

'Why are the higher educated healthier?'

The relationship between education, health, risk attitude and time preference

Bachelor thesis

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Abstract

There is a large correlation between education and health. But the mechanisms through which education influences health are largely unknown. In this essay the influences of time preference and risk attitude, as mechanisms of education on health, are measured. Education may impact individual characteristics that affect health investments and ultimately health. It could lower discount rates and stimulate risk aversion. In this paper use is made of data of the Dutch DNB Household Survey. The research question is: 'Is it possible that education changes the risk attitude and time preference of individuals, and therefore makes the higher educated healthier?' The results show that more intelligent individuals have a lower time preference rate, but it is uncertain if this is caused by education, other factors or is intrinsic. The results stated the less educated aren't more likely to engage in riskier behaviours

Intent

- Intent.....3
- 1. Introduction.....5
- 2. Data8
 - 2.1 Variables.....8
 - Education.....8
 - Health.....8
 - Time preference.....9
 - Risk attitude10
 - Other variables.....10
- 3. Methods.....11
 - 3.1 Correlation.....11
 - 3.2 Regression11
 - 3.3 How to use the methods to answer the research question13
- 4. Results.....14
 - 4.1 The relationship between education and health14
 - Correlation.....14
 - Table 1: Spreading self-assessed health into five categories15
 - Table 2: Spreading self-assessed health into two categories15
 - Regression analysis16
 - Table 3: Regression self-assessed health with educational dummies.....17
 - Table 4: Regression self-assessed health on control variables18
 - Ordered logistic regression.....19
 - Graphic 1: Self-assessed health.....19
 - Table 5: ordered logistic regression, negative log-log20
 - 4.2 The relationship between risk attitude, education and health.....21
 - Graphic 2: Risk attitude21
 - 4.3 The relationship between time preference, education and health22
 - Future questions.....22
 - Table 6: Correlations between time preference and health & education24
 - Table 7: Regression time preference on health25
 - Factor analysis of the future questions.....26

Table 8: Total variance explained.....	26
Table 9: Regression health using factor variables	26
Table 10 Regression health using factor variables	27
Regression analysis	28
Graphic 3: Time preference	28
Table 11: Regression health on time preference and education	29
Table 12: Regression health on education, time preference and risk attitude	30
4.4 Comparison time preference	31
Comparison larger group of students.....	31
Table 13: Comparison time preference of students.....	31
Table 14: Comparison time preference of non-students	32
Comparison smaller group of students.....	33
Table 15: Comparison time preference of non-students with a similar age.....	33
5. Conclusion and discussion.....	34
5.1 Results	34
5.2 Conclusion	34
5.3 Discussion	35
6. References	36
7. Appendix.....	37
7.1 Descriptive statistics 2009.....	37
Table 1: The highest level of education completed	37
Table 2: Health measures.....	38
Table 3: Risk attitude	39
Table 4: Time preference	39
Table 5: Other variables.....	40
Table 6: Regression self-assessed health on control variables	40
Table 7: Regression health on risk attitude and education.....	41

1. Introduction

Everyone knows education improves income, job opportunities, working conditions, but it even makes you healthier. There is a large and persistent association between education and health, but nowadays there is even proof of a large causal effect of education on mortality (Cutler and Lleras-Muney, 2006).

The higher educated Dutch population lives on average about six till seven years longer than the lower educated, the difference in life expectancy in self-assessed good health is even around sixteen till nineteen years. Men who only finished primary school, live in general only fifty years in good health. The higher educated not only have a higher life expectancy compared to the less educated, they also live more years in good health.¹

However, the mechanisms through which education affects health are largely unexplained. Does an education for example teach individuals to use healthcare efficient (Grossman, 2000), are the higher educated better informed (Mirowsky and Ross, 2003) or makes education them more aware of the importance of the future by changing their time preference rate (Fuchs, 1982) and risk attitude?

In this inquiry the influences of time preference and risk attitude, as mechanisms of education on health, are measured. Education may impact individual characteristics that affect health investments and ultimately health. It could lower discount rates and stimulate risk aversion. In economics, the time preference or discount rate describes how much an individual appreciates enjoyment nearer in time over more remote enjoyment. Someone with a high time preference is more focused on his well-being in the present relatively to the average person, in contrast to someone with a low time preference who will emphasize their well-being in the future. Mathematically the time preference is captured in a discount function with related discount rates. But in principle the time preference rate or discount rate can be seen as the same. Risk aversion measures the influences of uncertainty. Risk aversion shows the preferences of individuals for a higher uncertain payoff or a more certain, but possibly lower expected payoff. This choice when facing risks is of everyday life and influences the behaviour of individuals. Some of them are cautious, preferring to minimize every risk even when the potential benefit is large. In contrast to others who love to face risks when even knowing the possible negative consequences.

¹ According to the Central Bureau of Statistics, *Gezondheid & Zorg in cijfers*, 2008.

If education lowers time preference, then a higher appreciation of the future could be an explanation for a healthier life style. Behaviour related to time preference involves a trade-off between current costs and future benefits, such as the wasted energy of sporting, the loss of pleasure eating healthy food, not smoking a cigarette or drinking alcohol. The expected benefits arise in the future by reduction in the probability of diseases and mortality, which could be an explanation why the higher educated have a healthier life style.

On the other hand, the amount of education depends partly on the time preference rate of individuals. Both education and health decisions depend on trade-offs of outcomes in time. Individuals with high time preference rates will tend to invest less in education because they prefer present consumption instead of investments for a higher future consumption. So, the question is does education change the time preference. Or are more intelligent individuals born with a lower time preference rate?

Risk attitude is also measured as an individual characteristic that could affect health, wondering if it determines risky and addictive behaviours like smoking and drinking. Could it be that education affects health, especially due to the lower chance of an addiction, through risk aversion? Are the higher educated for example taught to dislike risk more or is there no association?

Related literature shows different results regarding to differences in individual discount rates and the influence on health. Grossman (1972) started to explain variations in health outcomes by differences in discount rates. Where Fuchs (1982) only found minor relations between discount rates and health, Vuchinich and Simpson (1998) and Madden et al. (1997) found consistent relations between time preference and addictive behaviours. The time preference rate expectantly plays a crucial role in education and behaviour, but there isn't a lot of evidence. Therefore this research will focus on the influence of the time preference and risk attitude on education and eventually health. In addition to the existing literature the influences of these mechanisms on education and health are inquired. There seems to be a relationship between health en education and also of time preference and the discount rate on health and even education. But if this change of time preference and discount rate is caused by education and therefore would directly influence health isn't proved and will be the emphasis of this research.

Hence, the main aim of this paper is to investigate the role of time preference and risk attitude in the relationship between education and health. Are the less educated more likely to engage in riskier behaviours? Do they have another time preference? Are the higher educated more willing to sacrifice their well-being in the present, to achieve certain results in the future? And do these changes influence their health? Consequently the main research question is: 'Is it possible that education changes the risk attitude and time preference of individuals, and therefore makes the higher educated healthier?' The exploited dataset to answer all these questions is from the Dutch DNB Household Survey.

The composition of this thesis will be the following. At first there is a short description of the used dataset, including the used variables. After which the methods of research, namely correlation and regression, will be described. Further on the results and analyses will be explained. At first the relationship between education and health will be explained, followed by the relationship between education, risk attitude and health. And ending with the relationship between education, time preference and health. To conclude the paper with an answer to the research question and some suggestions for further research.

2. Data

This chapter describes the used dataset and the most important variables used for research. In this paper use is made of data of the Dutch DNB Household Survey. It is a unique dataset with a focus on psychological and economic aspects of financial behaviour. Annually around 2000 households participate on this panel survey, which started in 1993. Within each household, all persons aged 16 or over were interviewed. The dataset contains general information on the household, information about health and income, and even economical and psychological concepts, with almost no change in the yearly questions.

2.1 Variables

Relevant variables used for research:

- **Education.** In the DNB Household survey the level of education is measured by the educational credentials individuals obtain. The highest level of education attended (regardless of an certificate/diploma) and the highest level of education completed, determines the level of education. The impact of the highest level of education completed on health, is of main interest in the analysis. Both of the variables have nine categories:
 1. (continued) special education
 2. Kindergarten/primary education
 3. VMBO (pre-vocational education)
 4. HAVO, VWO (pre-university education)
 5. MBO (Senior vocational training or training through apprentice system)
 6. HBO (Vocational colleges)
 7. University education
 8. No education (yet)
 9. Other sort of education/training

Special education and other sort of education are not used because of the small percentage according to the descriptive of the dataset and because other sort of training and special education aren't specific enough. As well respondents who didn't had education yet aren't used, because the influence of education can't be measured.

- **Health.** The main measure of health used is self-assessed health, which measures an individual's perception of his overall health. It is a common measure of health in empirical research (Crossley T.F, 2002), there is even literature that shows that self-assessed health predicts mortality and morbidity (Idler and Kasl, 1995). In the survey the following question

was asked to measure the self-assessed health: 'In general, would you say your health is: excellent (1), good (2), fair (3), not so good (4) or poor (5).' Another measure used to test the influence of education on health is whether a respondent suffers from a long illness, a chronically illness, has an disorder or handicap or suffers from the consequences of an accident. Furthermore addictive diseases like excessive alcohol use and smoking are measured, especially to determine the impact of risk attitude.

- **Time preference.** The Dutch DNB household has an supplementary survey in 2004, where six detailed time preference questions were presented. Because there is only information of 2004, time preference is measured from the answers to a couple of statements regarding to future orientation. The concept of future orientation is highly related to an individual's time preference and is also seen as a determinant of human capital investments (Killingsworth, 1982). The data used is derived from agreement with the following statements:
 - 'I think about how things can change in the future, and try to influence those things in my everyday life.'
 - 'I often work on things that will only pay off in a couple of years.'
 - 'I am only concerned about the present, because I trust that things will work themselves out in the future.'
 - 'With everything I do, I am only concerned about the immediate consequences (say a period of a couple of days or weeks).'
 - 'Whether something is convenient for me or not, to a large extent determines the decisions that I take or the actions that I undertake.'
 - 'I am ready to sacrifice my well-being in the present to achieve certain results in the future.'
 - 'I think it is important to take warnings about negative consequences of my acts seriously, even if these negative consequences would only occur in the distant future.'
 - 'I think it is more important to work on things that have important consequences in the future, than to work on things that have immediate but less important consequences.'
 - 'In general, I ignore warnings about future problems because I think these problems will be solved before they get critical.'
 - 'I think there is no need to sacrifice things now for problems that lie in the future, because it will always be possible to solve these future problems later.'

- 'I only respond to urgent problems, trusting that problems that come up later can be solved in a later stage.'
- 'I get clear results in my daily work, this is more important to me than getting vague results.'

Agreement is indicated on a 7-point scale. Where 1 indicates 'totally disagree' and 7 indicates 'totally agree'. This future questions seem good proxies for the individual discount rate (Borghans, Golsteyn, 2005). A low time preference, means a higher appreciation of the future. Because of the different future questions there can't be stated that a higher score, indicates a high time preference. In this research not only the extreme rates are used, but also the other values on the 7-point scale. To have a complete view of the results.

- **Risk attitude.** Data used in this paper is derived from the answers to a statement regarding to risk behaviour. The statement is: 'I am prepared to take the risk to lose money, when there is also a chance to gain money.' Agreement is indicated on a 7-point scale. Where 1 indicates 'totally disagree' and 7 indicates 'totally agree'. The approach of asking people for a global assessment of willingness to take risks generates an useful all-around measure of risk attitudes in self-reported surveys (Dohmen, Falk and Sunde, 2005) Risk aversion means answering 1 on the question. And risk seeking means people answer 7 on the question. In this research not only the extreme rates are used, but also 2-6 on the 7-point scale.
- **Other variables.** Different other variables used for research are: age/birth year, financial situation, gender, urbanisation and living with a partner. The financial situation is indicated on a 5-point scale. From there are debts (1), need to draw upon savings (2), it is just about manageable (3), some money is saved (4), a lot of money can be saved (5). As well the urbanisation is indicated on a 5-point scale; very high degree of urbanization (1), high degree of urbanization (2), moderate degree of urbanization (3), low degree of urbanization (4) and very low degree of urbanization (5).

3. Methods

There are different methods used in this research, mainly correlation and regression.

At first the use of correlation will be discussed. Next the use of the appropriate regression methods in this research will be explained. To end with the explanation of the use of these two methods in answering the research question.

3.1 Correlation

At first there will be tested on correlation between education, health, time preference and risk attitude. Because correlation (r) measures the direction and strength of the relationship between two quantitative variables. Positive correlation indicates positive association between the variables, meaning that when one variable increases the other also increases, and negative correlation indicates a negative association, meaning that when one variable rises the other one declines. Simple bivariate correlation could be used. As well as partial correlation, which describes the linear relationship between two variables, controlling for the effects of additional variables, for example for gender, age and urbanisation.

3.2 Regression

Regression describes a relationship between an explanatory variable and a response variable. A regression analysis cannot determine causal relationships among variables, it can only predict dependent values. So a regressions does not necessarily implies a causal relationship.

At first we regress health on education, because there is stated that the higher educated are healthier. The different categorical variables are: (continued) special education, kindergarten/primary education, VMBO (pre-vocational education), HAVO-VWO (pre-university education), MBO (senior vocational training or training through apprentice system), HBO (vocational colleges) and university education. Because a regression analysis uses numerical variables and these categorical variables don't have a real numerical relationship, dummies variables are used. A dummy variable can take a value of 1 or 0 to indicate the presence or absence of the categorical effect.

Further on other regressions will be made. The expectation is that different values of time preference and risk attitude rates will produce different responses on health and education. The independent variables, time preference and risk attitude rates, are both continuous data,

because they may take any value within a (in)finite interval, that is an interval from 1-7.

A variable is continuous or scale when its values represent ordered categories with a meaningful metric. When the dependent variable is a scale variable linear regression is used.

The dependent variables take different forms, therefore different statistic regression techniques are used. The main measurement of health is self-assessed health, which are ordinal data, because it are categorical data. They could be ranked in a numerically meaningful way, the answers range from excellent, good, fair, not so good till poor. Because the outcome variable is categorical, ordinal regression is used. A variable is ordinal when its values represent categories with some intrinsic ranking. Linear regression models, don't work predicting ordinal responses, because they assume that the dependent variable is measured on an interval scale.

Other dependent variables are whether a respondent suffers from a long illness, a chronically illness, has an disorder or handicap or suffers from the consequences of an accident. And in addition smoking and drinking. These are binary/nominal variables, because they have an value of 1 (yes) or 0 (no). Because the dependent variable can only take two values, probit regression is used. Probit analysis is the most appropriate when a estimation is made of the effect of one or more independent variables on a binomial dependent variable.

The square of the correlation r^2 is the fraction of the variation in the values of y that is explained by the least-squares regression of y on x . The residual is the difference between the observed value of the response variable and the value predicted by the model.

3.3 How to use the methods to answer the research question

The correlation tests will be done first, because when there are no relationships between the variables, it's useless to test the strength of influence of the variables by using regression.

Regression is used to make the general analyses, because it describes a relationship between an explanatory variable and a response variable. The influence of different variables can be determined by using regression. At first the relationship between education and health will be inquired. Because when there seems to be no strong relationship between a higher education and a better health status, there is no reason to test for other mechanisms influencing education and health. Secondly the mechanisms that could be influenced by education and therefore are related to health are inquired. Since it will be interesting to determine which part of education creates a better health or that higher educated are intrinsic different and always are having a better health, regardless to education. The mechanisms that will be tested by using a regression are time preference and risk attitude. At first the influence of risk attitude regarding to health and education will be tested by using regression. Secondly the influence of time preference regarding to health and education will be determined.

These general analyses are made using the participants of the DNB data survey in 2009. When education lowers the time preference rate, a higher appreciation of the future could be an explanation for a healthier life style. But when using only these regressions there can't be stated that time preference is influenced by education and therefore a higher education influences your health. Because it could also be, that higher educated are having other time preference rates and another risk attitude in comparing to the lower educated. Therefore the time preference rate of students started their study and finished it, in the time period of 1993-2010, are compared. When the time preference rate changes due to education there can be stated that education changes time preference and maybe influences their health status. These results are compared to individuals of the same age group, who don't study, to determine if the time preference rate will change in the control group or could be intrinsic. In the next chapter the results of these analyses will be discussed.

4. Results

In this chapter the results of the correlations, regressions and comparing of means will be analysed. In the first paragraph the relationship between education and health will be reviewed, to see if there is a relation between higher education and a better health. This is done using correlations, linear regressions and an ordered logistic regression.

Followed in the second and third paragraph; by the analysis of the mechanisms that could influence education and therefore health. This consists in the analysis of the relationship between risk attitude, education and health. And the analysis of the relationship between time preference, education and health. Both of these analyses will first focus on the relationship between the mechanism and health, followed by the relationship of the mechanism and education, using correlation- and regression analyses.

The last paragraph concludes with the comparison of the means of time preference for non-students and students, at the beginning and end of their study. This is done to determine if the time preference rate will change due to education or could be intrinsic determined.

4. 1 The relationship between education and health

Correlation

At first a correlation is made between education, the highest level of education completed, and health. Both the self-assessed health with five categories and when defined into good (excellent, good) and bad (fair, not so good or poor) are used. As said special education, no education and other sort of education, which aren't specified, aren't used. These health categories are ordinal data, so instead of working with Pearson's Correlation, Gamma another measure of correlation is used. Gamma is used for collapsed ordinal variables, which are limited ordinal categories. A value of +1 for Gamma indicates a perfect correlation between the two variables, in contrast to -1 which indicates a perfect negative correlation.

The correlation between health defined into five groups, from excellent(1) till poor(5) and education is small (-,119) but significant (0,000) this means that when education level raises, the self-assessed health level decreases, so when individuals getting higher education they feel healthier.

The next table shows the spreading of the self-assessed health in every education category.

Table 1: Spreading self-assessed health into five categories							
Highest level of education completed		Excellent	Good	Fair	Not so good	Poor	Total
	Primary education	7 (8%)	60 (68%)	13 (20%)	8 (9%)	0 (0%)	88 (100%)
	VMBO	50 (10%)	320 (64%)	103 (22%)	21 (4%)	6 (1%)	500 (100%)
	HAVO/VWO	32 (15%)	129 (61%)	33 (16%)	15 (7%)	3 (1%)	212 (100%)
	MBO	29 (9%)	228 (70%)	53 (16%)	8 (2%)	6 (2%)	324 (100%)
	HBO	56 (12%)	327 (69%)	75 (16%)	15 (3%)	3 (1%)	476 (100%)
	University	38 (17%)	151 (67%)	29 (13%)	6 (3%)	0 (0%)	224 (100%)
Total		212	1215	306	73	18	1824

Table 2: Spreading self-assessed health into two categories				
		Bad Health (0)	Good Health (1)	Total
Highest level of education completed	Primary school	21 (24%)	67 (76%)	88 (100%)
	VMBO	130 (26%)	370 (74%)	500 (100%)
	HAVO/VWO	51 (24%)	161 (76%)	212 (100%)
	MBO	67 (21%)	257 (79%)	324 (100%)
	HBO	93 (20%)	383 (80%)	476 (100%)
	University	35 (16%)	189 (84%)	224 (100%)
Total		397	1427	1824

The correlation between health defined into two groups, namely healthy(1) and unhealthy (0) and education is small (,137) but significant (0,001). The correlation means that when education

raises, the self-assessed health also raises. The second table shows the spreading of the self-assessed health in every education category, when it is defined into two categories: good(excellent, good) and bad (fair, not so good or poor).

Regression analysis

Because there is stated that the higher educated are healthier: a regression, which describes the relationship between an explanatory variable and a response variable, is made to determine the influence of education on health. The explanatory variable is education and the response variable is health. The response variable is ordinal, because it are categorical data, the answers range from excellent, good, fair, not so good till poor.

The different categorical variables are: kindergarten/primary education, VMBO (pre-vocational education), HAVO-VWO (pre-university education), MBO (senior vocational training or training through apprentice system), HBO (vocational college) and university education. Because regression analyses uses numerical variables and these categorical variables don't have a real numerical relationship, dummies variables are used. Later on the differences between the categories are described, you could imagine the difference between university and HBO is smaller compared to the difference between primary school and VMBO. When using dummy variables, university education is the reference group. The coefficient of the dummy variable is equal to the difference between the group coded 1 and the reference group.

Table 3: Regression self-assessed health with educational dummies

	B	Std. Error	Sign.
(constant)	2,034	,046	,000
Primary school	,216	,089	,015
VMBO	,192	,056	,001
HAVO/VWO	,155	,068	,022
MBO	,145	,061	,018
HBO	,088	,057	,122

The results of the regression stated that, when you finished an university study, you are much healthier compared to the students who only finished primary school, because the coefficient increases with a value of ,216, which indicates a poorer health. Every higher form of education changes the self-assessed health in a positive way. HBO isn't significant, probably because the difference between university and HBO is too small.

Since the dependent variable, in this case, can only take only five values, this linear regression model can't give a good prediction. But the results (table 3) can give an impression of the influence of education on health. Later on an ordered regression is made, to see what the influence is of the different categories.

Table 4: Regression self-assessed health on control variables			
	B	Std. Error	Sign.
Constant	17,390	2,586	,000
Education	-,034	,012	,006
Age	-,008	,001	,000
Gender	,023	,037	,537
Living with partner	-,166	,043	,000
Financial situation	-,095	,020	,000
Urbanisation	,018	,013	,157

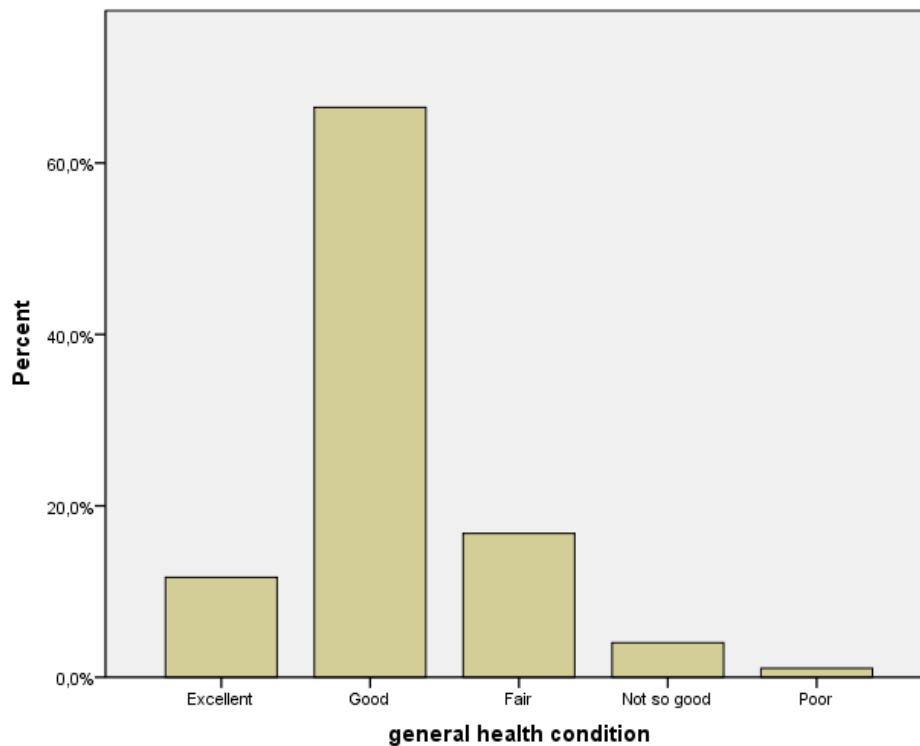
When using more variables in a regression on self-assessed health (table 4), education still has an significant influence. Education is captured into one variable instead of using educational dummies. This is to have a better overview, see table 6 the appendix for the regression using educational dummies. Also age has an significant positive influence on health and living with a partner. Other factors which influence health are for instance the financial situation of the individuals. When having a better and more stable financial situation, individuals feel healthier. Age and gender are both control variables. The financial situation could be a mechanism instead of a control variable, in that case it shouldn't be included in the regression. If the financial situation is influenced by education and therefore not directly influences education and health, it is a mechanism. Thus it could be a variable which isn't determined before treatment, in this case before education. This should be taken into account. But the dataset is from different households so therefore it could be determined before education, because parents also participate and influence the financial situation, and the individuals who study don't directly influence this situation.

Ordered logistic regression

The ordinal regression procedure is an extension of the general linear model which is used with ordinal categorical data. Since the use of linear regression models don't work very well when predicting ordinal variables, because the general linear model assumes that the outcome variable is measured on an interval scale. Given that the outcome variable is ordinal, namely different health categories, the assumptions on which linear regression relies are not satisfied.

The spreading of general health is represented by this graph.

Graphic 1: Self-assessed health



Since the dependent variable is ordinal, ordered probit and logit functions can be used to predict the dependent variable category. The most cases are in the lower categories, like 2 (good) and 3 (fair), therefore negative log-log is used in the ordinal regression. This function is recommended when the probability of the lower category is high. There is made a comparison when using the Cauchit. The Cauchit function is used when extreme values, category 2 (good), are present in the data. In this case the negative log-log is more appropriate to use because the chi-square of the model fitting information is higher, 15,58 (sign. 0,008) compared to 12,716 (sign. 0,026). Because the r-square is also higher the negative log-log will be applied.

Table 5: Ordered logistic regression, negative log-log								
		Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	Health=excellent	-,548	,080	47,158	1	,000	-,704	-,391
	Health=good	1,634	,091	319,457	1	,000	1,455	1,813
	Health=fair	3,203	,130	609,080	1	,000	2,949	3,458
	Health=not so good	4,844	,248	382,153	1	,000	4,359	5,330
Location	Primary school	,375	,150	6,209	1	,013	,080	,670
	VMBO	,322	,096	11,347	1	,001	,135	,510
	HAVO/VWO	,144	,114	1,608	1	,205	-,079	,367
	MBO	,295	,103	8,140	1	,004	,092	,497
	HBO	,191	,096	3,941	1	,047	,002	,379
	University	0 ^a	.	.	0	.	.	.

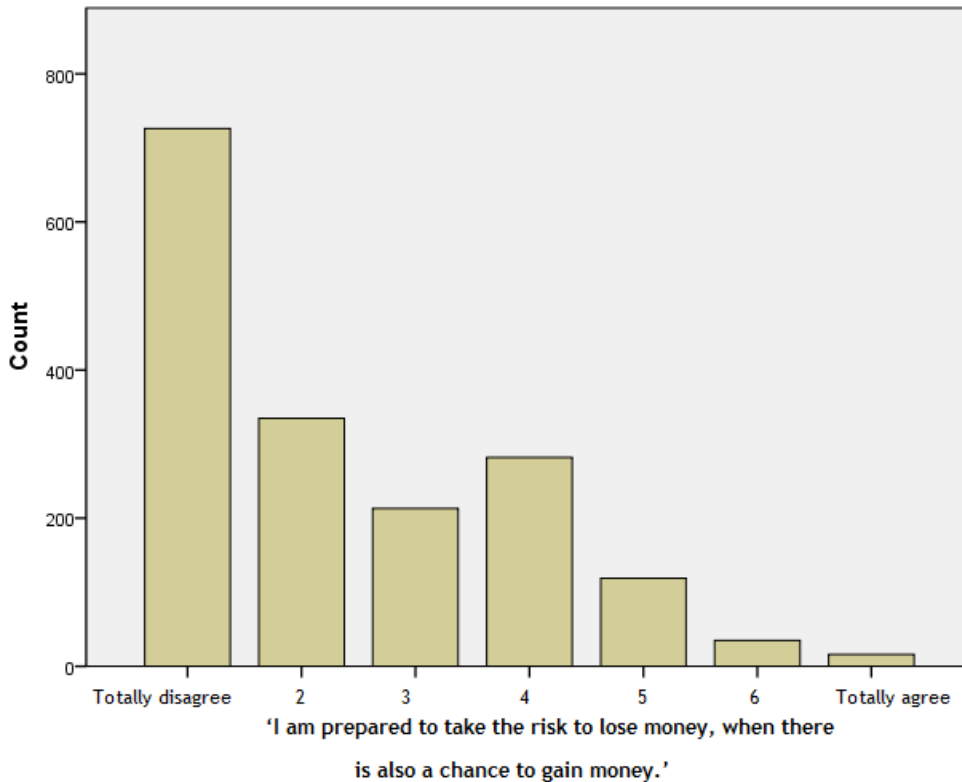
From the observed significance levels in table 5, you see that almost every education level is related to the different health levels. They all have positive coefficients. People with an higher education are more likely to experience an excellent health.

The findings of the ordered logistic regression are in line with the regular linear regression. According to the two regressions the higher educated indeed are healthier. This means it is possible to search for mechanisms influenced by education which create a better health. The next two paragraphs will focus on risk attitude and time preference as mechanisms.

4.2 The relationship between risk attitude, education and health

Secondly a correlation is made between risk attitude and health. The question which defines risk aversion is: 'I am prepared to take the risk to lose money, when there is also a chance to gain money'. This question describes the risk attitude spreading. A total agreement means that individuals are risk searching and a disagreement means individuals are risk averse.

Graphic 2: Risk attitude



The correlation between health defined into five groups, from excellent(1) till poor(5) and risk aversion is $-0,132$ (sign. 0,000). The correlation between risk attitude and addictive diseases like excessive alcohol use and smoke aren't significant at all. Risk aversion means answering 1 on the question. And risk seeking means people answer 7 on the question. According to the correlation: when individuals are more risk seeking they tend to feel healthier. The correlation between risk aversion and education is $0,123$ (sign 0,000). This implicates that the higher educated are also more risk seeking.

Risk attitude was measured as an individual characteristic that maybe could affect health, wondering if it determines risky and addictive behaviours like smoking and drinking. Thinking it could be possible that education affects health, especially due to the lower chance of an addiction, through risk aversion. Mainly because the higher educated are for example taught to dislike risk more. In that case the results are opposite to the expected. This could be because the question is related to monetary decisions in contrast to risk attitude towards health. According to this survey risk attitude isn't a behaviour or individual characteristic which is changed due to education creating a better health. See table 7 of the appendix for a regression analysis of health on risk attitude and education.

4.3 The relationship between time preference, education and health

The influence of time preference is the second mechanism which will be tested. Behaviour related to time preference involves the trade-off between current costs and future benefits. If education lowers time preference, then a higher appreciation of the future could be an explanation for a healthier life style. The wasted energy of sporting, the loss of pleasure eating healthy food, not smoking a cigarette or drinking alcohol are all examples of behaviour related to time preference and health. The expected benefits mostly arise in the future by reduction in the probability of diseases and mortality, which could be an explanation why the higher educated have a healthier life style.

First correlations between time preference and health will be made. To test whether time preference is related to health. After that the correlations between time preference and education will be made. Next to that there will be a factor analysis of the proxies for time preference. To conclude with a regression analysis of health on time preference and education.

Future questions

Time preference is measured from the answers to a couple of statements regarding to future orientation. This future questions seem good proxies for the individual discount rate, therefore correlations are made between these questions, health and education to determine the questions which seem to be relevant (table 6). Only one question seems to have a significant correlation of -0.125 with health, which is 'I am ready to sacrifice my well-being in the present to achieve certain results in the future'. When individuals are more willing to sacrifice their present well-being, they seem to be healthier.

In contrast almost every question has a significant correlation with education (table 6). The directions of the correlations indicate that when individuals are having lower time preference rates they are higher educated. In the previous question higher educated are more willing to sacrifice their well-being in the present, to achieve certain results in the future. If education lowers time preference, than a higher appreciation of the future could be an explanation for a healthier life style.

When regressing health on these proxies of time preference rate, there are more significant relationships between time preference rate and health (table 7). But, the chosen questions about the future determines whether there is a significant relationship between health and time preference. So, there could be a relationship between health and time preference, but this depends on the chosen time question. In further research it could be interesting to compare the differences and similarities of the future questions.

Table 6: Correlations between time preference and health & education

	Education	Sign.	Health	Sign.
'I think about how things can change in the future, and try to influence those things in my everyday life.'	,084	,000	-0,047	,185
'I often work on things that will only pay off in a couple of years.'	,188	,000	-0,018	,601
'I am only concerned about the present, because I trust that things will work themselves out in the future.'	-,135	,000	-,004	,931
'With everything I do, I am only concerned about the immediate consequences (say a period of a couple of days or weeks).'	-,066	,005	0,021	,539
'Whether something is convenient for me or not, to a large extent determines the decisions that I take or the actions that I undertake.'	,015	,546	-,025	,488
'I am ready to sacrifice my well-being in the present to achieve certain results in the future.'	,129	,000	-,125	,000
'I think it is important to take warnings about negative consequences of my acts seriously, even if these negative consequences would only occur in the distant future.'	,192	,000	-,017	,649
'I think it is more important to work on things that have important consequences in the future, than to work on things that have immediate but less important consequences.'	,146	,000	,036	,808
'In general, I ignore warnings about future problems because I think these problems will be solved before they get critical.'	-,082	,001	-,022	,530
'I think there is no need to sacrifice things now for problems that lie in the future, because it will always be possible to solve these future problems later.'	-,114	,000	-,050	,145
'I only respond to urgent problems, trusting that problems that come up later can be solved in a later stage.'	-,141	,000	,009	,803
'I get clear results in my daily work, this is more important to me than getting vague results.'	-,152	,000	,036	,302

Table 7: Regression time preference on health

	B	Std. Error	Sign.
Constant	2,302	,113	,000
'I think about how things can change in the future, and try to influence those things in my everyday life.'	-,021	,016	,204
'I often work on things that will only pay off in a couple of years.'	,000	,017	,983
'I am only concerned about the present, because I trust that things will work themselves out in the future.'	-,015	,016	,349
'With everything I do, I am only concerned about the immediate consequences (say a period of a couple of days or weeks).'	,018	,013	,166
'Whether something is convenient for me or not, to a large extent determines the decisions that I take or the actions that I undertake.'	-,009	,015	,538
'I am ready to sacrifice my well-being in the present to achieve certain results in the future.'	-,050	,014	,000
'I think it is important to take warnings about negative consequences of my acts seriously, even if these negative consequences would only occur in the distant future.'	,002	,015	,878
'I think it is more important to work on things that have important consequences in the future, than to work on things that have immediate but less important consequences.'	,032	,017	,064
'In general, I ignore warnings about future problems because I think these problems will be solved before they get critical.'	,013	,016	,414
'I think there is no need to sacrifice things now for problems that lie in the future, because it will always be possible to solve these future problems later.'	-,043	,016	,009
'I only respond to urgent problems, trusting that problems that come up later can be solved in a later stage.'	,002	,017	,889
'I get clear results in my daily work, this is more important to me than getting vague results.'	,035	,016	,031

Factor analysis of the future questions

As said before, time preference is measured from the answers to a couple of statements regarding to future orientation. According to the correlations and regression analyses the relationship between health and time preference depends on the chosen time question. So there seem to be differences and similarities in the future questions. To control for these differences a factor analysis will be made. It is possible to use only one future question to determine time preference, but when using factors it is possible to use the more similar questions, namely the questions which are highly correlated.

Factor analysis is a technique which summarizes a large number of variables into a smaller number of factors. Factor analyses are performed by examining the pattern of correlations or covariances between the observed measures, in this case the future questions. The questions which are highly correlated are likely to be influenced by the same factors, and in contrary those that are relatively uncorrelated are likely to be influenced by different factors.

When using factor analysis 28,36% of the variance is explained by the first component and 20,83% by the second (table 8).

Table 8: Total variance explained			
Component	Extraction Sums of Squared Loadings		
	Total	Percentage of variance	Cumulative percentage
1	3,403	28,358	28,358
2	2,500	20,832	49,190
3	1,086	9,046	58,235

A relatively low percentage of the variance is explained by the first component. And the regression on health with the factor variables doesn't give significant results (table 9). Also a regression of health on the factor variables and other variables such as education and risk attitude has been made, but this wasn't significant as well (table 10). The factor analysis seems to be no good solution for the problem of the different time preference questions, because it didn't gave significant results.

Table 9: Regression health using factor variables			
	B	Std. Error	Sig.
Constant	2,176	,018	,000
Factor 1	,018	,018	,307
Factor 2	-,015	,018	,407
Factor 3	-,011	,018	,562

Table 10: Regression health using factor variables, education and risk attitude

	B	Std. Error	Sig.
Constant	2,415	,064	,000
Education	-0,036	,012	,003
Factor 1	-0,010	,018	,580
Factor 2	-0,017	,019	,373
Factor 3	-0,013	,018	,474
Risk attitude	-0,037	,013	,003

One of the research questions was: 'Does education change the time preference rate, or are the more intelligent individuals born with a lower time preference rate?' To answer this question the last paragraph concludes with the comparison of the means of time preference for non-students and students, at the beginning and end of their study. This is done to determine if the time preference rate will change due to education or could be intrinsic.

Because the factor variables can't be used over time and is not that significant, only one future question is chosen to determine time preference. Of course using only one question to determine time preference is really simplistic and can't be generalised. First a couple of regression analyses of this one future question will be made. The end of this chapter will focus on the comparison of the means of this one future question to answer one of the main research questions.

Regression analysis

For now, only the following question is used to determine time preference; 'I am ready to sacrifice my well-being in the present to achieve certain results in the future.' A low time preference, means a higher appreciation of the future. In this paragraph regression analyses are made to test the influence of this one future question on health. First the spreading of the time preference of the individuals will be shown. After that a simple regression analysis shows the influence of education, time preference, risk attitude and the interaction effect of time preference and risk attitude on health. To end with the same regression using educational dummies.

This graph shows the spreading of the time preference of the individuals in 2009. An agreement with the statement indicates a low time preference, in contrast a disagreement indicates a high time preference. A higher appreciation of the future, so a low time preference, could be an explanation for a healthier life style. According to this graph the individuals prefer a high time preference.

Graphic 3: Time preference

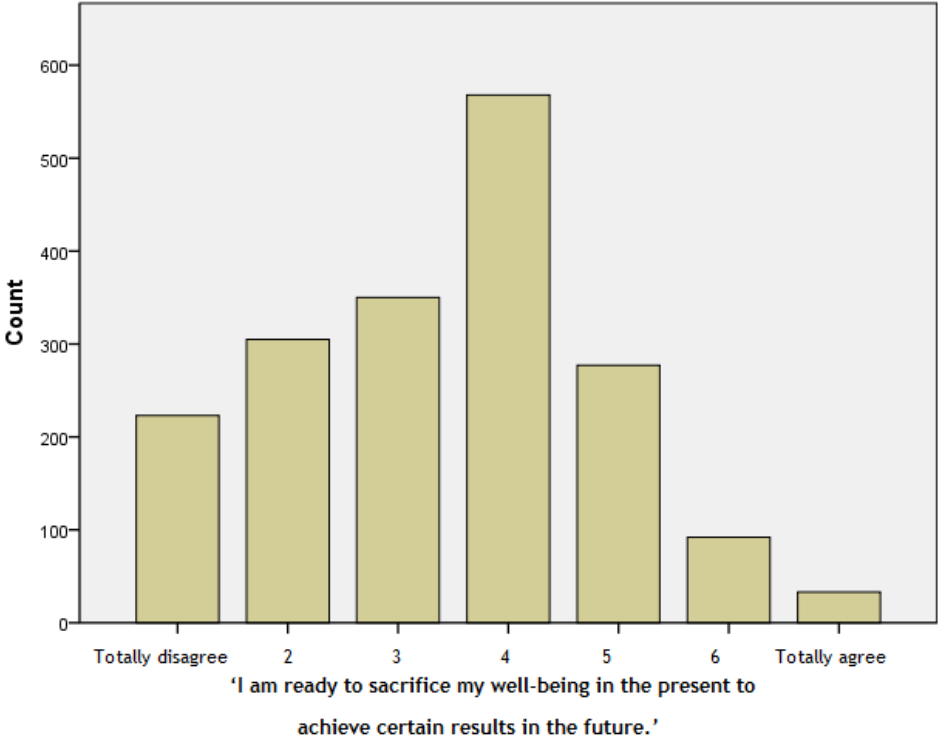


Table 11: Regression health on time preference and education			
	B	Std. Error	Sign.
Constant	2,318	,059	,000
Education	-,032	,012	,007
Time preference* risk attitude	-,032	,019	,086
Time preference	-,039	,019	,040
Risk attitude	-,045	,019	,017

The regression analysis (table 11) shows that a low time preference, a high risk attitude and a higher education improve self-assessed health. The interaction-effect is tested by a new variable (time preference*risk attitude), which is attributed to the model. The two variables interact if the combination of the variables leads to results that wouldn't be anticipated pure on the basis of the main effects of those variables. In this regression the main effect of time preference is -,039 and of risk attitude -,045, while the interaction effect shows an effect of -,032.

Table 12 : Regression health on education, time preference and risk attitude						
				With time preference and risk attitude		
	B	Std. Error	Sign.	B	Std. Error	Sign.
(constant)	2,034	,046	,000	2,198	,073	,000
Primary school	,216	,089	,015	,143	,099	,148
VMBO	,192	,056	,001	,184	,061	,002
HAVO/VWO	,155	,068	,022	,150	,072	,038
MBO	,145	,061	,018	,173	,066	,009
HBO	,088	,057	,122	,106	,060	,080
Time preference* risk attitude				-,033	,019	,081
Time preference				-,028	,013	,033
Risk attitude				-,028	,013	,026

When dividing education in the subcategories of primary school, VMBO, HAVO/VWO, MBO, HBO and university by the use of dummies the individual effects can be seen (table 12). The effect of time preference and risk attitude is still significant. But the effect of only finishing primary school is suddenly a lot smaller and not significant. Could it be that there is an influence of time preference on the primary school? And could the difference in health be determined by the difference in time preference? Would it be a solution to send these primary school students to university so they suddenly get healthier, or are these students intrinsically different?

4.4 Comparison time preference

The main research question is: 'Does education change time preference or are more intelligent individuals born with a lower time preference rate?' According to the previous regressions a low time preference rate improves your health. But is this change of time preference rate due to education? First a comparison of a bigger group of students who started to study and finished studying compared to the control group will be made. But this control group isn't totally similar in terms of age, therefore a second comparison will be made. This will be done with a smaller group of students and a smaller control group, but totally similar in age.

Comparison bigger group of students

A comparison of the time preference rate of a group of students who started their study and finished it shows only a very small difference (table 13). The average time preference rate at the start is 4,12 and when ending 4,17.

Table 13: Comparison time preference of students						
	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Time preference when started their study	272	1,00	7,00	1121,00	4,12	1,42331
Time preference when finished their study	272	1,00	7,00	1134,00	4,17	1,41711

Of course this is only a group of 272 students. But the suggestion is made that the time preference rate doesn't change due to studying. Therefore a control group is made. This control group exists of respondents with other primary occupations such as employment, working in their own business, being a freelancer, looking for work, or working in their own household, being disabled, being a volunteer, or being too young to work. So if studying doesn't change your time preference rate, it could be that more intelligent individuals are born with a lower time preference rate. Therefore the change of the time preference rate of this control group is measured, because when you are born with a lower time preference and it doesn't change as a result of education, this shouldn't change either in the control group.

The average birthdate of the students is 1979. The students didn't start their study on the same time. The ages of the students who were started to study, differ from the age 17 till 28, calculated based on the average birth rate.

The control group exists in a total of 272 individuals of two different groups. Because the dataset is limited it isn't possible to select a larger control group. Two groups of exactly the same total amount of individuals are used -one group compared the years 1996-1999 and one group 2006-2009-, because the dataset is limited on individuals in the same age range, who didn't study. And because two different time periods are measured the data are more trustworthy. The birth rate is lower because of the limited dataset. The average starting age is 32, which is of course much higher than the highest age of the students from the previous results, but still comparable. The difference in time preference within three years is measured.

The change of time preference rate in three years of a small group of non-students also shows only a very small difference (table 14). The average time preference rate in 1996 is 3,76 and in 1999 is 3,82. In 2003 the average time preference rate is 3,84 in comparison with 3,97 in 2009. The average change is 0,09 this is higher than the change of 0,05 of students but still very small.

Table 14: Comparison time preference of non-students							
		N	Minimum	Maximum	Sum	Mean	Std. Deviation
First group 1996-1999	Birth year	136	1957,00	1977,00	266909	1963	4,09101
	Time preference 1996	136	1	7	511	3,76	1,342
	Time preference 1999	136	1	7	520	3,82	1,333
Second group 2006-2009	Birth year	136	1973	1988	268814	1976,57	2,543
	Time preference 2006	136	1	7	522	3,84	1,492
	Time preference 2009	136	1	6	540	3,97	1,316

According to the comparison of the means studying doesn't change the time preference rate and neither the control group experiences a change of time preference rate. Therefore it seems to be that more intelligent individuals are born with a lower time preference rate.

Because the difference in time preference rate isn't caused by education, the individual time preference is a more intrinsic value, which seems not determined by schooling. Of course there should be taken into account that the compared groups are still small, and the control group isn't totally similar. Therefore a comparison of a smaller group of students with a control group with a total similar age will be made. But using only one future question to determine time preference still isn't extremely trustworthy.

Comparison smaller group of students

Because the previous comparison didn't had a totally similar control group in terms of age. A second comparison will be made. This will be done with a smaller group of students and a smaller control group, but totally similar in age. Table 15 shows the results of the comparing of means.

Table 15: Comparison time preference of non-students with a similar age						
Birth Year	Student			Non Student		
	N	Mean TP before studying	Mean TP after studying	N	Mean TP 2006	Mean TP 2009
1975	8	4,75	4,63	29	3,88	3,77
1976	15	4,00	4,27	23	3,65	4,17
1977	13	4,69	4,31	21	3,57	3,71
1978	22	4,59	4,41	15	4,93	4,73
1979	35	4,34	4,40	4	4,25	4,75
1980	27	4,19	4,59	11	3,82	4,09

Overall most of the time preference rates of non-students are smaller than the rates of students. On the opposite of the comparing of the previous analyse the differences in time preference are larger in this smaller group. This could be because of the very limited dataset, or the poor reliability of the future question, or could indicate that the time preference isn't intrinsic.

The two comparisons show different results, therefore there can't be stated with certainty that the time preference rate seems to be intrinsic. Further research regarding to time preference rates and education are needed, to test whether this is intrinsic defined.

5. Conclusion and discussion

In this chapter the research question of the paper will be answered. Furthermore the limitations of this research and possibilities for further research will be discussed. At first the results of this research will be briefly described.

5.1 Results

According to the regression analysis a higher education, a lower time preference rate and a higher risk attitude improves the self-assessed health. The influence of education on health is $-.032$ (sign. $.007$) and of time preference it is $-.039$ (sign. $0,04$). The influence of risk attitude on health is $-.045$ (sign. $0,017$). Study doesn't cause a great change of the time preference rate (the average time preference rate when starting studying is $4,12$ and when ending $4,17$) and neither the control group experiences a great change of time preference rate, in the larger comparison.

5.2 Conclusion

There is a large correlation between education and health. But the mechanisms through which education influences health are largely unknown. In this essay the influences of risk attitude and time preference, as mechanisms of education on health, are measured.

The results stated the less educated aren't more likely to engage in riskier behaviours. According to the correlation: when individuals are more risk seeking they tend to feel healthier. The correlation between risk aversion and education implicated that the higher educated are also more risk seeking.

The results show that there is an effect of time preference on education and health. The higher educated are more willing to sacrifice their well-being in the present, to achieve certain results in the future. But this difference according to the comparison of non-students and students seems not caused by education, according to one of the comparisons. The two comparisons show different results, therefore there can't be stated with certainty that the time preference rate seems to be intrinsic. The conclusion is that more intelligent individuals have a lower time preference rate, but it is uncertain if this is caused by education, other factors or is intrinsic.

5.3 Discussion

The results stated the less educated aren't more likely to engage in riskier behaviours, in contrast when individuals are riskier they seem to be healthier. This raises the question about the reliability of the dataset. There should be taken into account that the used dataset contains especially information with a focus on psychological and economic aspects of financial behaviour. And therefore can't be generalised.

The measurement of risk attitude was limited. This is also the case for the measurement of time preference, because only one future question is used to determine the time preference rate. There is assumed that time preference rate drives education and health choices, but there is relatively little evidence to suggest a relation between monetary time preference questions and health. The measurement of health as well can be questioned. According to the analysis of this panel dataset the less educated individuals in 2010 were suddenly much healthier, in contrast to other findings.

Repeating this analysis using more robust and better measures of risk attitude, time preference and health in addition to a greater amount of participants will be important for further research.

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7. Appendix

7.1 Descriptive statistics 2009

Table 1: The highest level of education completed		
	Frequency	Percentage
1. (continued) special education	20	,5
2. Kindergarten/primary education	392	9,4
3. VMBO (pre-vocational education)	926	22,1
4. HAVO, VWO (pre-university education)	401	9,6
5. MBO (senior vocational training) or training through apprentice system	621	14,8
6. HBO (vocational colleges)	768	18,4
7. University education	365	8,7
8. No education (yet)	649	15,5
9. Other sort of education/training	33	,8
10. Missing	10	,2
Total	4185	100

Table 2: Health measures

	Frequency	Percentage
Self-assessed health:		
-Excellent	217	11,7
-Good	1233	66,4
-Fair	313	16,9
-Not so good	75	4
-Poor	19	1
Chronically illness/handicap/accident		
-Yes	478	25,7
-No	1379	74,3
Smoking		
-Yes, sometimes	91	4,9
-Yes, daily	291	15,7
-More than 20 cigarettes a day	-75	-4
-Less than 20 cigarettes a day	-216	-17,7
-No	1475	79,4
Excessive alcohol use		
-Yes	112	6
-No	1745	94

Table 3: Risk attitude

	Frequency	Percentage
'I am prepared to take the risk to lose money, when there is also a chance to gain money.'		
- totally disagree	726	39,3
- 2	335	18,1
- 3	213	11,5
- 4	282	15,3
- 5	119	6,4
- 6	35	1,9
- totally agree	16	0,9
- missing	1726	6,6

Table 4: Time preference

	Frequency	Percentage
'I am prepared to take the risk to lose money, when there is also a chance to gain money.'		
- totally disagree	223	12,1
- 2	305	16,5
- 3	350	18,9
- 4	568	30,7
- 5	277	15,0
- 6	92	5
- totally agree	33	1,8

Table 5: Other variables					
	Frequency	Minimum	Maximum	Mean	Std. Deviation
Birth year	3480	1915	1999	1961,92	18,161
Financial situation	1751	1	5	3,48	,949
Gender	3483	1	2	1,50	,500
Urbanisation	3469	1	5	4,10	1,429
Living with a partner	3483	0	1	,85	,362

Table 6: Regression self-assessed health on control variables using educational dummies			
	B	Std. Error	Sign.
Constant	17,477	2,630	,000
Primary school	,307	,108	,005
VMBO	,165	,061	,007
HAVO/VWO	,184	,074	,013
MBO	,196	,066	,003
HBO	,118	,060	,052
Age	-,008	,001	,000
Gender	,024	,037	,527
Living with partner	-,168	,043	,000
Financial situation	-,093	,019	,000
Urbanisation	,017	,013	,179

Table 7 : Regression health on risk attitude and education						
				With risk attitude		
	B	Std. Error	Sign.	B	Std. Error	Sign.
(constant)	2,034	,046	,000	2,103	,060	,000
Primary school	,216	,089	,015	,161	,098	,103
VMBO	,192	,056	,001	,198	,060	,001
HAVO/VWO	,155	,068	,022	,156	,072	,030
MBO	,145	,061	,018	,191	,066	,004
HBO	,088	,057	,122	,116	,060	,055
Risk attitude				-,037	,060	,000