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Own and Parents' Schooling as Predictors of Cognition: Findings from the Longitudinal Chilean Social Protection Survey

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Keywords

Schooling, cognition, Chile, Longitudinal Chilean Social Protection Survey, aging

Disciplines

Economics

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Abstract

A large literature on the predictive powers of own schooling, and increasingly one's parents' schooling on cognitive and physical health of aging individuals focuses on high-income countries. There is a paucity of studies for other contexts, including Latin America and the Caribbean (LAC). We use data from the longitudinal Chilean Social Protection Survey to investigate associations between one's own schooling, one's parents' schooling, childhood family economic status and cognition of aging adults in a country that differs substantially from the U.S. and from other LAC countries. We further test whether these associations differ by gender. Our estimates suggest that own schooling significantly predicts cognition and that parental (particularly maternal) schooling and childhood family socioeconomic status are significant predictors of cognition. We also find significant heterogeneities in associations between the respondents' own schooling and cognition for women and men.

Section 1. Introduction

There is a large and growing literature on the predictive power of own schooling attainment, and increasingly one's parents' schooling attainment and early life family circumstances, on cognitive and physical health and mortality at older ages. Most of this literature is focused on the United States (U.S.) and a few other high-income countries (HICs) particularly in Europe. There is a relative paucity of such literature for other contexts, including the Latin America and the Caribbean (LAC) Region. We use data from the longitudinal Chilean Social Protection Survey (SPS) to investigate the associations between one's own schooling, that of one's parents, childhood family economic status and cognition in Chile, a country that during the lifetimes of individuals in this study, was primarily a middle-income country (MIC) that advanced to being a HIC only recently. We further test whether these associations differ by gender. We first summarize recent literature on the predictive power of own schooling attainment and one's parents' schooling attainment and childhood economic status, on cognitive health of older adults (Section 2). We then discuss the Chilean context and how it differs from that of the United States and Latin American Countries on average (Section 3). In Section 4, we describe the longitudinal Chilean Social Protection Survey (SPS) and the data used in this study. We then present results of the analyses (Section 5), followed by a discussion, summary and conclusions.

Section 2. Selected Previous Literature

It is increasingly recognized that childhood environment can influence adult health outcomes via childhood exposures to infectious diseases, poor nutrition or in utero exposers and indirectly through attained socioeconomic status in adulthood (Elo and Preston 1992; Preston et al., 1998). Much of the evidence for these associations has been based on studies from United States and Europe, with growing evidence from less developed countries (e.g., Hayward and Gorman 2004; Almond et al. 2005; Kohler and Soldo 2005; Engle et al. 2007, 2011; Hoddinott et al. 2009, 2013; Currie 2009; Huang and Elo 2009; Palloni et al. 2009; Huang et al. 2011; Walker et al. 2011; Currie and Vogl 2013: Elo et al. 2014; Gertler et al. 2014; Majid 2015; Ho 2015; Nandi et al. 2018, 2019a,b; Majid et al. 2019). These studies typically documented significant associations between childhood conditions, including parental schooling and family's socioeconomic status,

and adult health outcomes that were attenuated to varying degrees with the inclusion of a range of controls for socioeconomic status in adulthood.

More recently, evidence also has been accumulating for the role of childhood circumstances, including parental schooling, as well as one's own schooling, which is commonly attained relatively early in life, on cognitive performance at middle and older ages (e.g., Cagney and Lauderdale 2002; Alley et al. 2007; Langa et al. 2009; Lee and Schafer 2021; Maluccio et al.; 2009; Zhang et al. 2016; Schneeweis et al 2014; Oi and Haas 2019). For example, Schneeweis et al. (2014) using data from six countries in the Survey of Health, Ageing and Retirement in Europe (SHARE), documented a protective impact of schooling on cognition at ages 45 and above using schooling reform as an instrument to estimate the causal effect of schooling on cognition. Lyu and Burr (2016), using data from the Health and Retirement Study (HRS), documented a significant association between disadvantaged socioeconomic status (SES) in childhood and cognitive function at ages 65 and above, an association that was mediated by adult SES. The results also pointed to an important role of mother's schooling attainment and financial status in childhood (Ibid: Table 2). Lee and Schafer (2021), using data from the National Social Life, Health and Aging Project Wave 3, find that respondents who reported growing up with happy family life and in families with higher socioeconomic status also had better cognitive function at older ages, an association that was attenuated with the inclusion of respondents' own adult resources, including educational attainment.

A number of recent studies from low- and middle-income countries (LMICs) have similarly documented the associations of schooling with cognitive performance at younger, middle and older ages. Maluccio et al. (2009), using longitudinal data over ~35 years from Guatemala, documented the positive impact of a randomly assigned protein-enriched nutritional supplement when 0-2 years of age on adult reading skills and cognition (Raven's test) at ages 26-42.
Zhang et al. (2018) found both mother's and father's schooling attainment, as well as one's own schooling attainment, to predict episodic memory in China at ages 45 and above with one's own schooling attainment accounting for some but not all documented associations. Schooling attainment has also been found to be a highly significant predictor of cognitive performance in India (Lee et al. 2014). A study of life-course socioeconomic disadvantage and cognitive

functions among individuals 60 years and over in seven (LAC) cities found that several childhood conditions, such as poor childhood health, were associated with poor cognitive functioning at ages 60 and above (Nguyen et al. 2008). In the Mexican Health and Aging Study higher levels of maternal and paternal schooling predicted better cognitive function that was mediated by the respondent's own schooling (Hazzouri et al. 2011).

Cognitive function at middle and older ages is also known to vary by gender. Several studies have documented similar or better cognitive performance for women than for men in HICs (Langa et al. 2009). In LAC cities and Mexico, cognitive impairment was higher among women than men as was the case in India (Hazzouri et al. 2011; Nguyen et al. 2008; Lee et al. 2014). There is less evidence available, however, about whether the predictive power of one's own and parents' schooling and childhood family background for cognitive health at older ages individuals differs by gender.

Section 3. The Chilean Context

The Chilean context differs substantially from that of the rest of Latin America in a number of respects. For example, Chile has had the highest economic growth in Latin America over the past quarter century. Gross national income per capita in purchasing power parity terms in Chile ($22,760) is 35% higher than in Mexico, 50% higher than in Brazil, and 52% higher than in LAC on average but 60% lower than in the United States. Mean adult schooling in Chile (10 grades) is 1.4 grades higher than in Mexico, 2.6 grades higher than in Brazil, and 1.8 grades higher than in LAC on average. Over the course of the 20th century, Chile has also experienced rapid urbanization with 89% of the population living in urban areas in 2015, with heavy concentration in the capital region Santiago with 40% of the total population. The relatively high urbanization and urban concentration in Chile may facilitate access to health services, but also may have negative impacts on health through greater congestion, pollution, and junk food access.

At the same time, the Chilean population is aging rapidly and life expectancy in Chile is close to that of the United States and higher than in many other parts of Latin America. In 2017, 11% of the Chilean population was aged 65 and above compared to an average of 8% in Latin America, and up from 6-7% in 1990. In the same year, female life expectancy in Chile (82.1 years) exceeded that of the female life expectancy in the United States (81.8) and the Latin American

average of 78.9 years. Similarly male life expectancy (77.2 years) exceeded the LA average of 72.6 years and was close to the US male life expectancy (77.3 years). Although health-related risk factors, such as prevalence of smoking (38%) and overweight and obesity (64.4% among males and 63.1% among females), are higher than the LA average (15.8% for smoking, 57.1% for male and 58.3% for overweight and obesity), the age-standardized death rates per 100,000 are lower than the LA average for ischemic heart disease and cerebrovascular diseases, 33.6 versus 65.9 and 32.4 versus 42.9 respectively. Appendix Table 1 provides additional comparisons between Chile, Mexico, Brazil, the United States and the Latin American average.

Section 4. Data

Section 4.1 Chilean Social Protection Survey

The Chilean Social Protection Survey (SPS) originated in 2002, with instruments based on the HRS and the Mexican Health and Aging Study (MHAS). The SPS is a stratified random national longitudinal sample of ~20,000 adults 18+ years old, with seven follow-up surveys, funded primarily by the Chilean government. The SPS collects information on demographic and socioeconomic characteristics of respondents, including wealth and pension data, as well as self-reported chronic conditions and characteristics of the family of origin, such as parental education and economic conditions of the family during the respondents' childhoods.

Because of increasing interest in mental and physical health and related issues of the rapidly-aging Chilean population, the Chilean government supported an additional survey of 2,523 SPS sample members who were 60+ years old in 2017-18 (SPS-60+). This survey obtained broad information on mental and physical health, well-being and sociodemographic characteristics, including reports on chronic diseases associated with aging and a measure of cognition using an abridged version of the Mini-Mental examination of cognitive performance. These data have been linked to five previous SPS data rounds to permit rich characterization of life-cycle paths over ~15 years prior to the SPS-60+, and thus of precursors and predictors of cognition reported in the SPS-60+.

Data used in this study come from SPS60+ and 2002, 2004 and 2015 waves of the longitudinal SPS. Our analytic sample includes 2,418 respondents ages 60 and above who were interviewed in the SPS60+. We excluded individuals (N=105) who lacked information on our outcome of

interest – the Mini-Mental test – as well as on one's own schooling, the economic status of the respondents' families of origin, and self-reported affiliation with one of Chile's indigenous groups.

Section 4.2 Measures

Our outcome is a continuous measure of cognitive function. This summary measure is based on an abridged version of the Mini-Mental Test. It includes measures of word recall, serial 7's, backward spell, drawing, object naming, and other items assessing orientation and attention. The total cognitive score ranges from 0 to 19, with higher scores indicating better cognitive function.

Our explanatory variables are age, gender, respondents' self-reported affiliation with one of Chile's indigenous groups, the respondents' own completed grades of schooling, the completed grades of schooling of the respondents' mothers and fathers and the economic status of the respondents' families of origin. The last three measures are self-reported by the respondents when they were interviewed in either 2002 or 2004. One's own schooling attainment and whether the respondent belonged to an indigenous group come from the 2015 SPS wave. Completed grades of schooling is constructed based on the respondents' reports of the highest level (primary, middle and higher education) attained by him/herself and the respondents' parents and the number of completed grades within each level. The family's economic status in childhood distinguishes between very good/excellent and fair/poor households.

Section 4.3 Analytic Methods

We first show descriptive statistics and then estimate the following six models. Model 1 includes age, gender, indigenous status, and one's own completed grades of schooling. Model 2 includes age, gender, indigenous status, mothers' and fathers' completed grades of schooling and families' economic status in childhood. Model 3 builds on the first two models and includes all explanatory variables simultaneously. In Model 4, we test whether the association between one's own schooling and the outcome varies by gender of the respondents, whereas in Model 5 we examine whether the associations between the outcome and respondents' mothers' and fathers' schooling and the economic status of the family of origin varies by gender. In Model 6, we introduce all explanatory variables and the interactions between gender and the respondents' own and parental schooling and families' economic status in childhood.

We estimate OLS regressions for cognition, measured by the abridged Mini-Mental score. We use multiple imputation to account for the missing values for mothers' (24% missing) and fathers' (33%) completed grades of schooling.

Section 4.4 Descriptive Statistics

Table 1 shows the descriptive statistics for our outcome measure and the explanatory variables by gender and for the entire sample. The mean Mini-Mental Test score was similar for men and women. The mean number of completed grades of schooling was slightly higher for male (7.83 completed grades) than female (7.39) respondents, and fathers (4.93) had completed more grades of schooling than mothers (4.01) on average, reflecting generational differences in schooling attainment. About half of the sample reported that their childhood economic status was very good or excellent.

Table 1: Descriptive Statistics

	Male			Female			Total		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Dependent Variables									
Abridged Mini-Mental Score	15.36	4.18	1123	15.37	3.75	1295	15.36	3.96	2418
Sociodemographic Characteristics									
Age	70.99	8.13	1123	71.36	8.34	1295	71.19	8.24	2418
Indigenous[1]	0.04	0.19	1123	0.05	0.22	1295	0.04	0.21	2418
Completed Grades of Schooling[2]	7.83	4.40	1123	7.39	4.29	1295	7.59	4.35	2418
Father's Completed Grades of Schooling[2]	4.80	4.15	764	5.05	4.32	862	4.93	4.24	1626
Mother's Completed Grades of Schooling[2]	4.01	3.61	805	4.01	3.68	1029	4.01	3.65	1834
Very good/Excellent Childhood Economic Status[3]	0.43	0.50	1123	0.49	0.50	1295	0.46	0.50	2418

[1]Self-reported affiliation to one of the indigenous groups recognized in Chile. [2]Completed grades of schooling is constructed based on respondents' reports of the highest level (primary, middle and higher education) attained and the number of completed grades within each level. [3]Self-reported retrospective family economic status. The summary statistics are reported for complete cases of the dependent and independent variables (excluding the parental schooling variables).
Source: Chilean Social Protection Survey (SPS).

Section 5. Regression Results

In Table 2, we report regression results for cognitive performance measured by the abridged Mini-Mental score. As seen in Model 1, one's own completed grade of schooling is a highly significant predictor of cognition. Each one grade increase in completed schooling increases the cognitive score by 0.205 points. We also find a significant association between cognition and

mothers' completed grade of schooling such that each one year increase in mothers' completed schooling predicts an increase of the respondents' cognitive score by 0.109 points (Model 2). In contrast, fathers' schooling is not a significant predictor of cognition, whereas having grown-up in a family with good or very good economic status exhibits a significant association with cognition in late life, increasing the respondents' cognitive score by 0.602 points.

These results hold in Model 3 where all explanatory variables are included simultaneously. When comparing the size of the coefficients between Model 1 and Model 3, the coefficient for respondents' own schooling is attenuated slightly from 0.205 to 0.180 and remains highly significant, suggesting that only a small fraction of this association is accounted for by childhood background. In contrast, the introduction of respondents' one's own schooling attenuates the coefficients for mother's schooling and for childhood economic status by 48% and 46% respectively, although both remain significant predictors of cognition. Thus, the association between family background and cognition is operating at least in part through schooling attainment of the respondent.

In Models 4-6, we test our hypothesis that associations between one's own schooling and that of his/her parents and the Mini-Mental score vary by gender of the respondent. As seen in model 4, we find significant gender differences in the associations between one's own schooling attainment and cognition, such that the association for men from additional schooling is greater than women in terms of their cognitive ability in later life. Each one grade increase in schooling predicts an increase in men's cognitive score by 0.270 points compared to a predicted increase of 0.146 points for women. With respect to maternal education and household economic status, we find that these associations do not vary by the gender of the respondent (Model 5). Of the schooling interactions discussed above, the interaction between one's own schooling and the gender of the respondent remains significant in the fully adjusted model (Model 6).

Table 2: Coefficients from OLS Regression for Mini-Mental Score (Multiple Imputation)

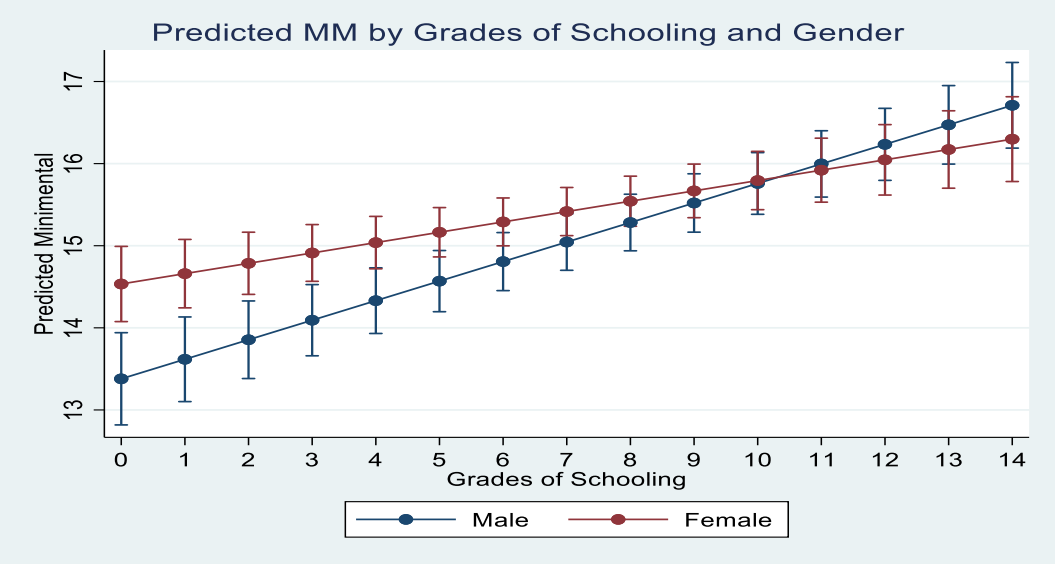
	Dependent variable: Abridged Mini-Mental Score					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.147	0.034	0.120	1.090***	0.511*	1.155***
	(0.152)	(0.154)	(0.153)	(0.349)	(0.287)	(0.363)
Age	-0.114***	-0.139***	-0.116***	-0.115***	-0.138***	-0.116***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Indigenous[1]	-0.653*	-0.572	-0.565	-0.661*	-0.581	-0.584
	(0.375)	(0.390)	(0.380)	(0.375)	(0.392)	(0.381)
Completed Grades of Schooling[2]	0.205***		0.180***	0.270***		0.238***
	(0.018)		(0.021)	(0.026)		(0.031)
Father's Grades of Schooling[2]		0.002	-0.017		0.029	0.010
		(0.029)	(0.028)		(0.044)	(0.042)
Mother's Grades of Schooling[2]		0.109***	0.057*		0.141***	0.067
		(0.032)	(0.032)		(0.050)	(0.051)
Very good/Excellent		0.602***	0.328*		0.625**	0.200
Childhood Economic Status[3]		(0.170)	(0.171)		(0.258)	(0.256)
Interactions						
Female * (Grades of Schooling) [2]				-0.124***		-0.112***
				(0.035)		(0.041)
Female * (Father's Grades of					-0.048	-0.045
Schooling) [2]					(0.058)	(0.057)
Female * (Mother's Grades of					-0.056	-0.017
Schooling) [2]					(0.065)	(0.066)
Female * Very good/Excellent					-0.053	0.218
Childhood Economic Status[3]					(0.332)	(0.331)
Constant	21.889***	24.534***	21.897***	21.458***	24.207***	21.342***
	(0.841)	(0.764)	(0.840)	(0.854)	(0.774)	(0.859)
Observations	2,418	2,418	2,418	2,418	2,418	2,418

.[1]Self-reported affiliation to one of the indigenous groups recognized in Chile. [2]Completed grades of schooling is constructed based on respondents' reports of the highest level (primary, middle and higher education) attained and the number of completed grades within each level. [3]Self-reported retrospective family economic status. The summary statistics are reported for complete cases of the dependent and independent variables (excluding the parental schooling variables).
*** p < 0.001; ** p < 0.05; * p < 0.10.
Source: Chilean Social Protection Survey (SPS).

Despite the fact that schooling is associated with larger increases in the Mini-Mental Tests for men than women, at lower levels of schooling attainment women outperform men on the Mini-Mental Test. Only at the higher schooling levels do men score higher than women. These

patterns are clearly seen in the following Figure 1, which graphs the association between one's schooling attainment and the Mini-Mental Score from Model 6, Table 3.

Figure 1.



The figure plots the predicted Mini-Mental score implied by Table 3, Model 6. Completed grades of schooling is constructed based on respondents' reports of the highest level (primary, middle and higher education) attained and the number of completed grades within each level

Source: Chilean Social Protection Survey (EPS).

Section 6. Discussion, Summary and Conclusion

There is a large literature on predictive powers of own schooling, and increasingly one's parents' schooling, on cognition of aging individuals. Most of this literature focuses on the United States and other high-income countries. There is an increasing number of studies, but still a limited number, in other contexts, including Asia, Africa and Latin America and the Caribbean (LAC).

We first briefly describe how Chile differs in terms of economic, demographic and health contexts from the United States and the rest of Latin America and the Caribbean. Chile has had more rapid economic growth in the past quarter century and has per capita income substantially above the LAC average, though substantially below the US. The population has been aging relatively rapidly and, though a gap with the US with regard to the population share 60+ still remains, it has been closed considerably. Life expectancy at birth has increased and surpassed that for U.S., particularly for females. Smoking prevalence has declined, but remains far above the average for LAC or the US. Mortality rates from non-communicable diseases are lower than in

LAC on average and in the USA, especially for heart disease and are relatively low in comparison with LAC on average. The economic/health/disease environment in Chile results in much different patterns of causes of death than in LAC on average. These differences make Chile an interesting case in which to study aging in general, and the predictive power of schooling on cognition in particular. We further test whether these associations differ by gender. Our estimates suggest that own schooling significantly predicts the cognitive indicator, and that maternal schooling and childhood family socioeconomic status are significant predictors of cognition. We also find significant heterogeneities in associations between schooling and cognition for women and men.

Our results are similar to prior research that has investigated one's childhood background and one's own educational attainment and cognition in later life. These studies similarly find that one's own schooling attainment is associated with better cognition among older adults. Factors that have been hypothesized to account for the association between higher levels of schooling and cognition include, for example, better health-related behaviors, more stimulating social environments, and better socioeconomic status in adulthood (Langa et al. 2009). Furthermore, one's own schooling is likely to reflect one's family background. In this study, we find a significant positive association between family background and parental education and better cognitive function above age 60, which is attenuated with the inclusion of one's own schooling. Among the childhood characteristics, maternal education is a more robust predictor of cognition than is father's education. We hypothesize that this result reflects parenting practices such that mothers are more likely to have spent more time with the children when they were young, whereas fathers' education may be more closely associated with material resources and the economic well-being of the family. In that regard, we also find that the respondents who grew up in wealthier households also have better cognition than respondents who grew up in poorer households. We find that women have higher cognition than men at lower schooling levels, but that the marginal associations of schooling with cognition is higher for men with the result that men have higher cognition at high schooling levels.

Our study has limitations. We currently only have data on an abridged Mini-Mental test. We also in this study only consider the predictive power of schooling, not the causal effects. We further

do not explore possible mediators between schooling and health outcomes of aging individuals, such as labor force and marital histories. In future work on the project of which this paper is a first study we will be able to address these weaknesses. But despite these limitations, our study contributes new knowledge about the predictive power of own schooling, parental schooling and childhood family SES on cognitive and physical health outcomes for aging individuals using longitudinal data over 16 years for a different context than has been studied in the previous literature.

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Table 1. Selected Demographic, Economic, Mortality, Health & Health Resoruces Indicators Related to Aging for Chile, Mexico, Brazil, Southern Cone, Latin America & USA from PAHO WHO *Core Indicators: Health Situation in the Americas*, 2017

	Chile	Mexico	Brazil	Southern Cone	Latin America	USA
Demographic Characteristics Related to Aging						
Median age (years) 2017	34	28	32	32	30	38
Population aged ≥ 65 (%) 2017	11	7	9	11	8	15
Life expectancy at birth (years) 2017 - Male	77.2	74.9	72.1	73.9	72.6	77.3
Life expectancy at birth (years) 2017 - Female	82.1	79.7	79.3	80.4	78.9	81.8
Mean adult schooling (years) 2015 - Total (CH 2013, BR 2014)	10	8.6	7.4	na	8.2	13.5
Per Capita Income						
Gross national income (US$ per cápita [ppp]) 2015	22,760	16,860	15,140	19,631	15,017	57,540
Age-Adjusted Cause of Death Rates (per 100,000)						
Non-communicable diseases 2015 - Total (CH 2013)	343	458.6	458.7	420.1	452.5	384.1
Total Lung cancer 2015	13.4	6.5	13.6	17.8	12.3	28
Prostate cancer 2015 - Male	20.2	13.4	20.2	18.6	19.2	10.6
Breast cancer 2015 - Female	11.8	10.8	14	18.7	14	14.9
Total Colorectal cancer 2015	10.6	5.4	8.6	13.1	8.4	9.7
Total Isquemic heart diseases 2015	33.6	76.6	58.5	39	65.9	58.7
Total Cerebrovascular diseases 2015	32.4	30.2	53.1	37.4	42.9	21.3
Total Diabetes mellitus 2015	18.4	91.8	31.3	21	45.2	14.4
Indicators of Health and Health-Related Behaviors						
Overweight and obesity in adults (%) 2014 - Male	64.7	63.6	55.2	64.5	57.1	72.8
Overweight and obesity in adults (%) 2014 - Female	63.1	65.2	53	59.8	58.3	62.9
Insufficient physical activity in adults (%) 2010 - Total	21.3	26	27.8	33	31.2	32.4
Prevalence of current tobacco smoking in adults (%) 2015 - Total	38	13.4	15.2	26.8	15.8	17.2
Total Alcohol consumption in adults (liters/per person/year) 2016	9	7.1	8.9	8.7	7.5	9.3
Prevalence of raised systolic blood pressure (%) 2015 - Male	25.4	22.3	26.7	26.9	23.8	15.3
Prevalence of raised systolic blood pressure (%) 2015 - Female	16.5	17.3	19.9	17.6	18	10.5
Prevalence of raised fasting blood glucose/diabetes (%) 2014 - Male	10.2	10.9	7.8	9.8	8.9	8.2
Prevalence of raised fasting blood glucose/diabetes (%) 2014 - Female	10.8	11.5	8.7	9.7	9.6	6.4
Resources Directed Towards Health						
Physicians - Human resources per (10,000 pop) 2014	21.5	21.2	15.1	na	17.7	26
Nurses - Human resources per (10,000 pop) 2014	22	25.1	7.1	na	14.3	111.4
Dentists - Human resources per (10,000 pop) 2014	10	4.3	5.5	na	4.4	6.2
Public - National health expenditure as % of GDP 2014	3.9	3.3	3.8	3.3	3.7	8.3
Private - National health expenditure as % of GDP 2014	3.9	3	4.5	2.9	3.4	8.9