Sewage system (yes = 1)	0.98	0.13	0.98	0.99	−0.01	0.98	0.98	0.00

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$
[a]*T* test of mean differences between (i) working and retired individuals and (ii) females and males

between cognition and retirement with convincing instruments, as has been done in other studies focused on developed countries where social security participation is extended (for example Rohwedder and Willis 2010).[6] Differences in retirement laws are generally used as instruments in those studies, but in developing countries such as Peru, social security coverage for poor individuals is almost non-existent. For all these reasons, we should regard our results as associations instead of causal effects.

4 Results

This section describes the results of two groups of estimations: (i) models where the dependent variable is the total cognition score (Table 3) and (ii) models for each component of cognition (Table 4).

As expected, the dummy 'retirement' is negatively associated with the cognitive score in every specification of Table 3. The coefficient of retirement indicates that being retired is associated with a loss of 0.41 points in the score of cognition before including any regional level variable (see column 7). Given that the mean for cognition is 11.7 points, being retired is associated with a reduction in cognition of approximately 3.5% on average. One extra year in age is associated with a reduction of approximately 0.1 points for the cognition score. We also introduce age in quadratic form, but the coefficients of age are non-significant. This is possibly because the range of age in our sample (65 to 80) is not large enough in comparison with other studies that find a significant coefficient for polynomials of age. For instance, Bonsang et al. (2012) use individuals aged 50+ and Lei and colleagues (2014) use individuals aged 45+. Adding the cubic form of age makes the coefficients of age statistically significant but the interpretation is more difficult. Substituting age with dummies of age brackets also indicate a positive relationship between age and cognition. These coefficients show a sharp decrease of cognitive with age in the first age groups, and then a smoother fall.

Education is a very important predictor of cognitive functioning. We find that being illiterate is associated with 1.7 fewer points for the cognition score, which is equivalent to a 14.5% reduction of the score on average. Having an indigenous mother tongue is negatively associated with the cognitive score (with the exception of the last model specification that employs district fixed effects). This negative relationship is likely to be reflecting long-term disparities in access to education and other public services for indigenous populations in Peru. In our preferred model (in column 8 of Table 3), cognition is reduced by 0.31 points when the individual mother tongue is Quechua instead of Spanish, and it falls by over three times more (0.95 points) when the mother tongue is Aymara instead of Spanish. The sharp difference between these two indigenous groups in cognition performance is puzzling, although this could be the result of more severe cumulative deprivations suffered by Aymara individuals than their Quechua counterparts.[7]

With regard to the effects of nutritional status, it is found that both short-term (haemoglobin) and long-term (arm span) nutritional status has a statistically significant influence on cognitive functioning. In model 8, the score for cognition increases by 0.12 points for each extra 10 cm of arm span, while it increases by 0.06 points for each additional 10 g/L of haemoglobin. These results lend support to the suggestion that the quality of nutrition acquired during childhood and experienced currently, both have an impact on cognition in old age, even in a selected sample of poor elderly individuals.

Table 3 Tobit model estimations of cognition in old age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Male (yes = 1)	0.890***	0.887***	0.892***	0.891***	0.079	−0.143*	−0.102	−0.155*	−0.125	−0.179
	(0.067)	(0.065)	(0.065)	(0.065)	(0.073)	(0.081)	(0.096)	(0.089)	(0.095)	(0.117)
Mother tongue Quechua (yes = 1)	−0.795***	−0.795***	−0.795***	−0.797***	−0.679***	−0.674***	−0.682***	−0.308***	−0.358**	0.249**
	(0.182)	(0.181)	(0.181)	(0.183)	(0.192)	(0.186)	(0.172)	(0.093)	(0.148)	(0.098)
Mother tongue Aymara (yes = 1)	−1.584***	−1.583***	−1.580***	−1.587***	−1.551***	−1.571***	−1.516***	−0.950***	−1.070***	−0.829***
	(0.095)	(0.095)	(0.093)	(0.093)	(0.132)	(0.129)	(0.148)	(0.126)	(0.202)	(0.237)
Age	−0.107***	−0.345	18.837**		−0.091***	−0.086***	−0.086***	−0.081***	−0.085***	−0.083***
	(0.008)	(0.237)	(7.849)		(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
Age^2		0.017	−2.648**							
		(0.017)	(1.087)							
Age^3			0.123**							
			(0.050)							
Age 68–70				−0.245**						
				(0.115)						
Age 71–73				−0.612***						
				(0.081)						
Age 74–76				−1.074***						
				(0.094)						
Age 77–80				−1.275***						
				(0.119)						
Illiterate (yes = 1)					−1.720***	−1.701***	−1.661***	−1.737***	−1.696***	−1.673***
					(0.075)	(0.078)	(0.079)	(0.084)	(0.083)	(0.077)
Retired (yes = 1)					−0.367***	−0.367***	−0.410***	−0.510***	−0.441***	−0.471***
					(0.081)	(0.076)	(0.064)	(0.051)	(0.053)	(0.075)

Table 3 Tobit model estimations of cognition in old age *(Continued)*

Arm span						0.013***	0.012**	0.012***	0.011***	0.013***
						(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
Haemoglobin						0.006***	0.006***	0.006***	0.006***	0.006***
						(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Urban (yes = 1)							0.241**	0.249**	0.364**	0.360**
							(0.101)	(0.108)	(0.148)	(0.168)
Constant	19.303***	27.854***	−431.315**	12.250***	19.176***	16.166***	16.178***	15.538***	15.674***	15.215***
	(0.540)	(8.340)	(188.521)	(0.079)	(0.582)	(0.813)	(0.798)	(0.623)	(0.981)	(0.694)
Department fixed effects	No	No	No	No	No	No	No	Yes	No	No
District level variables[a]	No	No	No	No	No	No	No	No	Yes	No
District fixed effects	No	No	No	No	No	No	No	No	No	Yes
Observations	3884	3884	3884	3884	3884	3884	3884	3884	3884	3884
Pseudo *R*-squared	0.026	0.026	0.026	0.026	0.051	0.052	0.053	0.060	0.055	0.094

Standard errors clustered at department level are shown in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

[a]The set of variables at district level includes poverty rate, mean and standard deviation of altitude in the district, number of social assistance centres, number of hospitals, number of social centres for old age, dummies for whether the coverage of electricity and water is at least 50% of the total district and a dummy for sewerage system

Table 4 Tobit estimates for dimensions of cognition in old age

Variables	Total cognition		Memory		Mental intactness	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Male (yes = 1)	−0.155*	(0.089)	−0.431***	(0.091)	0.149**	(0.063)
Mother tongue Quechua (yes = 1)	−0.308***	(0.093)	−0.277**	(0.135)	−0.155**	(0.063)
Mother tongue Aymara (yes = 1)	−0.950***	(0.126)	−0.584***	(0.159)	−0.630***	(0.078)
Age	−0.081***	(0.008)	−0.060***	(0.006)	−0.048***	(0.006)
Illiterate (yes = 1)	−1.737***	(0.084)	−0.577***	(0.098)	−1.497***	(0.046)
Retired (yes = 1)	−0.510***	(0.051)	−0.315***	(0.045)	−0.330***	(0.071)
Arm span	0.012***	(0.004)	0.005	(0.005)	0.009***	(0.003)
Haemoglobin	0.006***	(0.002)	0.004***	(0.001)	0.003*	(0.002)
Urban (yes = 1)	0.249**	(0.108)	0.086	(0.094)	0.194***	(0.060)
Constant	2.097***	(0.065)	1.822***	(0.096)	1.581***	(0.043)
Observations	3884		3884		3884	
Pseudo *R*-squared	0.060		0.027		0.084	

Standard errors clustered at department level are shown in parentheses. All models include dummies for department
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

We also find that being male is associated with reduced cognitive functioning (in model 8), although the statistical significance is at the 10% level. This result is similar to that of Guven and Lee (2015), who also find a negative association between being male and cognitive functioning (for verbal fluency, immediate and delayed recall and a summary cognitive score, but not for numeracy) in a sample of elderly Europeans. In addition, cognition increases by 0.25 points for individuals living in urban areas, which is about half the size of the coefficient of retirement. This suggests that disparities between urban and rural areas (for example, labour market conditions and access to services) have a considerable impact on cognitive functioning levels.

Model 9 in Table 3 shows the results after including variables for the district where the individual lives. The coefficients do not change drastically after this inclusion. By contrast, the model 10 includes district fixed effects and some results change. For example, the gender is not significant and having mother tongue Quechua is positively associated with cognition, perhaps reflecting correlations between the district and the concentration of indigenous individuals in some districts. The association between cognition and Aymara mother tongue is also reduced. The same occurs with the associations of education and retirement. Given most of the coefficients keep their directions and magnitude does not change drastically, it seems that unobserved heterogeneity of districts in our sample plays a marginal role.

As an additional analysis, we estimate the predictors of the two dimensions of cognition described in Section 2.2. Table 4 shows that retirement is associated with a decrease both in memory and mental intactness. Being female is positively associated with memory, but negatively associated with mental intactness. Age is a more important predictor (negative) for memory than for metal intactness. Retirement is associated with a reduction in the score for memory and mental intactness by 0.32 and 0.33 points, respectively, which represents a fall of about 6.2 and 5.0% for the average individual. The negative association of being illiterate is much larger for mental intactness than for memory. According to the corresponding coefficients of Table 4 and the means of the cognitive dimensions, illiteracy is associated with a reduction in the scores for memory and mental intactness by 11 and

23%, respectively. In addition, long-term nutrition quality (arm span) does not matter for memory, but it does for mental intactness. Current nutrition quality (haemoglobin) has a statistically significant effect on both types of cognitive measurements.

5 Conclusions

There is a limited availability of survey data measuring cognition at later ages and other health outcomes in developing countries, and even more so among the poor elderly population. The Peruvian survey ESBAM, which focuses on the elderly poor, offers a rare opportunity to study the relation between retirement and other socioeconomic characteristics and cognitive functioning among the poor.

The recent and growing popularity of non-contributory pension schemes targeting the elderly poor in low and middle-income countries, prominently Latin America, represents a shift in the strategy to deal with social protection and poverty in old age. However, not much is known about the most salient characteristics of the elderly poor persons, in particular about their cognitive functioning and other health outcomes. Our study provides evidence about this. Recall that cognitive impairment or dementia is associated with a lower quality of life, more disability and higher health expenditure and can compromise the resources for other family members.

We find that retirement is associated with a loss of half a point in the score for cognition, which means that cognitive functioning decreases by approximately 4.4% on average. This result is stable across different specifications. In addition, both short-term (haemoglobin) and long-term (arm span) nutritional status have a statistically significant relationship with cognition. For each extra 10 cm of arm span, the score for cognition increases by 0.13 points, while for each additional 10 g/L of haemoglobin, the score increases by 0.06 points. These results, even in a selected sample of poor elderly individuals, are in line with other empirical results in the literature, which argue for the positive impact of high-quality nutrition on cognition in later life. We also show that education—in our sample, the variable is literacy—has an important protective effect on cognition. Being illiterate is associated with a drop of about 15% in the cognitive score. The inclusion of variables at the district level does not produce any significant effect, and controlling for district fixed effects produces only small changes in the described results. It seems that the covariates included in our models capture a great deal of the individual variability.

Endnotes

[1]It is expected that the recent emergence of non-contributory pension schemes aimed at alleviating poverty in old age will induce a significant number of elderly individuals to enter into retirement. De Carvalho-Filho (2008) estimates that about 40% of recipients retired completely on receiving a non-contributory pension in rural Brazil, with the rest of the recipients drastically reducing their working hours. Latin America in particular has experienced a boom in new non-contributory pension schemes during the last decade (Olivera and Zuluaga 2014). Nowadays, about 19 million individuals are recipients of a non-contributory pension in Latin America, which represents 32% of the population aged 60 and over in this region. This figure is computed with data extracted on 15 May 2016 from http://www.pension-watch.net/ and the United Nations' World Population Prospects 2015 revision. Most of the data refers to the years 2012 and 2013.

[2]The department is the first political and territorial division in Peru, the second one is the province and the third one is the district. Some districts, particularly in rural areas, are further divided into villages (*centros poblados*).

[3]*Pension 65* targets individuals aged 65 and over who are not covered by social security and live in a household officially classified as extremely poor. A household can be classified as non-poor, non-extreme poor and extreme poor according to the government's household targeting system, SISFOH.

[4]ESBAM includes the same questions to evaluate retirement that are used in the Peruvian National Household Survey (ENAHO), which is the leading survey in Peru to study living conditions.

[5]For example, Dell (2010) illustrates the long-term effects of mandatory mining work in Peru's highlands on the current health of indigenous people. In the particular case of the generation in our sample, other severe limitations suffered are that the illiterate were not allowed to vote in political elections before 1980 and that the Agrarian Reform Bill (*Reforma Agraria*) was only implemented during the early 1970s. This major redistribution of land represented the end of the *Haciendas* system, in which an impoverished labour force (of peasants) was attached to rural states.

[6]In order to deal with the potential endogeneity (e.g. reverse causality) of retirement and cognitive functioning, we also estimated an Instrumental Variable (IV) model. As instruments for retirement, we use the number of months since Pension 65 has been operating in the district of the respondent and the total number of Pension 65 beneficiaries in the district in October–November 2012, just before the ESBAM data was collected. Both variables are obtained from administrative data of Pension 65. We exploit the variation in the timing of implementation of the programme across districts and argue that observing a stronger presence of Pension 65 in the district increases the expectation of an individual to receive the transfer. Results from this analysis, at the first stage, show that a stronger presence of the Pension 65 programme in the district is statistically associated with an increase in the probability of retirement. At the second stage, the results show that the error terms of the reduced form and main equation are uncorrelated and there is no endogeneity problem. This suggests that applying a Tobit model is appropriate and brings unbiased estimates.

[7]The interviewers for ESBAM conducted the survey in the language of the respondent if needed. In order to address the issue of potential interviewer bias, we added dummy variables for the interviewers and ran the model 8 of Table 3 again. The coefficient estimates for Quechua and Aymara did not change notably (−0.25 and −0.88, respectively).

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