Childhood cognitive skills and later life presence of chronic diseases: a life-course approach

Bachelor’s thesis Human Geography & Urban and Regional Planning

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Summary

Each year, approximately 35 million people die worldwide because of chronic diseases; it is the largest cause of deaths globally, and the term "chronic disease" encompasses many different illnesses: asthma, cardiovascular diseases, strokes, Alzheimer and dementia, cancer and many other conditions. As people grow older, the risk of being subject to one of these diseases increases, with the elderly being more at risk of developing chronic diseases.
The focus on healthy ageing has increased over the years to tackle down the onset of those diseases. Furthermore, the so-called "Life-course approach" started to be applied to the life course to investigate how early life experiences transform future events, in this case, disease incidence. In this thesis, the life course approach is implemented alongside statistical regressions to determine whether higher cognitive skills are associated with a lower risk of chronic diseases. Furthermore, the frequency of engagement in vigorous activities is also examined based on cognitive skills. Ultimately, household incomes are tested to determine whether they can moderate the results obtained.
Data of a cohort of people older than 50 and coming from *easy*SHARE are used. In order to answer the main research question, multiple linear regression is used, with the addition of the household income variable when mediating for it. Binary logistic regression is adopted for investigating activity rates and cognitive skills.
It is found that people who had higher cognitive skills at age 10 are less likely to suffer from a chronic disease, while the risk is higher for those who had below-average cognitive skills at age 10. Regarding incomes, the regression suggests that the higher they are, the less likely it is to be subject to chronic health conditions, although they mediate cognitive skills.
Furthermore, people who had above-average cognitive skills at age 10 are more likely to engage in vigorous activities, while it is contrary for those with lower cognitive skills: they engage less often in physical exercises.
Regarding the life-course approach, two principal aspects seem to influence the onset of chronic diseases: disease-preventing behaviours and socioeconomic conditions. Those two aspects combine and shape the path of the initial situation, with different outcomes based on the individual's choices and behaviours.
For further research, it is advised to compare two different countries with, e.g., different average incomes to weight the effect that socioeconomic condition has. From a policy perspective, campaigns advocating for a healthy lifestyle can make people understand the importance choices have on later-life health development

Sommario

Background

A chronic disease is a health condition with either persistent or long-lasting effects, usually non-curable (Bernell & Howard, 2016). Under the umbrella term "*chronic condition*", it is possible to recognize four different categories: cancer, cardiovascular diseases (e.g. heart failure), chronic respiratory diseases (e.g. asthma) and diabetes mellitus. Furthermore, there are many other chronic diseases, such as Parkinson's, HIV/AIDS, Alzheimer's and Multiple Sclerosis (WHO, 2015).

Beside longstanding physical conditions, researchers have also started to investigate if it is possible to look at mental health problems as chronic diseases. Findings suggest that, e.g., depression can be considered as such (Monroe & Harkness, 2012). Moreover, treating depression by a chronic disease management model would be beneficial (Andrews, 2000).

In 1996, the number of deaths due to chronic conditions was approximately 29 million (Murray and Lopez, 1996). In 2005, this number rose to 35 million, representing 60% of all that year's deaths (WHO, 2005).
As it is possible to observe, despite the large increase in life expectancy of the past 100 years (Kinsella, 1992), the digit of individuals succumbing to chronic diseases keeps expanding.
The primary causes of chronic conditions are *non-modifiable risk factors*, such as age and hereditary genes, alongside *modifiable risk factors*, for instance tobacco use, unhealthy diet and physical inactivity (Braveman, 2010; WHO, 2015;).

Furthermore, research has shown that childhood health and environmental conditions impact later-life well-being (Barker, 2004).

Chronic diseases have been studied from many different perspectives. To name a few, Brown et al. (2003) investigated the relationship between races and chronic conditions, while Sum et al. (2018) the financial burden those illnesses cause.
With the rapid rise and development of cognitive epidemiology, researchers started to investigate whether IQ and cognitive skills in general can prognosticate later health outcomes (Deary & Batty, 2007).

So far, cognitive epidemiology has shown that individual mortality, as well as health, can be predicted based on IQ level (Deary, 2008). Gottfredson (2004) suggests that this is because people of higher intelligence are more likely to make conscious judgments since they can analyze situations more efficiently. Different studies among middle-aged and older-aged people confirm the hypothesis that with a higher IQ level, there are fewer health risks (Bassuk et al., 2000; Pavlik et al., 2003).

However, the most considerable share of the literature on this topic merely analyzes IQ and health outcomes. Only a small portion of articles focuses on a life-course approach to explain childhood general cognitive skill levels and well-being consequences later in life. Furthermore, most studies solely focus on IQ as the measurement level of individual intelligence; this is not per se negative, but it would be beneficial to analyze cognitive skills with another scale of measurement. “cognitive skills” is a more general term which encompasses concepts such as learning, decision making and language abilities (Kiely, 2014).

The central problem is that everyone ages, but intelligence level seems to influence the degree to which chronic diseases develop. Gaining a more profound understanding of how this happens can be propitious for both future kinds of research as well as for society. Moreover, healthy ageing is a topic which is considerably growing in importance, as shown, e.g. by the World Health Organization: the decade 2020-2030 has been indicated as "decade of Healthy Ageing" (WHO, 2020).

Combining statistical analysis with a close look at the life course theory can be beneficial for future research, adding more depth to a field not extensively studied yet. Furthermore, depending on the findings of the paper, new societal solutions might be carried out to tackle down health problems, such as recurrent screenings for individuals more at risk or international cooperation to reach common goals as ensuring healthy ageing for every individual.

Research problem

This paper's primary purpose is to investigate whether the childhood mathematical and language skills of respondents have a significant relationship with the later-life onset of chronic diseases.
Furthermore, an analysis of behaviours kept by individuals will allow examining if skilled-children engage more frequently in the so-called "disease-preventing behaviours", which should lower the likelihood of *modifiable risk factors*. Lastly, incomes of respondents will be used as a mediator to investigate whether the socioeconomic conditions play a role in health outcomes.

The approach used is the life course one in order to better comprehend the possible involvement of a childhood condition in older-age detrimental health circumstances. The life course approach will be explained and applied to the topic of the paper in order to describe possible implications and potential relationships.

The research question is formulated as follows:
"*Are children with high mathematical and language skills less prone to chronic diseases, when aged 50 or more*?"

The first sub-question: "Do income levels effectively mediate the relationship between cognitive skills and later-life chronic health outcomes?"

The second sub-question covers a *modifiable risk factor*, namely physical inactivity: "*Do children with high mathematical and language skills engage more often in vigorous activities compared to non-gifted children, when aged 50 or more*?".

Structure of the thesis

Following this introductory chapter, *literature review* highlights the relevant theories and concepts, with references to the scientific literature. On the basis of the discussion, a conceptual model is present to visualize the theoretical framework
Afterwards, *methodology* chapter is present to introduce the research method, which type of data has been used, and the different statistical tests carried out; ethical considerations are discussed as well.
In the results chapter, the results of data analysis are presented and discussed based on the theoretical framework; furthermore, links are drawn between the results of the paper and those of previous academic articles, in order to find similarities and differences.
Lastly, *conclusion* chapter briefly presents and summarizes the main results of the paper. Moreover, a concise reflection of weak and strong points of the study is present, alongside future recommendations for policymakers, as well as for researchers.

Theoretical framework

Health outcomes are a factor dependent on several variables. The focus of this paper on the relationship between childhood cognitive skills and later well-being issues is in itself highly complex and comprises several further underlying factors.
As previously mentioned, the theory used in the paper is the Life-Course approach. This type of approach investigates how early life experiences and events benefit or endanger future prosperity, from a physical and a cognitive perspective (Kuh et al., 2007). In this study, the central aim is to examine whether higher cognitive skills can lead to better health later in life, as regards to the presence of chronic diseases.

So far, academic research has come up with different explanations to why a high childhood IQ play a role in later life health outcomes. Gottfredson & Deary (2004) suggest that individuals with high IQ tend to take greater care of their health. Thanks to their intelligence, they are more likely to engage in behaviours preventing chronic diseases. Those people adhere to complex treatment regimens with higher success as well. Further researches confirm this last finding (Taylor et al., 2003; Williams et al., 1995), with intelligence directly related to the ability to follow treatment instructions and understand the nature of the disease. On the base of the literature mentioned above, individuals with great cognitive skills tend to have better control of diseases, primarily because of their better literacy. Their understanding of, e.g. how a treatment works make them less subject to errors in case they have to follow precise instructions.

Furthermore, cognitively skilled children tend to have a well-balanced and healthy diet (Batty et al., 2007), and they engage in higher levels of physical exercises (Anstey et al., 2009). Moreover, they are less likely to smoke once in older age (Martin et al., 2004), and they are also less subject to

possible obesity (Sorensen & Sonne-Holm, 1985). Overall, children with high cognitive skills engage more often in proactive disease-preventing behaviours. From a Life-Course perspective, it is beneficial if children do physical activities, eat well and so forth. These actions can have a very positive influence, especially in a period of rapid change such as childhood. Indeed, childhood can be considered a "sensitive period" in which events have a more profound effect on health than in other stages (Gee et al., 2012).
Besides that, activities such as eating well, exercising and not smoking correspond to a slower rate of decline as people grow older (Kuh, 2019). Therefore, cognitively skilled children engaging in disease-preventing behaviours at a young age might have less future negative health implications.

Moreover, cognitive functions do not always diminish per se risks of diseases, but they instead increase the socioeconomic status (SES) of the individual (Batty et al., 2007; Johnson et al., 2011). In this case, a higher socioeconomic level is associated with better health access, which can therefore explain why cognitively skilled people tend to have better overall health outcomes (Macintyre, 1998). From a life-course perspective, this helps preventing diseases, not waiting until a clinical threshold is reached, but instead directly acting at the first sign of decline (Kuh, 2019).

Furthermore, researches have shown that children from socioeconomically disadvantaged families are more likely to suffer from poor health, especially cardiovascular risks (Melchior, 2007; Davey Smith, 1998). Findings from Everson et al. (2002) suggest that economic hardship causes cumulative damages, meaning that the longer the economic difficulties, the greater the health risks.

Besides the economic aspect, education level seems to influence the likelihood of developing a chronic illness. Katzman (1993) identified an increased risk of Alzheimer's Disease among individuals with low or no education at all. Karp et al. (2004) drew the same conclusions, pointing out that education level was a significant predictor alongside income level. Moreover, Winkleby et al. (1992) found out that the highest risk of suffering from cardiovascular disease is directly related to the educational level of the individual.

Conceptual model

After this literature review, it is necessary to visualise the conceptual model based on the various concepts mentioned above.

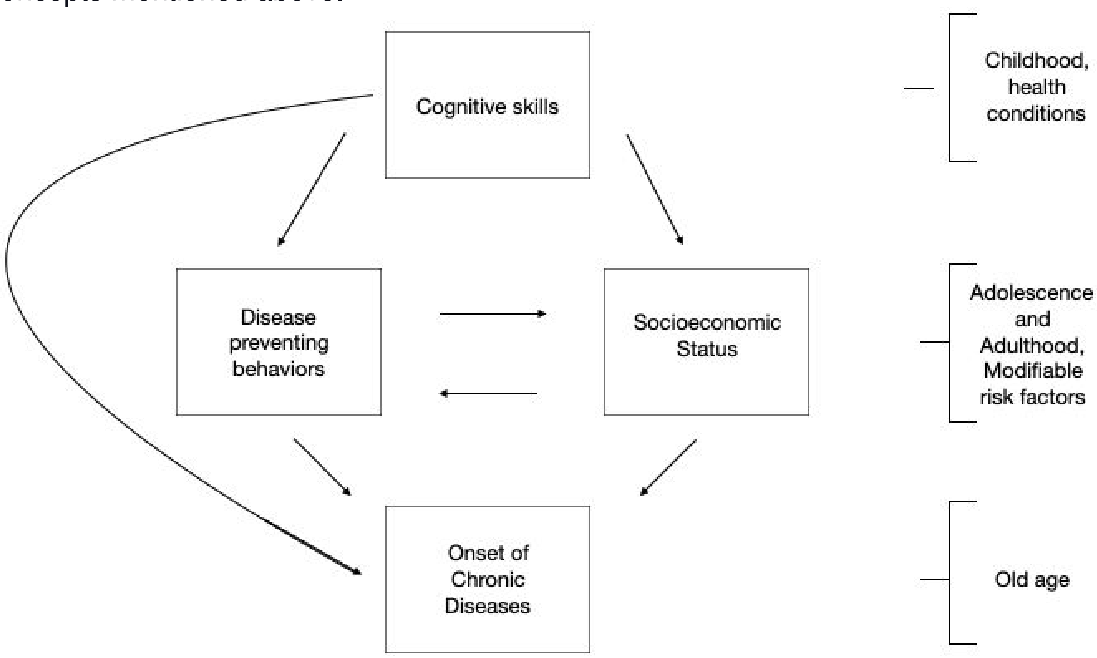

Figure 1 – conceptual model

At the very top, there is the presence of "cognitive skills.
From this box, arrows move to two panels, namely "*Socioeconomic status*" and "*Preventing behaviour*s", concepts introduced in the review of existing literature. The panels are not dependent on cognitive skills only, but they are also interdependent with each other. A change in one of the two can influence and modify the other one. Furthermore, the two concepts ultimately affect the possible onset and presence of chronic diseases, which is also influenced by cognitive skills.

Up until now, the conceptual model does not differ much by a typical conceptual model used in research. The principal difference is that stages of life are present as well, as it is possible to see on the right side of the model.
Childhood, *Adolescence and Adulthood* and *Old Age* are associated with the concepts discussed above so that the life-course approach can be applied to this research. In fact, the time perspective must be present since time is a fundamental concept in life course epidemiology (Kuh et al., 2003).

In the first two life stage boxes, there is also the presence of "*health conditions*" and "*modifiable risk factors*". These concepts are the main source of risk for an individual during that particular life phase: poor health conditions for children, who cannot look after themselves and are vulnerable, while adolescents and adults can – more or less willingly - expose themselves to hazards such as unhealthy diet and physical inactivity.
In case an individual is subject to those risks, (s)he could engage in disease preventing behaviours, with the influence individual's cognitive skills or socioeconomic position.
As it is possible to observe, choices and behaviours are never independent, but strongly tied together and always influencing and modelling each other.

Based on what has been discussed so far, it is possible to formulate hypothesises. In the discussed literature, there is always a clear correlation between cognitive skills and health outcomes in later life; furthermore, socioeconomic conditions do play a role in influencing the presence of diseases, or in general the access of the individual to health.

In this paper, the hypothesis regarding the main research question is that children with higher cognitive skills have a lower chance of suffering from adverse health outcomes at old age. At the same time, below average childhood cognitive skills result in a higher possibility of developing chronic diseases.
As regards the first sub-question, the hypothesis is that cognitively skilled people are more likely to engage in vigorous physical activities, compared to non-skilled individuals. In any case, it is to be expected that the lower the skills level, the lower the rate of engagement in physical activities.
Finally, the hypothesis with the second research question is that income will significantly contribute to the model, resulting significative as well as increasing the explanatory power of the model.

Methodology

Data

The focus of the paper is on how childhood cognitive skills affect the later-life onset of chronic diseases; due to the complexity of the investigation and the high number of respondents required, the most feasible approach is to use secondary data, coming from a large study which covers different themes. As it will later be explained, multiple variables are necessary to contextualize a possible relationship between cognitive skills and later-life chronic diseases.

The dataset coming from the SHARE Survey is the one used in this analysis. SHARE is the acronym for "Survey of Health, Ageing and Retirement in Europe". The survey is a panel study, with individual-level data covering different topics such as health & health behaviours and household composition. A characteristic of SHARE is that it has a longitudinal design: this means that each respondent is interviewed numerous times. In total, there have been seven interview-waves, with the oldest being in 2004 and the most recent in 2017. In total, there are approximately 140'000 respondents, aged 50 or more, coming from 28 European Countries and Israel. The considerable number of interviewees allows the sample to be representative of each country. Moreover, the design of SHARE permits to compare different countries.
As regards ethical considerations, the survey was reviewed and approved by the Ethics Committee of the University of Mannheim and by the Ethics Council of the Max Planck Society (SHARE Project, 2019).

Variables and operationalization

The central research question is "Are children with high mathematical and language skills less prone to chronic diseases, when aged 50 or more?". In order to try to answer the question, it is necessary to discuss which variables will be taken into consideration.

As regards the dependent variable, this will be "*chronic_mod*", which measures the chronic illnesses respondents reported. This variable is the lowest box of the conceptual model, "Onset of chronic diseases"

Regarding independent variables, an interviewee is considered with above-average skills when (s)he replied with "*better*" or "*much better*" to both variables "maths_age10" and "language_age10". Those variables measure the mathematical and language performances of the respondent at the age of 10, compared to other children.
Secondly, an individual is considered with average skills when (s)he selected "*about the same*" in both variables "maths_age10" and "language_age10".
Thirdly, if an interviewee picked "*worse*" or "*much worse*" in the two variables mentioned above, then (s)he will be considered as below average.
As a consequence, variables "Above_Average", "Average" and "Below_Average" are the first three independent variables. A disadvantage of this method is that respondents whose skills level differs between discipline are not included in the analysis; nonetheless, the amount of recorded cases is large enough.

Furthermore, there are three other independent variables in the analysis of the main research question:

- "*Childhood_health*" measures the general health status of respondents throughout the entire childhood, and it refers to the concept of "Health conditions*"* present in the conceptual model.
- "*isced1997_r"*" refers to the highest stage of education completed by individuals, according to ICSED classification. This variable is an indicator of "Socioeconomic position", central in the conceptual model.
- Lastly, "*Age*" measures how old respondents were when they completed the SHARE Survey. As mentioned above, age is a central aspect in the life-course approach: this is shown in the conceptual model, with the presence of different life stages.

As regards the first sub-question, the variables used are the same, with the addition of the net household income variable, which is used as a mediator. "*Log_Income*" is represented in the conceptual model by the term Socioeconomic position. Adding this new variable to the model in a second moment can show the impact of income on the previous model, revealing its impact and whether it actually mediates the results previously obtained. "Log_Income" is the logarithmic transformation of variable “thinc_m”: as it will later be explained, this variable did not satisfy the requirements for the statistical analysis; therefore it must be transformed into logarithmic values.

The second sub-question is defined as follows: “"Do children with high mathematical and language skills engage more often in vigorous activities compared to non-gifted children, when aged 50 or more?".

In this case, the dependent variable is no longer “*chronic_mo*d”, but “*Vigorous_Activity*”. This variable was transformed from an ordinal one to a binary one. “Vigorous_Activity” measures whether respondents engage at least once a week in physical activities such as sport. In the conceptual model, this variable represents “Disease-preventing behaviours”.

Regarding the independent variables present in the second sub-question, there are some differences with the first two. In fact, “*Childhood Health Status*” is no longer present, and it is instead substituted by “*bmi*” and “mobilityind”.
“*bmi*” represents the reported body mass index of the respondents; a high digit is detrimental, since it means that the person is overweight or obese. In the conceptual model, “*bmi*” represents “modifiable risk factor”.
“mobilityind” is a variable which measures whether the individual is subject to mobility difficulties. In this case, this variable is added as a control variable: a person might not engage in any vigorous activities not because (s)he does not want to, but because (s)he is simply physically incapacitated. Furthermore, “*icsed1997_r*”, “age”, “*above_average*” and “*below_average*”

Table 1 is a brief overview and explanation of the different variables with their values.

Name of the variable	Level of measurement	Description of variable
Age	Ratio	Age of the respondent
Above_Average	Binary	Respondent with above-average cognitive skills
Average	Binary	Respondent with average cognitive skills
Below_Average	Binary	Respondent with below-average cognitive skills
BMI	Ratio	Body mass index of respondents
Childhood_health	Ordinal	Health of respondents during childhood, ranging from 0 (Excellent) to 5(poor)
Chronic_mod	Ratio	Reported number of chronic diseases
Isced1997_r	Ordinal	Level of education, ranging from 0 (no education) to 6 (tertiary education)
Log_Income	Ratio	Household net income, transformed in Log.
Mobilityind	Ordinal	Mobility index, ranging from 0 (no difficuluties) to 4(sever difficulties)
Vigorous_activity	Binary	Vigorous activity at least once a week, NO (0), YES (1)

Table 1- brief description of variables

Statistical Method

For the main research question, the most suitable statistical test is a multiple linear regression. “Chronic_mod” contains the reported number of chronic diseases each respondent has, meaning that is a ratio variable. Due to this level of measurement, the most appropriate statistical test is multiple linear regression. This method of analysis requires homoscedasticity, independent cases and normal distributions for each variable (Uyanik and Guler, 2013).

In case those requirements were not met, it would be possible to run a binary logistic regression, with the transformation of "chronic_mod" into a dummy variable: value 0 would be given to people not suffering from any chronic diseases, while value 1 to respondents who have at least one chronic disease.

The first research sub-question is aimed at investigating the possible effect that income has on the later-life onset of chronic diseases. As seen in the analysis of the scientific literature, income levels seem to be a possible moderator for the origin of chronic disorders. Based on this hypothesis, the same regression ran for the main research question will be repeated, introducing variable "Log_income", which contains the household net income transformed into logarithmic scale, since the normal variable was not normally distributed.

Lastly, for the second research sub-question, the dependent variable “Vigorous_Activity” is a binary one; in this case, it is possible to run a binary logistic regression. In this case, it is not necessary to assume homoscedasticity, nor linearity or normality (Sarkar et al., 2011).
The output generated by SPSS will not inform about a score of the independent variable, but rather in which of the two groups (either 0 or 1) the independent variables are more likely to end up in.

Descriptive statistics

Variables	N	Mean	Std. Deviation
Age at interview (in years)	63576	66,5359965	10,22091017
Body mass index	63576	25,95	7,356
Number of chronic diseases	63576	1,14	1,39
Education of respondent in ISCED-97 Coding	63576	3,03	6,248
Log_income	62949	4,385	0,40243
Mobility index	63576	0,5	1,012
Vigorous_Activity	63529	0,49	0,5

Table 2 – Descriptive statistics of variables

As it is possible to see from table 2, respondents had approximately a mean age of 65.5 years. Body mass index is 25.95, value which indicates an average slightly overweight situation.
The mean of number of chronic diseases is 1.14, but it tends to vary to a great extent, since the standard deviation is 1.39. The average education level reached is 3.03, which on the ordinal scale represents upper secondary education. As regards income, the mean is 24,266.1 Euro, when transformed back. Furthermore, most people do not have mobility limitations, since on the total the mean is only 0.5, meaning no to very mild limitations. In addition, around just a little bit less of the half of respondents engage at least once a week in physical activities.

Results

The main research question focuses on the effect of childhood cognitive skills on the presence of chronic diseases. As mentioned in the methodology chapter, a multiple linear regression has been run; here are the results:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,281[a]	,079	,079	1,334

Table 3 - *Model Summary first research question.*

As it is possible to observe in table 3, R Square is equal to 0.079. This number is a mere 7.9%. It is safe to say that the independent variables entered in the model explain only a small portion of the variance of the dependent variable.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9768,979	5	1953,796	1098,022	,000[b]
	Residual	113526,085	63801	1,779		
	Total	123295,064	63806			

Table 4 – *ANOVA Table.*

One step further, the ANOVA table (table 4) is statistically significant: this means that the regression model is a good fit of the data, although as seen above the R squared value is low.

The central part of the analysis is unquestionably the coefficients table.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1,388	,035		-39,222	,000		
	Above_Average	-,048	,013	-,014	-3,647	,000	,980	1,020
	Below_Average	,186	,024	,029	7,607	,000	,986	1,015
	Childhood health status	,010	,001	,051	13,184	,000	,969	1,032
	Education of respondent in ISCED-97 Coding	-,003	,001	-,015	-3,995	,000	,993	1,007
	Age at interview (in years)	,038	,001	,282	73,199	,000	,970	1,031

Table 5 - *Table of Regression Coefficients, first multiple linear regression.*

In table 3, it possible to see that all regression predictors are statistically significant since the p-value is <5%. This means that for every predictor, it is possible to reject the null hypothesis: each independent variable has a linear relationship with the dependent one.
At this point, it is possible to observe B, an unstandardized coefficient which is of great value in explaining what each coefficient means.
For *Above_Average*, there is a decrease of 0.048 in the total number of reported chronic diseases. On the other hand, people with below average cognitive skills see an increase of 0.186 on the total number of chronic diseases an individual report.
Although these digits are not remarkably high, they confirm the findings that with higher cognitive skills, the number of chronic diseases seem to decrease (Bassuk et al., 2000; Pavlik et al., 2003).
Talking about the other variables, for every increase in *education attainment* there is a decrease of 0.003 in the total number of chronic diseases: the higher the education, the lower the reported number of chronic conditions. As regards *age*, one extra year of life is equal to an increased risk of 0.038. Lastly, for every increase in the *Childhood Health Status* there is an expanded possibility of 0.01; considering that the variable ranges from value 0 – excellent to value 5 – poor, the worse the health conditions during childhood, the higher the number of chronic illnesses.
Moreover, table 3 shows that every requirement for a multiple linear regression has been respected, with multicollinearity statistics attesting no irregular value: Variance Inflation Factor

displays value close to 1, far away from values >5, which would mean that p-values are questionable.

As concerning second research sub-question, results are now presented.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,285[a]	,081	,081	1,333

Table 6- *Model summary first research sub-question*.

Table 6 shows that there is an increase in the explanatory power of the model when accounting for household income. However, the growth is limited to a small 0.002, meaning that the model increases by only 0.2%.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-,604	,075		-8,020	,000		
	Above_Average	-,035	,013	-,010	-2,610	,009	,974	1,026
	Below_Average	,166	,025	,026	6,738	,000	,982	1,018
	Childhood health status	,009	,001	,049	12,542	,000	,964	1,037
	Education of respondent in ISCED-97 Coding	-,003	,001	-,014	-3,576	,000	,991	1,009
	Age at interview (in years)	,037	,001	,273	68,944	,000	,930	1,075
	Log_income	-,160	,014	-,046	-11,768	,000	,944	1,059

Table 7 - *Table of regression coefficients, second multiple linear regression*

Table 7 displays the regression coefficients for the variables. Again, every variable is statistically significant, resulting in the rejection of the null hypothesis.
Analysing *Log_income*, it is possible to say that an increase in income is associated with a decrease of 0.0016 in the total number of chronic diseases. This finding does suggest that there is a negative correlation between higher income and the possibility to suffer from a chronic illness.
This finding is comparable to different papers covering the relationship between income and detrimental health outcomes (Melchior, 2007; Macintyre, 1998).
However, looking at "*Below_Average*" and "*Above Average*" it is possible to see that "*Log_Income*" mediates those coefficients. If the two coefficients models are compared, adding household income decrease the reported number of chronic conditions for "*Below_Average*", from 0.186 to 0.166, while for "Above average" it moves from -0.048 to -00.35.

As regards the secondary sub-question, results of the binary logistic regression are now shown.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	78881,641[a]	,138	,185

Table 8 – *Model Summary second research sub-question.*

As it is possible to observe in table 8, Nagelkerke R square is 0.185; this is quite a satisfying result, higher than the value of the first linear regression. However, Nagelkerke R square is a pseudo R square measure, which is not the same thing as a standard R square; overall, it is possible to say that the variables of the model presented here explain 18.5% of the phenomenon.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Above_Average(1)	,087	,021	16,670	1	,000	1,091
	Below_Average(1)	-,194	,040	23,173	1	,000	,824
	Age at interview (in years)	-,039	,001	1820,224	1	,000	,962
	Education of respondent in ISCED-97 Coding	,006	,001	17,324	1	,000	1,006
	Mobility index (high: has difficulties)	-,767	,013	3627,187	1	,000	,464
	Body mass index	-,004	,001	9,775	1	,002	,996
	Constant	2,958	,070	1767,320	1	,000	19,266

Table 9 - *Table of regression coefficients, binary logistic regression.*

In table 9, variables are displayed, with their p-value as well as their B coefficient. The first thing to notice is that also in this case, each predictor is statistically significant, meaning that no regression coefficient is equal to 0.

The most important predictors to look at are *Above Average* and *Below average*. The first has a B value of +0.087, meaning that people with higher cognitive skills are 1.091 times more likely to engage in vigorous activities at least once a week than those who are *not* cognitively skilled.

As regards individuals with childhood below average skills, they are 0.824 times likely to do physical exercises, compared to those who were at least average.

From these results, it is possible to state that higher cognitive skills are associated with a more frequent engagement in vigorous activities; on the other hand, lower cognitive skills seem to reduce the frequency of physical exercises. These findings are similar to Anstey et al., (2009), who also came up with a higher level of activities for individuals with above-average cognitive skills.

Regarding other variables, individuals with higher levels of educations are 1.006 times more likely to engage in vigorous activities. Furthermore, people with a high mobility index are 0.464 times less likely to engage than those who have a low score – meaning that the higher the physical incapability, the less the vigorous engagement rate.

As regards body mass index, a higher body mass is associated with a likelihood of vigorous physical activities of 0.996 as opposed those with a lower BMI.

Discussion

Based on the statistical analysis, it is possible to say that childhood cognitive skills play a role on the number of reported chronic diseases. Indeed, a statistically significant result has been found, showing that people with greater cognitive abilities are less likely to suffer from those conditions. However, childhood cognitive skills are not the only concept responsible for this, but there are also other factors. *Socioeconomic Position* and *Disease-Preventing Behaviours* are key notions in explaining why those with greater childhood cognitive skills report less chronic conditions.

As it is possible to see in the conceptual model, when an individual grows old and enters adolescence and adulthood, (s)he will engage in disease-preventing behaviours, or disease control, accordingly to the own cognitive skills. The socioeconomic status will play a role, and those factors will combine, resulting in a continually evolving situation.

However, as emerged from the literature review and as confirmed by the statistical analysis, high cognitive skilled children are more likely to engage in disease-preventing behaviours, such as engaging more in vigorous activities. From a life-course perspective, this is unmistakably beneficial, there is a reduction of risks with a lower exposure to risk factors. Children with lower cognitive skills might be subject to more risks, such as eating more unhealthy food or lower levels of exercising, which in the short run does not seem too negative, but in a long-term perspective, it might result detrimental. The concept behind this reasoning is the *accumulation of risks theory,* which means that life course exposures continuously accumulate through episodes of illness and health-damaging habits (unhealthy food, no physical activities) (Kuh et al., 2003). Therefore, from a life-course perspective, children with higher cognitive skills seem to start better, or at least with fewer risks, which could later evolve in serious health complications.

The statistical analysis has confirmed that the higher the level of education, the lower the presence of chronic illnesses, as already discovered by Katzman (1993), Karp et al. (2004) and WInkleby et al. (1992).
Furthermore, household incomes seem to be related to lower number of chronic diseases, but when applying the variable to the model it mediates the effect childhood cognitive skills have on chronic illnesses.

Overall, the findings of this thesis fit in the literature of the topic, since cognitive skills seem to influence the number of chronic conditions (Bassuk et al., 2000; Pavlik et al., 2003; Gottfredson & Deary, 2004), and highly cognitive skilled people engage more often in vigorous activities (Anstey et al., 2009), although income effect is not really univocal in this paper.

Recommendations and reflections on the thesis

A possible weak point of the paper could be that there was no IQ measurement, but only cognitive skills at age 10 compared to peers for both maths and language. These values might be not as trustworthy as an IQ measurement, but there was no other choice than using what was present in the easySHARE Survey.
Regarding a strong point, the use of the life-course approach is definitely beneficial: it gives new insights, and it allows us to examine the situation from a perspective that considers the whole life path.

This paper can be a starting point for investigating further implications of cognitive skills on later-life health conditions. Since the thesis encompasses all European Countries plus Israel and many different chronic conditions, there are several ways in which the topic could be broken down and analyzed. Comparing two different countries could be beneficial, e.g. a high-income country with a middle-income one, to better investigate the potential impact of income levels on health situations. Also, more specific health conditions could be examined, such as cardiovascular complications or arthritis, instead of chronic diseases in general.

Regarding policy recommendations, it would help to develop campaigns that advocate and promote a healthy and active lifestyle, starting from elementary school: making children understand the importance of a healthy diet alongside physical activities is crucial for healthy ageing.
Furthermore, during the life course of at-risk individuals, periodic health screenings could be useful, to recognize possible health issues at the very beginning and intervene right away, instead of acting only when a condition worsens and becomes a severe threat for the individual's life.

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