Meistararitgerð

í heilsuhagfræði

Does Individual Income affect Health Production in Iceland?

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Abstract

Background and aims: It is well known that individual's health is affected by many economic and social factors. Generally people in lower socioeconomic groups are less healthy than people in higher socioeconomic groups. There is a widespread and growing demand for primary health care. This demand in turn displays a growing appetite among policymakers for knowledge related to how health-care systems can become more equitable, inclusive and fair. The main objective in this study is to assess the effect of individual income on health production in Iceland. The focus is on a hypothesis suggesting that the relationship between income and health is not monotonic and robust former research on the same topic. To do this, systematic variations in health depending on individual income, is examined.

Data and methods: The data utilized in this study is originated from a health and lifestyle survey carried out by the Public Health Institute of Iceland, in the year of 2007. The cross sectional data was gathered on individual income, self-assessed health and other socio-demographic characteristics at individual level. It includes 5906 respondent aged 18-79 years and response rate was 59%. Traditional regression techniques are used to estimate a health-production function, with the focus on the coefficient for income.

Results: Higher income is associated with better self-assessed health among both males and females. The relationship is not monotonic, income is positively related to both male and female health at lower income levels, but negatively related to health at higher income levels.

Conclusions: Individuals in highest income category appear to report marginaly worse health than individuals in the income category below, the resons for the sign reversal are not as clear. The sign reversal of the health-income relationship at higher income levels, is qualitatively the same result as Asgeirsdottir (2007) established in her analysis. The outcome of this study thus robusts her findings.

Úrdráttur

Bakgrunnur og markmið: Það er vel þekkt að samfélagslegir og efnahagslegir þættir hafa áhrif á heilsu einstaklinga. Almennt er talið að einstaklingar í lægri þrepum samfélagsins séu heilsuveilli en einstaklingar í hærri þrepum þess. Eftirspurn eftir heilbrigðisþjónstu fer sífellt vaxandi. Þessi aukna eftirspurn veldur því að stjórnmálamenn vilja vita hversu vel heilbrigðiskerfið virkar með tilliti til sanngirni og réttlæti. Meginmarkmið þessarar rannsóknar er að meta áhrif launa á heilsuframleiðslu á Íslandi. Einblínt er á þá tilgátu að sambandið milli launa og heilsu sé ekki sívaxandi ferill og þannig reynt að styrkja fyrri rannsókn um sama efni. Þetta er gert með því að meta kerfisbundinn breytileika á heilsu sem kemur til vegna launa einstaklinga.

Gögn og aðferðafræði: Gögnin sem notuð eru í rannsókninni eru þversniðsgögn og eru frá könnun sem gerð var af Lýðheilsustöð, um heilsu og líðan Íslendinga, í lok árs 2007. Spurningar voru lagðar fyrir 10.000 einstaklinga á aldrinum 18-79 ára, um laun, eigið mat á heilsu og aðra lýðfræðilega þætti. Svarhlutfall var 59%. Hefðbundin aðhvarfsgreining er notuð til að meta heilsuframleiðslufallið þar sem einblínt er á stuðlamatið á launabreytunni.

Niðurstöður: Hærri laun eru tengd betra mati á heilsu, bæði hjá körlum og konum. Sambandið er þó ekki sívaxandi, laun eru jákvæð tengd heilsu karla og kvenna á lægri launaþrepum, en neikvætt tengd heilsu á hærri launaþrepum.

Umræður: Einstaklingar í hæsta launaþrepinu skýra frá litlu verri heilsu en einstaklingar í næsthæsta launaþrepinu, ástæðan fyrir þessum viðsnúningi er ekki ljós. Þessi viðsnúningur á heilsu og launa sambandinu á hæsta launaþrepinu, er sama niðurstaða og Tinna Laufey Ásgeirsdóttir fékk í sinni rannsókn frá 2007. Þessi rannsókn staðfestir því hér með hennar niðurstöður.

Formáli

Verkefni þetta er meistararitgerð í Heilsuhagfræði og er til 30 ECTS. Leiðbeinandi minn er Tinna Laufey Ásgeirsdóttir, doktor í hagfræði og lektor við Hagfræðideild Háskóla Íslands. Vil ég hér þakka Tinnu fyrir að hafa fengið að nota nýútgefna bók hennar, Lifestyle Economics, til hliðsjónar við gerð þessa verkefnis. Einnig vil ég þakka henni fyrir góða leiðsögn og gagnlegar ábendingar. Ritgerðin er skrifuð á ensku þar sem fyrirhugað er að senda hana til birtingar í erlent tímarit.

Ég vil þakka Stefáni Hrafni Jónssyni hjá Lýðheilsustöð og öðru starfsfólki þar fyrir að veita mér aðgang að gögnum úr nýlegri könnun frá lok árs 2007, sem send var 10.000 Íslendingum um heilsu og líðan þeirra. Könnunin er unnin af Lýðheilsustöð í samstarfi við Landlæknisembættið, Vinnueftirlitið, Krabbameinsfélag Íslands og sérfræðinga frá Kennaraháskóla Íslands, Landbúnaðarháskóla Íslands, Háskóla Íslands, Háskólanum í Reykjavík og Háskólanum á Akureyri. Að lokum vil ég þakka eiginmanni mínum, Viðari Jakobi og sonum okkar tveimur, þeim Erlingi Ísar og Birki Gunnari, fyrir góðan stuðning.

1. INTRODUCTION

Income, education, occupation, marital status and sex are all correlated with health in one context or another. People in lower socioeconomic groups are on average less healthy than people in higher socioeconomic groups (Muller, 2002; Mackenbach, 2002).

There is a widespread and growing demand for primary health care. This demand in turn displays a growing appetite among policymakers for knowledge related to how health-care systems can become more equitable, inclusive and fair. Reducing health inequality is one of the main aims of any health-care system and health inequalities are regularly used to compare of health system performance (WHO, 2008). It is common in Iceland and other European communities to be concerned with how the social system meets each individual's "right" to have equal access to health-care systems. Actually it is a goal per se, to decrease variation in health by financial means or socioeconomic status.

Numerous studies have reported the existence of an association between the level of income inequalilty and health outcomes in a population (Hildebrand and Van Kerm, 2005). Many developed countries have experienced a sharp rise in income inequality during the past decades, and Iceland is no exception. For example, the average monthly salary in Icelandic Kronur (ISK) in the year 1998 was 285,643 ISK (in inflation-adjusted 2007 Kronur) compare to 424,000 ISK in the year 2007. That is a 48 percent increase over less than one decade. By contrast monthly salary for directors and chief executive officers (high-income individuals) has more than doubled during the same period. In the year 1998 it was 673,939 ISK (in inflation-adjusted 2007 Kronur) compare to the year of 2007, when it was 1,351,000 ISK (Statistics Iceland, n.d.I).[1]

[1] In the year of 1998 the Consumer price index for Iceland was 183.3 and year of 2007 it was 272.7. The average income in 1998 was 192,000 ISK, in inflation-adjusted 2007 kronur it is (192,000*272.7)/183.3 =285,643 ISK. An average income for directors and chief executive officers

Communities try to equalize health as much they can. It is evident that most governments in European countries, including Iceland, are very committed to providing good access to health care for all citizens. One way that this goal is pursued in Europe is through centralized medical systems (Asgeirsdottir, 2007). In Iceland, the government has focused on reducing the health-income relationship and as verification for that, the Icelandic law on health care starts by stating that "all citizens should have available to them the greatest quality health care services that they can possibly be provided with at any given time, to protect their psychological, physical and social health" (Vefutgafa Althingistidinda, 2008).

The Icelandic health-care system can be described as universal and extensive. It is largely financed with taxes, although the patient pays some fees at the time of service. Health outcomes and the quality of health care in Iceland are very good by international comparison. In 2006, life expectancy at birth for the whole population stood at 81.2 years, more than two years above the average of Organization for Economic Co-operation and Development (OECD) which was 78.9 years. The infant mortality rate stood at 1.4 deaths per 1000 live births, the lowest rate among OECD countries and well below the OECD average of 5.2 (OECD, 2008).

However the health-care system is expensive. The rise in health care expenditure per capita in the past four decades has been higher in Iceland than in many other countries of the OECD. Total expenditures on health care, as a percentage of Gross Domestic Product (GDP), in Iceland have more than doubled since 1970, from 4.7% to 9.5%. Health expenditures for the year of 2006 indicate Iceland spending the fifth largest portion of GDP on health per capita among the OECD countries. Furthermore, only six OECD countries spent a smaller percentage of GDP on private medical services (OECD, 2007). Total, private, and public health expenditures are presented in Table 1.1., as a percentage of GDP.

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was 453,000 ISK, thus again calculated in inflation-adjusted 2007 kronur (453,000*272.7)/183.3 = 673,939 ISK.

Total Health Expenditures in Iceland			
	Total expenditures on health % GDP	**Public expenditures on health % GDP**	**Private expenditures on health % GDP**
1970	4.7	3.1 (65.9%)	1.6 (34.1%)
1975	5.7	5.0 (87.7%)	0.7 (12.3%)
1980	6.3	5.5 (87.3%)	0.6 (12.7%)
1985	7.2	6.3 (87.5%)	0.9 (12.5%)
1990	7.8	6.8 (87.2%)	1.0 (12.8%)
1995	8.2	6.9 (84.1%)	1.3 (15.9%)
2000	9.3	7.6 (81.7%)	1.7 (18.3%)
2005	9.5	7.9 (83.2%)	1.6 (16.8%)

Table 1.1.

The centralization of the medical system in Iceland is motivated by equalitarian views and makes the case of Iceland both important and interesting. In study from Asgeirsdottir (2007) the effect of household income in the production of health was considered, using Icelandic data from 2002. The results reveal a statistically significant relationship between health and income in Iceland. However this relationship appears to be less tangible than reported for many other countries. Furthermore, unexpected adverse effects of income on health are revealed at high-income levels.

In this study the focus is on a hypothesis suggesting that the relationship between income and health is not monotonic. In addition the intention is to robust results from a former study with a similar Icelandic data that demonstrated adverse effects of income on health for individuals with the greatest financial means (Asgeirsdottir, 2007). Before researchers embark on a quest to explain this unexpected finding, it is important to see if the results are simply due to some abnormality in the previously used data, or if there really is something to explain. This is especially true as the data used only contained 1062 observations.

The approach utilized in the current analysis involves examination of systematic variations in health depending on individual income. Traditional regression techniques are used to estimate a health-production function, with the focus on the coefficient for income. This is done using data gathered by Lydheilsustod which is the Public Health Institute of Iceland. The data was gathered in November and December

of 2007. This data contains information on almost six times as many individuals as the data used by Asgeirsdottir. The main research question is:

What is the effect of individual income on health production in Iceland?

Unfortunately, the aims for this study are not to address the causality between the health and income relationship, just the correlation between health and income. Despite an extensive search, a natural experiment was not found and usable instruments were not detected within the data.

To summarize, the paper will proceed as follows: Section 2 discusses the state of the literature and the relevant cultural and political structure in Iceland. Section 3 describes the dataset. Section 4 focuses on methods and results. The paper concludes with a discussion of the results.

2. LITERATURE REVIEW

Michael Grossman used the theory of human capital to explain the demand for health and health care. According to the human-capital theory, individuals increased their income or earnings by investing in themselves through education, training and health. Grossman gave special attention to medical care in the production of health as one of several factors that may be used to improve the health status of an individual. The model has been most widely used to explain the demand for medical care (Grossman, 1972; Asgeirsdottir, 2007).

The health-production function describes the relationship between health status and various factors that may help when producing good health. Grossman showed the way in which many important aspects of health demand differ from the traditional approach to demand. Health can, for example, be restored or produced with medical care. However it is not medical care as such that the consumer wants, but rather health. Then the medical care is a derived demand for an input to produce health (Folland et al., 2004). Also medical care is hardly the only input available to those interested in producing health. Many other factors are involved, such as the individual's environment and lifestyle. In many cases, income can facilitate health production. Although income is not generally included in a production function, it may enter the function through substitution of demand functions for factors of production (Asgeirsdottir, 2007).

Consider the following example where health (H) is produced using 5 inputs (X_1, X_2, X_3, X_4 and X_5). The health-production function thus takes the following form:

$$H = f(X_1, X_2, X_3, X_4, X_5) \quad (1)$$

The producer of H, the individual, will demand each of the factors of production. This factor of production will thus be demanded, as a function of other factors, including

income (I). One may thus express a hybrid of the health-production function and the factor-demand functions as follows:

$$H = f(X_1(I), X_2(I), X_3(I), X_4(I), X_5(I)) \quad (2)$$

or

$$H = g(I) \quad (3)$$

Such a substitution would thus substitute away all or some of the direct inputs into production and replace them with income.

Absolute income hypothesis states that income tends to be associated with health because higher incomes enable more consumption of goods and services that can enhance health. This is consistent with the structure of the health-production model explained above and estimated in this thesis. The relative income hypothesis, on the other hand, suggests that how individual's income compared with other people's incomes is also consequential for health. Thus, it is claimed that having lower income than the average in one's residential area will tend to influence health negatively, independent of the effects of the actual level of income (Wagstaff and Van Doorslaer, 2000). It seems according to the relative income hypothesis, an individual's health is not so much affected by his absolute level of income than by his level of income relative to the average income in his community (Hildebrand and Van Kerm, 2005).

According to Van Doorslaer et al. (1997) universal access to health care does not appear to break the link between social status and health in cross-country comparisons. Health care may reduce income-related health inequalities, but our health is not only influenced by the ability to pay our doctor, although that matters of course. The authors explored the statistical association between health inequality and total health-care expenditure per capita and the percentage of total expenditure borne by the government and they did not find a statistically significant association between those. However, the level of distribution of income, measured by the Gini coefficient,

proved to be positively and associated with health inequality. This is consistent with findings from other studies. [2]

Again, wealthy countries with more equal income distributions, such as Sweden and Japan, have higher life expectancies than the United States. The examples are numerous and many studies have provided support for this relative-income hypothesis and income distribution hypothesis, in the form of associations (Kawachi and Kennedy 2002, Kennedy et al. 1998). From these points of view the income distribution really matters for the health-income relationship.

There is widespread and longstanding agreement that there is a positive relationship between income and health but the causal direction of this relationship is not agreed upon. It is well known that lower income is a risk factor for premature mortality and increased morbidity. But it also should be noted that there exists evidence indicating the reverse pathway, from poor health status to persistent poverty and poorer economic growth (Subramanian and Kawachi, 2003).

Murthy (2007) examined the relationship between health status and income inequality by using cross-sectional data from 27 OECD countries. His results clearly indicated that income played an important role in explaining variation in health status among the countries included in the study.[3] Ten E.U. countries were examined in a longitudinal and cross national study by Hildebrand and Van Kerm (2005), they found statistically significant evidence supporting the strong income inequality hypothesis regardless of gender.[4] Mackenbach et al. (2005) examined the shape of the relationship between household equivalent income and self-assessed health (SAH) in seven European countries and the authors found out that higher household equivalent income was associated with better SAH in both men and women in all countries,

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[2] The Gini coefficient is a measure of income inequality. It takes a value between 0 and 1: A low Gini coefficient indicates more equal income, while a high Gini coefficient indicates more unequal distribution. Zero corresponds to perfect equality and 1 corresponds to a situation in which all the wealth or income is in the hands of one individual (Subramanian and Kawachi, 2003).

[3] The countries that are included in the study are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Mexico, Netherlands, Poland, Portugal, Slovakia Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

[4] The longitudinal data used came from European Community Household Panel (ECHP) survey and the E. U. countries in this survey were Austria, Belgium, Denmark, Finland, Greece, Italy, Ireland, Spain and the United Kingdom.

particularly in the middle income range. In the higher income ranges they found out that the relationship was generally curvilinear and characterized by less improvement in SAH per unit of rising income. However, Denmark was the only country were an indication of deteriorating SAH with rising incomes in the higher incomes ranges, particularly for women, but the deterioration was not statistically significant.[5]

In study from 2007 the effect of household income in the production of health was considered, using Icelandic data from 2002 (Asgeirsdottir, 2007). The results showed that income influences an Icelander's health under the current political and social structure. Results reveal a statistically significant relationship between health and income in Iceland, but it is smaller than that reported for many other countries. Furthermore, unexpected adverse effects of income on health are revealed at high-income levels. The reason for this unexpected finding is not clear and partly motivates the current analysis. Several hypothesis have been suggested to support this. It has, for example, been hypothesized that the reversal of the relationship could be due to the fact that in a system of limited monetary opportunity cost in health production, time costs become of increasing importance. As such, the high opportunity cost of time used in health production by high income individuals could be influencing their level of health production. Another possible reason could be that this result is limited to the data used in the study and is not representative of the Icelandic population. It is thus interesting to see if this relationship is validated within other datasets.

In a large follow-up study of household income there was an indication of flattening, or even reversal, of the income and mortality relationship at the high income level (Backlund et al., 1996). Ecob and Smith (1999) examined the relationship between income and morbidity and found out that morbidity was approximately linearly related to the logarithm of income in all income levels, except for very high and very low income levels, that is in other words diminishing returns of income in the production of health at higher income levels. For the highest income group they found some signs of reversal in the relation to health.

In contrary to former conclusions about positive relationship between income and health, many studies have not found any relationship or even a negative one. In

[5] Data were obtained from nationally representative health, level of living, or similar surveys in Belgium, Denmark, England, Finland, France, The Netherlands and Norway and applied to men and women aged 25 and older in the 1990s.

Denmark this relationship was examined by Osler et al. (2002) with two cohort studies. They find no association between income inequality and mortality after adjustment for individual income and they suggested that the Danish welfare system evens out differences in the effect on mortality of income inequality. Likewise, Gerdtham and Johannesson (2004) found no significant effect of income inequality on mortality in Sweden. Again, Snyder and Evans (2003) examined the impact of income on mortality in elderly population in United States and they found that the higher income group had a statistically significantly higher mortality rate.[6]

In summary, it is reasonable to conclude that there are influences between income and health that run in both directions. In such a setting, identifying causal relationships is difficult and it is perhaps not surprising that the evidence remains mixed in this area. The extent of the relationship running in either direction may differ based on the different social groups inspected, as well as the policy under which the examined group lives.

In fact, of all the socioeconomic variables, the relationship between income and health is probably the most complicated one. The correlation can vary from highly positive to weakly negative, depending on context, covariates, and level of aggregation. Even when the positive correlation is strong, the interpretations can include causality running from income to health, from health to income, and/or "third variables" that effect health and income in the same direction (Fuchs, 2004). For that reason it is not easy to analyze this health-income relationship and even harder to interpret.

Now, Icelandic policies and characteristics will be described. It has been argued that all health inequalities can to some extent be a cause of concern. Systematic health inequalities have been shown to exist not only in association with variables like income and education, but also in association with place of resistance, race, marital status and ethnic origin (Van Doorslaer and Jones, 2003).

The Icelandic health-care system can be described as universal and extensive. As described earlier in table 1.1., in year of 2005 83.2% of the health-care system was

[6] The authors used a major change in the Social Security law as exogenous variation in income to examine the impact of income on mortality. The legislation created a "notch" in Social Security benefits based upon a date of birth; those born before January 1. 1917 generally received higher benefits than those born afterwards.

financed with taxes and private expenditures only amounted to 16.8%. Because of the relative equality in health-care delivery and financing one could expect that the relationship between income and health would be reduced to some extent. However, even in community like Iceland, there are still some opportunities for differences based on financial means. Like for example, individuals with higher financial means could invest in their health, through elements such as private trainers in fitness center, getting nutritional counseling or living in healthier environments. Thus, the efforts of the Icelandic policymakers may or may not have dramatic effects regarding variations in health.

According to Halldorsson (1999) there were some differences in health based on financial means in Iceland. He examined health and well-being in Icelandic children according to their socioeconomic status and the results were that children in lower socioeconomic status had worse health and well-being than children of higher socioeconomic status.

Like mentioned earlier Van Doorslaer et al. (1997) explored the association between health inequality and the level of distribution of income. The level of income equality appeared to be important. Thus, the state of income inequality within Iceland will now be discussed. General income inequality is shown in Figure 2.1. The countries chosen are all in Europe. The Gini coefficient in Iceland has historically remained among the lowest in the world. However, it has increased significantly in recent years, leaving it around .26 in the year of 2006 (Statistic Iceland, n.d.II; Arnason, 2007). That is still relatively low within the OECD context, although it leaves Iceland with greater income inequality, than most other Nordic countries.

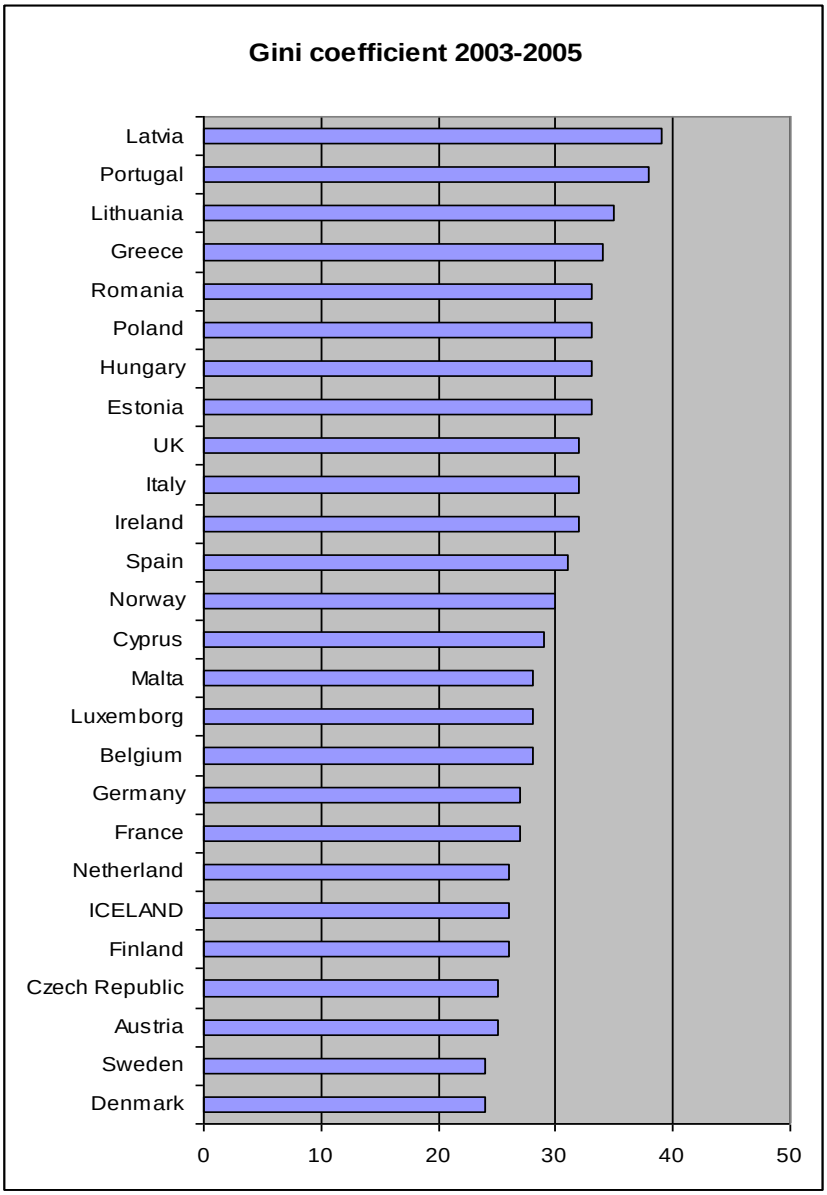

Figure 2.1. Gini coefficient in European countries (Statistics Iceland, n.d.II).

There are also factors beyond the political and social settings that are likely to influence income-related differences in health. Genetics have played a major role in the discussion of determinants of health and health variations. Although less important for policy implications and behavioral fields such as economics, it should be noted that the Icelandic population is genetically very homogeneous. This may influence the income-health gradient, as the distribution of income varies significantly across races. Furthermore, the relatively young age of the Icelandic population is expected to

reduce the health-income gradient even further as health inequality is known to increase with age (Asgeirsdottir, 2007)

In short, the amount of spending on medical care does not appear to have a great impact on income-related variations in health. However, according to Asgeirsdottir (2007), it should follow that income-related inequalities in health are relatively small in Iceland. Although income inequality is increasing in Iceland, it is not of great magnitude. The relationship between income and health in the year 2007 will be examined in the next section.

3. THE DATA

The data utilized in the current study is originated from health and lifestyle survey carried out by the Public Health Institute of Iceland in November and December of 2007. A random sample of 10,000 Icelanders between ages of 18 and 79, received questionnaires on health, illnesses, smoking and alcohol consumption, dental care, diet, height and weight, quality of life, exercise, accidents, social participation, sleeping habits, sunshine exposure and other lifestyle factors, as well as demographics and work-related issues. This sample comprises approximately 4.6 percent of the whole Icelandic adult population (18-79 years).

3.1 Representation

The response rate was 59%, which equates to 5906 returned questionnaires. The sample consists of 2,724 men and 3,108 women.[7] There are some discrepancies between population and sample data, the greatest inconsistency pertains to age representation. Individuals in their twenties were less likely to turn in their questionnaires than other age groups. There was also a greater tendency among young males than young females not to return their questionnaires. Furthermore, those above the age of 65 were more likely to do so than average. The discrepancies are reported in Table 3.1.1. (Statistics Iceland, n.d.III).

[7] When there is a discrepancy between total amount of answers and summary statistics for each variable it is because missing values are not included.

Representation of age				
	Males	(N=2724)	Females	(N=3108)
Age groups	Proportion in census	Proportion in sample	Proportion in census	Proportion in sample
18-23	0.120	0.063	0.121	0.072
24-28	0.111	0.051	0.107	0.063
29-33	0.103	0.054	0.098	0.077
34-38	0.101	0.078	0.096	0.081
39-43	0.100	0.082	0.100	0.087
44-48	0.103	0.081	0.100	0.091
49-53	0.095	0.095	0.093	0.088
54-58	0.081	0.088	0.080	0.086
59-63	0.065	0.111	0.066	0.086
64-68	0.045	0.089	0.050	0.085
69-73	0.037	0.102	0.042	0.092
74-79	0.039	0.106	0.047	0.093

Table 3.1.1.

The labor force participation in fourth quartile 2007 was 86.7% for males, while in the sample it was 82.2% and for females it was 76.4% in the census and 72.1% in the sample (Statistics Iceland, n.d.IV). [8]

In summary, the sample is fairly representative of Icelandic census.[9] The strength of the data lies in the amount of health and lifestyle information obtained for each individual. The sample size is quite large and it is actually almost six times the size of the sample that Asgeirsdottir (2007) used in her study. Furthermore the data are relatively new and have not been previously examined in a multivariate context.

Nevertheless, the actual data available generally differ from the ideal, and this study is no exception. What this sample lacks of is a natural experiment or an instrumental variable to aid in the disentangling of the relationships causality. The

[8] In Iceland there have been growing numbers of foreigners that have moved to the country to work temporarily in several industries but they do not intend to become Icelandic citizens so they haven't learned Icelandic and therefore they are not answering this survey. 1. on January 2008, 6.8% of the whole Icelandic population were foreign citizens but only 1 questionarrie of 5906 was from a foreign citizen. This social group can account for some of the missing questionnaries in younger age groups. When calculating labor force participation, individuals aged 16-74 years old were used in the census but aged 18-74 years in the sample.

[9] Sixty-eight observations were dropped from the sample because of lack of answer for the main health question that were used.

next section discusses each variable used and preparation of the data for further statistical analysis.

3.2 Description of Variables

Health: The survey contains several measures of health. The one chosen for the empirical analysis is a four-level measure of self-assessed health (SAH); excellent, good, fair and poor. The use of SAH as a health measure has both pros and cons. First of all it is believed to be a useful summary measure of general health (Case and Deaton, 2002). It is also supported by a literature that shows SAH to predict mortality and morbidity, even when a variety of other health and behavioral measures are controlled for (Idler and Benyamini, 1997; Long et al., 2005).

However, since SAH reflects perceived health, it may measure something different from actual health. An example is that people in deprived situations like those without a job, might report their health incorrectly perhaps owing to social pressure to justify that they are not working. Changes in norms and business cycle may also lead to similar biases (Butler et al., 1987).

However, one of the variables strengths is that it is the first variable in the survey and it did not suffer the missing observations that the other health variables did. The data also includes measures more closely related to health behavior, for example body mass index (BMI) and an indicator of never been a smoker as supplemental outcomes.

In all instances, the numeric values of the SAH variable are reorganized such that a higher number indicates better health. This is done to assist interpretation of empirical results. In this survey health is categorized into four ordinal values. For that reason it is possible to use ordered probit statistical techniques.[10] With that method more information is captured than when the variable is dichotomized. Summary statistics of the health variable used can be found in Table 3.2.1.

[10] The statistical methods referred to are ordered probit regression, where dependent variable is an ordinal variable. The numerical values representing the categories do not matter, except that higher numbers indicate better health.

Summary statistics of SAH		
	(N=2680) Males	(N=3108) Females
Variable	Proportion	Proportion
Poor	0.041	0.049
Fair	0.219	0.217
Good	0.488	0.482
Excellent	0.252	0.252

Table 3.2.1

Income: In the survey individuals are asked both about monthly individual income and monthly family income. Monthly individual income refers to total individual income before taxes, such as salaries and government benefits.[11] This income variable is absolute level of income, according to the absolute income hypothesis mentioned earlier in the paper.

In the survey, income is reported in five categories in Icelandic Kronur (ISK); less than 141000 ISK, 142000-279000 ISK, 280000-459000 ISK, 460000-619000 ISK and more than 620000 ISK.[12] Summary statistics of the income variables used can be found in table 3.2.2.

[11] Icelandic benefits come in multiple forms, such as child benefits, housing benefits, and interest relief, and generally depend on the individual's labor-market income.

[12] In December of the year 2007, the approximate exchange rate was: USD 1= ISK 62 and GBP 1 = ISK 124.

Summary statistics of Income		
	(N=2592) Males	(N=2895) Females
Variable	Proportion	Proportion
1 if income is less than 141000 ISK	0.186	0.388
1 if income from 142000-279000 ISK	0.259	0.357
1 if income from 280000-459000 ISK	0.326	0.191
1 if income from 460000-619000 ISK	0.135	0.041
1 if income more than 620000 ISK	0.093	0.023

Table 3.2.2.

Employment: Employment status was based on a question that asked if the individual is an employee, employer, student, homemaker, on maternity leave, ill or incapable to work, pensioned, unemployed or disabled.[13] Summary statistics of employment is presented in Table 3.2.3.

Summary statistics for employment status				
	Males		Females	
	Proportion	Number of obs	Proportion	Number of obs
1 if employee	0.750	(N=2369)	0.745	(N=2635)
1 if employer	0.245	(N=2248)	0.107	(N=2410)
1 if student	0.120	(N=2159)	0.209	(N=2397)
1 if homemaker	0.088	(N=2158)	0.264	(N=2448)
1 if on leave	0.015	(N=2143)	0.036	(N=2337)
1 if ill and can not work	0.060	(N=2157)	0.073	(N=2351)
1 if pensioned	0.221	(N=2333)	0.198	(N=2558)
1 if unemployed	0.044	(N=2128)	0.046	(N=2306)
1 if disabled	0.075	(N=2194)	0.106	(N=2409)

Table 3.2.3.

[13] Individuals could mark more than one box. That is the reason why some individuals were both employer and students and so on.

Education: Educational dummies indicate if the individual has finished the degree each question refers to. Individuals were asked to fill in the highest level of education they have.[14] Summary statistics of education can be found in Table 3.2.4.

Summary statistics for education		
	(N=2650) Males	**(N=3038) Females**
	Proportion	**Proportion**
1 if finished high school	0.365	0.468
1 if finished college	0.072	0.102
1 if finished vocational school	0.311	0.162
1 if finished technical graduate degree	0.050	0.012
1 if finished graduate degree	0.094	0.185
1 if finished postgraduate degree	0.070	0.049
1 if finished PhD	0.010	0.003
1 if other education	0.028	0.018

Table 3.2.4.

Lifestyle variables: While it is technologically feasible to ascertain the fat composition of an individual directly, such procedures are extremely costly and are rarely used in large samples. Indirect measures of fat composition, which are based on weight and height, are employed instead. The primary measure of this type is the Body Mass Index (BMI), which calculates the ratio of weight in kilograms to height in meters squared.[15] Summary statistics of BMI can be found in table 3.2.5.

[14] Sixty individuals marked their education as "other education" and then they had to write which education that was, many nurse assistant and sailors wrote down their education and they were categorized as finishing vocational school.

[15] $BMI = \frac{Kg}{m^2}$

Summary statistics of Body Mass Index			
		(N=2656)	(N=2985)
BMI		Males	Females
		Proportion	Proportion
BMI below 18.5	Underweight	0.005	0.013
BMI 18.5 to 25	Normal	0.293	0.407
BMI 25 to 30	Overweight	0.497	0.346
BMI above 30	Obese	0.206	0.235

Table 3.2.5.

Individuals are asked about their smoking habits; are they daily smokers, weekly, less than weekly, have stopped smoking or have never smoked. Individuals were also asked about their alcohol consumption habits; are they daily drinkers, drink three to four times a week, once or twice a week, once to three times a month or on rarer occasions.

There are 24 questions that relate to the individual's stress level and their satisfaction with their own life in general. Although numeric values of those variables are difficult to interpret for the untrained reader, that should not be of serious consequence as they are only used as control variables in a limited amount of analysis, and no attempts are made at interpreting the values of the associated coefficients. But, two questions are used regarding how much stress individuals experience in work and private life and thereby control for the stress factor that can influence an individual's health.[16] Summary statistics for lifestyle variables are presented in table 3.2.6.

Summary statistics for lifestyle variables				
	Males		Females	
	Proportion	Number of obs	Proportion	Number of obs
1 if smoking	0.205	(N=2564)	0.228	(N=2943)
1 if drinks alcohol more than 3 times a week	0.112	(N=2664)	0.050	(N=3039)
1 if experiences work-related stress	0.502	(N=2279)	0.552	(N=2400)
1 if experiences stress related to personal life	0.216	(N=2643)	0.313	(N=3024)

Table 3.2.6.

[16] It is widely believed that stress is a significant factor in an individual´s live and that it may contribute to illness (Lovallo, 2005).

Demographics and Education: For gender, age, number of children and marital status dummy variables are used. Summary statistics on those demographic variables can be found in Table 3.2.7.

Summary statistics for Demographics

	Males		Females	
Variable	**Mean**	**Std. Err**	**Mean**	**Std. Err**
Age	51.917	0.323	49.925	0.307
Number of children	2.397	0.031	2.433	0.029
1 if single	0.119	0.006	0.104	0.006
1 if divorced	0.040	0.004	0.061	0.004
1 if widowed	0.024	0.003	0.071	0.005
1 if married	0.624	0.009	0.551	0.009
1 if in a relationship	0.045	0.004	0.049	0.004
1 if cohabitating with a partner	0.148	0.007	0.164	0.007

Table 3.2.7.

As Iceland has a universal health insurance system, variable related to health insurance were not included in the analysis.

4. METHODS AND RESULTS

The relationship between health and income is examined using cross-sectional analysis and estimations of a health-production function. This will be explored in the following analysis, using traditional regression techniques. The focus of the discussion is on the coefficient of income, α, in the following health-production equation;

$$H_i = \beta X_i + \alpha I_i + \varepsilon_i \qquad (4)$$

Where H takes the value of 4 if the individual reports that he/she is in "excellent" health, 3 if he/she is in "good" health, 2 if he/she is in "fair" health and 1 if he/she reports "poor" health for individual i, X is a vector of control variables, I is a vector of income dummies for individual i, β and α are vectors of parameters and ε is the individual specific error term.[17] The individual's characteristics contained in X include age and age-squared, measures of family structure through marital status and number of children, as well as lifestyle factors such as smoking habits, alcohol misuse, experiencing stress related to work or to personal life and BMI and BMI-squared. Education is also controlled for, as it is traditionally thought of as a class divider. Indicators for employment status were also included, as has been the case in previous studies (Ettner, 1996). The model will be estimated, with the statistical software Stata 9,0, using ordered probit regression techniques.

A variety of binary logistic regression methods have been developed for covering categorical variables. The best known and most highly developed are methods for ordinal response variables. The ordered model can be used to estimate relationships between an ordinal dependent variable and a set of independent variables (Jones, 1998; Stata Press Publication, 2005). The dependent variable takes ordered multinomial outcomes, for example, $H_i = 1, 2, \ldots, m$. This applies to the measure of

[17] H is a ordinal dependent variable, I and X are independent variables or explanatory variables.

SAH, which has categorical outcomes poor, fair, good and excellent. The model can be expressed as:

$$H_i = j \text{ if } \mu j-1 < H_i^* \leq \mu j,\ j = 1, \ldots, m \tag{5}$$

where the latent variable, H*, is assumed to be a function of a vector of socioeconomic variables X and I:

$$H_i^* = \beta X_i + \alpha I_i + \varepsilon_i,\ \varepsilon_i \sim N(0, 1) \tag{6}$$

and $\mu 0 = -\infty$, $\mu j \leq \mu j+1$, $\mu m = \infty$. Given the assumption that the error term is normally distributed, the probability of observing a particular value of H is

$$P_ij = P(H_i = j) = \Phi(\mu j - \beta X_i - \alpha I_i) - \Phi(\mu j-1 - \beta X_i - \alpha I_i) \tag{7}$$

where $\Phi(\cdot)$ is the standard normal distribution function (Van Doorslaer and Jones, 2003; Verbeek, 2006).

The data is stratified by gender. When gender differences were examined, using a model with a gender dummy, the coefficient was statistically significant. Therefore, the sample was stratified by gender.

As expected, multicollinearity between BMI and its squared term and age and its squared term was evident as calculated by the variance inflation factor (VIF).[18] In the case at hand, VIF for other variables were all less than 10, in fact, they ranged between 1 and 4. The residuals were tested for normality and the p-value of the Chi-squared test statistic was below 0.00 for both males and females. The evidence fails to reject the null hypothesis of normality. Because the dataset is quite large, N=5906, assumption about normality can be avoided. [19]

[18] Variance inflation factor (VIF) measures the impact of collinearity among the X's in a regression model on the precision of estimation. It expresses the degree to which collinearity among the predictors degrades the precision of an estimate. Therefore, when VIF is high there is high multicollinearity and instability of the b and beta coefficients. Typically a VIF value greater than 10 is of concern (Garson, n.d.).

In Figures 4.1. and 4.2., correlation between income and health status is presented separately for gender. It shows percents of individuals in the five income categories (1 = <141000, 2 = 142000 - 279000, 3 = 280000 - 459000, 4 = 460000 - 619000 and 5 = >620000) and in each health state.

For males in the sample, 46.2% of those in the lowest income category (< 141000) reported poor or fair health compare to only 11.2% (460000 – 619000) and 11.7% (>620000) in the two highest categories. This represent a fourfold gradient effect from income on health status.

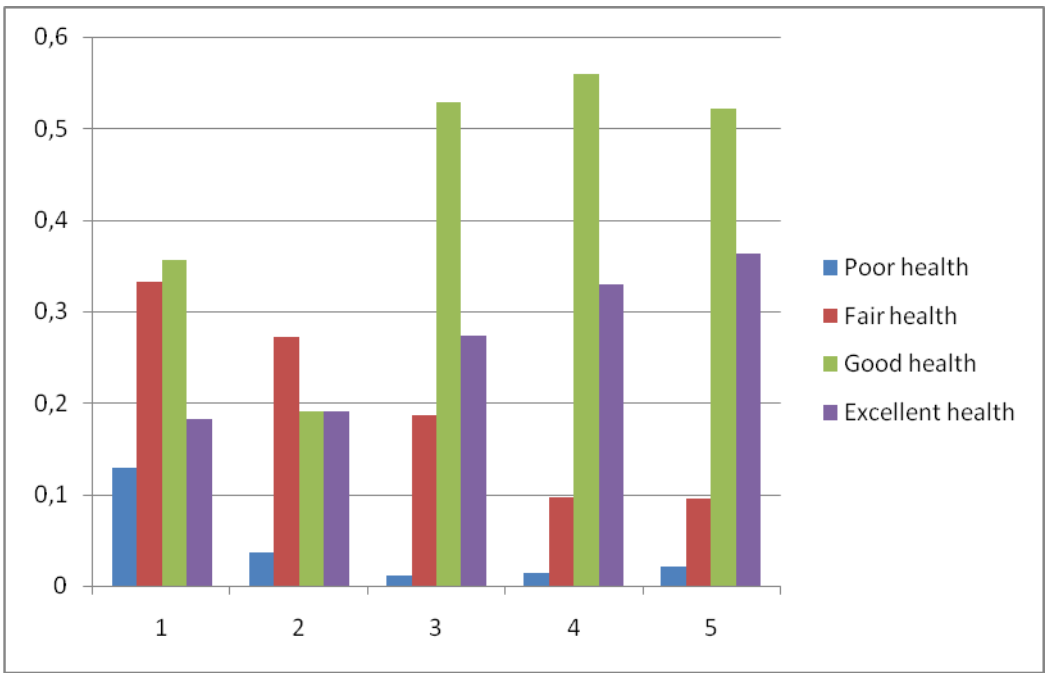

Figure 4.1. Correlation between health and income - Males

For females in the sample, 36.4% of those in the lowest income category (< 141000) reported poor or fair health compare to only 10.3% in the two highest categories (460000 – 619000 and >620000). This represent nearly a fourfold gradient effect from income on health status.

[19] The quality of the approximation increases as sample size grows. Even though errors are not normally distributed are test of coefficients approximately valid, when sample size is large (Verbeek,2004).

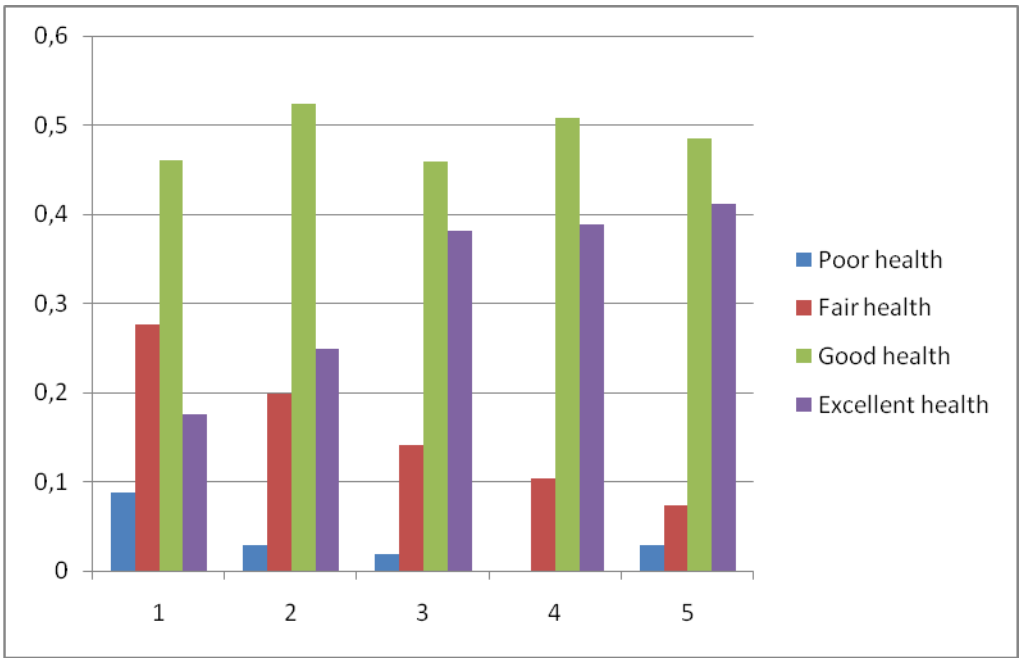

Figure 4.2. Correlation between health and income - Females

These figures indicate that, the largest proportion for both males and females that report excellent health, are individuals in the highest income category. Good health is the most frequently reported health status in all income categories for both males and females, except for males in the second lowest income category were fair health is more often reported.

In table 4.1., results are reported from full ordered probit regression for males in the sample. First, the Wald test strongly rejects that all coefficient in the model are equal to zero and p-value of 0.0000 of ratio chi-square tells that the model as a whole is statistically significant, as compared to a model with no predictors. The pseudo-R-squared is also given and is 0.1215. In the table coefficients, robust standard errors of coefficient and associated p-values are represented.[20]

[20] Robust estimates of standard errors (or variance) is a test that has a long tradition in the survey literature. It estimates the standard errors that are robust to the fact that the error term is not identically distributed. As such it corrects for possible heteroscedasticity (Stata Press Publication, 2005).

Ordered probit regression	Male		N= 2680	
Dependent variable is four-level health variable				
Variable	**Coef.**		**Robust Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,176	**	0,075	0,018
1 if income from 280000-459000 ISK	0,296	***	0,082	0,000
1 if income from 460000-619000 ISK	0,472	***	0,097	0,000
1 if income more than 620000 ISK	0,411	***	0,113	0,000
Age	0,027	**	0,012	0,022
Age squared	0,000	***	0,000	0,001
Body mass index	-0,109	***	0,028	0,000
Body mass index squared	0,001	**	0,000	0,019
Children	0,025		0,018	0,157
1 if smoking	-0,156	***	0,056	0,006
1 if drinks alcohol more than 3-4 times a week	0,095		0,071	0,184
1 if finished college	0,107		0,086	0,212
1 if finished vocational school	0,158	***	0,054	0,003
1 if finished technical graduate degree	0,325	***	0,102	0,002
1 if finished graduate degree	0,241	***	0,083	0,004
1 if finished postgraduate degree	0,332	***	0,103	0,001
1 if finished PhD	0,458	**	0,192	0,017
1 if in a relationship	0,149		0,130	0,253
1 if cohabitating with a partner	0,105		0,097	0,282
1 if married	0,065		0,091	0,474
1 if divorced	-0,105		0,137	0,443
1 if widowed	-0,192		0,175	0,271
1 if employee	0,064		0,064	0,320
1 if employer	0,079		0,061	0,192
1 if student	0,377	***	0,093	0,000
1 if on leave	-0,248		0,179	0,167
1 if ill or incapable to work	-0,898	***	0,114	0,000
1 if pensioned	0,097		0,093	0,298
1 if unemployed	0,115		0,126	0,363
1 if disabled	-1,084	***	0,117	0,000
1 if experiences work-related stress	-0,130	***	0,049	0,008
1 if experiences stress related to personal life	-0,309	***	0,056	0,000
/cut1	-3,819		0,491	
/cut2	-2,382		0,488	
/cut3	-0,862		0,487	
Wald chi2(32) = 656,03		1% significant level =	***	
Prob > chi2 = 0.0000		5% significant level =	**	
Pseudo R2 = 0.1215		10% significant level =	*	

Benchmark for income is less than 141000 ISK, for smoking it is to smoke less than daily, for alcohol consumption it is to drink less than 2 times a week, for education it is finishing a high school, for marital status it is being single, for employment status it is being a homemaker and for stress it is experiencing very little or little stress related to work or personal life.

Table 4.1.

Results indicate the relationship between income and health is nonlinearly related in a statistically significant way. The coefficients for all income variables (1 if income from 142000-279000, 1 if income from 280000-459000 ISK, 1 if income from 460000-619000 ISK, 1 if income more than 620000 ISK) display a positive sign and are statistically significant at 1% or 5% level, when comparing to the lowest income level. These results indicate that income does play an important role in explaining variation in health status after adjusting for a set of individual health predictors, for example smoking and stress. This means that as income increases, health status generally improves with the exception that a gain in income from the second-highest to the highest income category is associated with a decrease in health.

After the ordered estimation, marginal effects for each health outcome (poor, fair, good and excellent) were calculated (Appendix A, tables A.1.-A.4.). The marginal effects are computed at mean values of all independent (explanatory) variables. It is done by calculating the change in a dependent variable, resulting from a change in an independent variable from 0 to 1 and holding all other variables fixed at their mean (Verbeek, 2004). For poor health outcome; individuals in the second lowest income category are 0.7% less likely to report poor health status than do individuals in the lowest income category. Individuals in the middle income category are 1.2% less likely, individuals in the second highest are 1.8% less likely and individuals in the highest income category are 1.6% less likely to report poor health status than do individuals in the lowest income category (all statistically significant at 1 or 5% level). For fair health outcome; individuals in the second lowest income category are 4.7% less likely to report fair health status than do individuals in the lowest income category. Individuals in the middle income category are 8.0% less likely, individuals in the second highest are 12.7% less likely and individuals in the highest income category are 11.0% less likely to report fair health status than do individuals in the lowest income category (all statistically significant at 1 or 5% level). For good health status; individuals in the second lowest income category are 0.3% more likely to report good health status than do individuals in the lowest income category. Individuals in the middle income category are 0.5% more likely, individuals in the second highest are 0.8% more likely and individuals in the highest income category are 0.7% more likely to report good health status than do individuals in the lowest income category (none statistically significant). For excellent health status;

individuals in the second lowest income category are 5.1% more likely to report excellent health status than do individuals in the lowest income category. Individuals in the middle income category are 8.6% more likely, individuals in the second highest are 13.7% more likely and individuals in the highest income category are 11.9% more likely to report excellent health status than do individuals in the lowest income category (all statistically significant at 1 or 5% level). These results show that individual in the second highest income category (460000-619000 ISK) are most likely to report good or excellent health status and least likely to report poor or fair health status.

A probit estimation (Appendix A, table A.5.) with a binary health outcome was also done, where excellent health and good health were equated to 1 (good health), and fair and poor health were set equal to 0 (bad health). In this estimation, the marginal effects were calculated, the change resulting from a change in a dependent variable for 0 to 1, holding all other variables fixed at their mean. In Figure 4.2., the probability for being in good health is represented graphically.

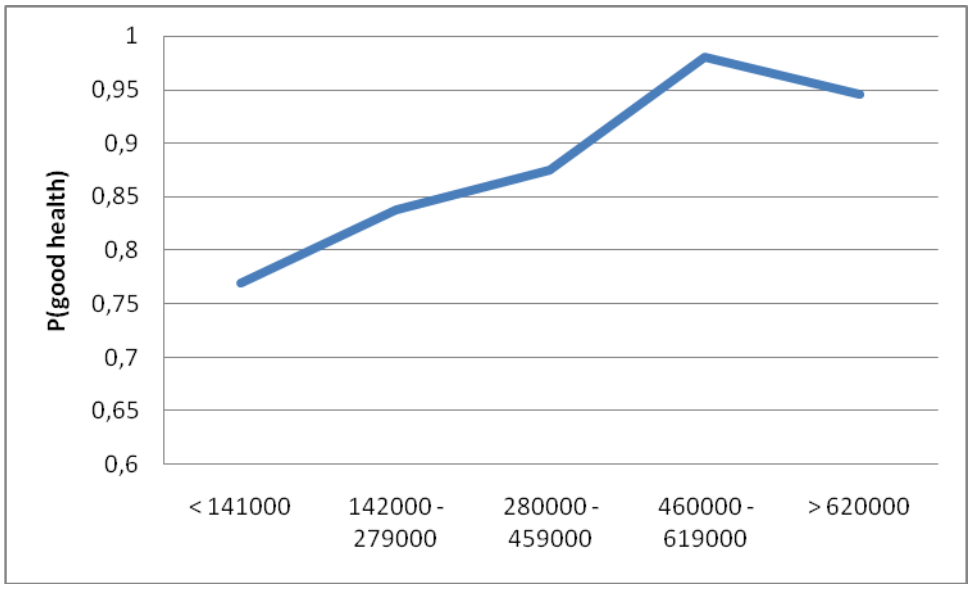

Figure 4.3. Probability of good health after binomial probit estimation - Males.

Results show a relationship between health and income that is not monotonic. First, an individual in the lowest income category has 77% probability to be in good

health. An individual in the second income category has 83.9% probability to be in good health. An individual in the middle income category has 87.5% probability to be in good health and an individual in second highest income category has 98.1% probability to be in good health. Then an individual in the highest income category has little less probability than an individual in the fourth income category, or 94.6% to be in good health. According to this, income is positively related to male health at lower income levels, but negatively related to health at higher income levels. These findings are qualitatively consistent with those found by Asgeirsdottir (2007).

Female results, reported in Table 4.2. and Figure 4.3., show a similar reversal in the relationship between income and health. In fact, the results for men and women appear to be remarkably similar. The relationship between income and female health is not as apparent as the relationship was for males, in terms of statistical significance, and the results are of a marginally lesser magnitude than those for males.

In table 4.2., results are reported from full ordered probit regression for females in the sample. First, the Wald test strongly rejects that all coefficient in the model are equal to zero and p-value of 0.0000 of ratio chi-square tells me that my model as a whole is statistically significant, as compared to a model with no predictors. The pseudo-R-squared is also given and is 0.1415. In the table coefficients, robust standard errors of coefficient and associated p-values are represented.

Ordered probit regression	Female		N= 3084	
Dependent variable is four-level health variable				
Variable	**Coef.**		**Robust Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,098	*	0,054	0,068
1 if income from 280000-459000 ISK	0,290	***	0,071	0,000
1 if income from 460000-619000 ISK	0,323	***	0,119	0,007
1 if income more than 620000 ISK	0,251		0,156	0,107
Age	0,033	***	0,010	0,002
Age squared	0,000	***	0,000	0,000
Body mass index	-0,109	***	0,016	0,000
Body mass index squared	0,001	***	0,000	0,000
Children	0,008		0,017	0,634
1 if smoking	-0,254	***	0,052	0,000
1 if drinks alcohol more than 3-4 times a week	0,106		0,099	0,283
1 if finished college	0,137	*	0,079	0,083
1 if finished vocational school	0,139	**	0,062	0,024
1 if finished technical graduate degree	-0,026		0,186	0,889
1 if finished graduate degree	0,261	***	0,066	0,000
1 if finished postgraduate degree	0,307	***	0,112	0,006
1 if finished PhD	0,173		0,355	0,626
1 if in a relationship	0,081		0,109	0,460
1 if cohabitating with a partner	0,164	*	0,084	0,052
1 if married	0,132	*	0,079	0,095
1 if divorced	0,184		0,114	0,105
1 if widowed	0,206	*	0,111	0,064
1 if employee	0,125	**	0,062	0,042
1 if employer	0,082		0,078	0,292
1 if student	0,177	***	0,068	0,010
1 if on leave	0,152		0,130	0,242
1 if ill or incapable to work	-0,845	***	0,104	0,000
1 if pensioned	0,020		0,086	0,813
1 if unemployed	-0,026		0,099	0,793
1 if disabled	-1,128	***	0,093	0,000
1 if experiences work-related stress	-0,147	***	0,050	0,003
1 if experiences stress related to personal life	-0,332	***	0,047	0,000
/cut1	-3,723		0,346	
/cut2	-2,351		0,342	
/cut3	-0,801		0,339	
Wald chi2(32) = 826,27		1% significant level =	***	
Prob > chi2 = 0.0000		5% significant level =	**	
Pseudo R2 = 0.1415		10% significant level =	*	

Benchmark for income is less than 141000 ISK, for smoking it is to smoke less than daily, for alcohol consumption it is to drink less than 2 times a week, for education it is finishing a high school, for marital status it is being single, for employment status it is being a homemaker and for stress it is experiencing very little or little stress related to work or personal life.

Table 4.2.

The results indicate the income-health relationship is nonlinearly related in a statistically significant way, for females. The coefficients for three income variables (1 if income from 142000-279000, 1 if income from 280000-459000 ISK, 1 if income from 460000-619000 ISK) display a positive sign and are statistically significant at the 1% or 10% level. The coefficient for the highest income level (1 if income more than 620000) is also positive and is close to being significant at the 10% significant level. These results indicate that income does play an important role in explaining variation in health status after adjusting for set of individual health predictors. This means as income increases health status improves, same as for males, the same reversal happens for individual in the highest income category.

After the ordered estimation, marginal effects for each health outcome (poor, fair, good and excellent) were calculated, as was done for males (Appendix B, tables B.1.-B.4.). For poor health outcome; individuals in the second lowest income category are 0.4% less likely (significant at 10% level) to report poor health status than do individuals in the lowest income category. Individuals in the middle income category are 1.3% less likely (significant at 1% level), individuals in the second highest are 1.4% less likely (significant at 1% level) and individuals in the highest income category are 1.1% less likely (not significant) to report poor health status than do individuals in the lowest income category. For fair health outcome; individuals in the second lowest income category are 2.6% less likely (significant at 10% level) to report fair health status than do individuals in the lowest income category. Individuals in the middle income category are 7.6% less likely (significant at 1% level), individuals in the second highest are 8.5% less likely (significant at 1% level) and individuals in the highest income category are 6.6% less likely (not significant) to report fair health status than do individuals in the lowest income category. For good health status; individuals in the second lowest income category are 0.2% more likely (not significant) to report good health status than do individuals in the lowest income category. Individuals in the middle income category are 0.7% more likely (significant at 5% level), individuals in the second highest are 0.7% more likely (significant at 10% level) and individuals in the highest income category are 0.6% more likely (not significant) to report good health status than do individuals in the lowest income category. For excellent health status; individuals in the second lowest income category are 2.8% more likely (significant at 10% level) to report excellent health status than

do individuals in the lowest income category. Individuals in the middle income category are 8.2% more likely (significant at 1% level), individuals in the second highest are 9.2% more likely (significant at 1% level) and individuals in the highest income category are 7.1% more likely (not significant) to report excellent health status than do individuals in the lowest income category. These results show that individual in the second highest income category (460000-619000 ISK) are most likely to report good or excellent health status and least likely to report poor or fair health status. Result for females are similar to result from males, but at marginally lesser magnitude.

For females the same kind of a probit estimation (Appendix B, table B.5.) with a binary health outcome was conducted, where excellent health and good health were equated to 1 (good health), and fair and poor health were set equal to 0 (bad health). In this estimation, the marginal effects at the mean values of independent variables were calculated. In Figure 4.4., the probability for being in good health is represented graphically.

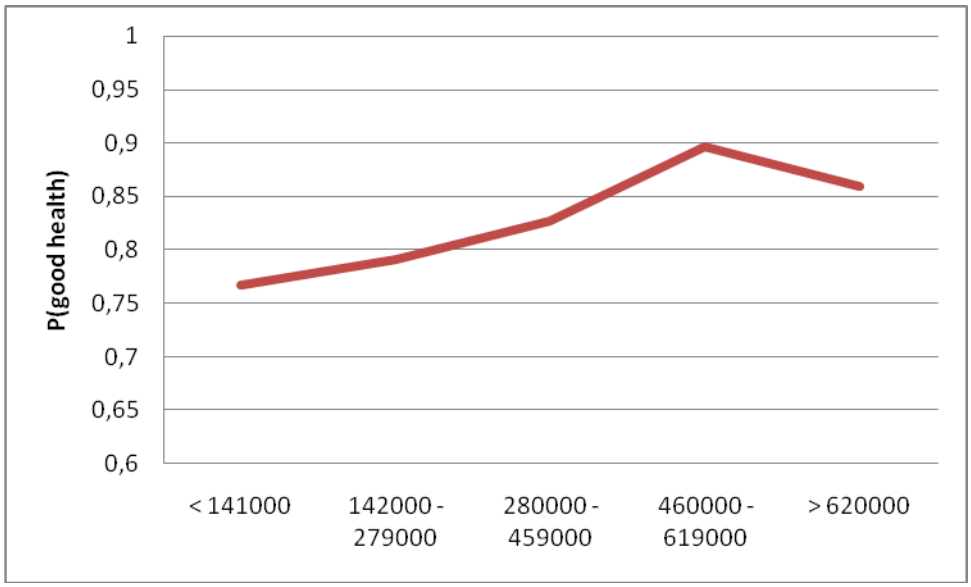

Figure 4.4. Probability of good health after binomial probit estimation - Females.

Results indicate a relationship between health and income that is not strictly increasing, as was the case for males. First, an individual in the lowest income category has 76.8% probability to be in good health. An individual in the second lowest income category has 79.2% probability to be in good health, an individual in

the middle income category has 82.7% probability to be in good health and an individual in second highest income category has 89.6% probability to be in good health. Then an individual in the highest income category has little less probability than an individual in the fourth income category, or 86.0% to be in good health. Accordingly the income is positively related to female health at lower income levels, but negatively related to health at higher income levels.

5. DISCUSSION

Although health inequalities exist in Iceland, this analysis indicates that the goal of income-related health equality has been attained reasonably well. The variation in health is not of great magnitude and the probability of being in good health is between 77% to 98% for the majority of the Icelandic population according to this results.

Although a systematic relationship between health and income is certainly detectable in terms of statistical significance, it is not very dramatic in magnitude. A higher income is associated with better self-assessed health among both males and females. The relationship is not monotonic and when traditional background and lifestyle factors have been controlled for, health appears to decrease with income at higher levels. The reversal sign of the health-income relationship at higher income levels, appears to be the same result as Asgeirsdottir (2007) established in her analysis. This analysis, thus robust her findings.

Still, the reason for this reversal is unclear. The first hypothesis involves the cost of time, which in Iceland is expected to form the majority of the opportunity cost of health production. As such, the high opportunity cost of time used in health production by high income individuals could be influencing their level of health production. The second hypothesis relates to the limited relationship in Iceland between education and income. This is for example due to the relatively restricted education of entrepreneurs and sailors in Iceland, who can traditionally have quite high income. The third hypothesis relates to the possibility that individuals in higher income levels are more querulous (complain more) about their health than individuals in lower income levels are. That is, they experience their health worse than others even though it isn´t worse. But this kind of bias should then be indicated in other similar analysis.

It should be noted that this study is based on cross-sectional data and for that reason caution should be used when interpreting the reversal of the relationship at high income levels. But of course it strengthens this result that a former Icelandic

study showed the same shape of the health-income relationship. More research is required in order to clarify the direction in which causal relationships between income and health operates and to examine the reasons behind the reversal sign that has now been identified in two Icelandic studies using different data.

APPENDIX A

This appendix contains ordered probit regression and binomial probit regressions for males that are described in section 4.

Ordered probit regression	**Male**		**N= 2680**	
Predict; poor health status (outcome 1)				
Variable	**dy/dx**		**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	-0,007	**	0,003	0,023
1 if income from 280000-459000 ISK	-0,012	***	0,003	0,001
1 if income from 460000-619000 ISK	-0,018	***	0,004	0,000
1 if income more than 620000 ISK	-0,016	***	0,005	0,001
Age	-0,001	**	0,000	0,027
Age squared	0,000	***	0,000	0,002
Body mass index	0,004	***	0,001	0,000
Body mass index squared	0,000	**	0,000	0,023
Children	-0,001		0,001	0,159
1 if smoking	0,006	***	0,002	0,007
1 if drinks alcohol more than 3-4 times a week	-0,004		0,003	0,188
1 if finished college	-0,004		0,003	0,218
1 if finished vocational school	-0,006	***	0,002	0,005
1 if finished technical graduate degree	-0,013	***	0,004	0,003
1 if finished graduate degree	-0,009	***	0,003	0,005
1 if finished postgraduate degree	-0,013	***	0,004	0,002
1 if finished PhD	-0,011	***	0,003	0,000
1 if in a relationship	-0,006		0,005	0,257
1 if cohabitating with a partner	-0,004		0,004	0,285
1 if married	-0,003		0,004	0,477
1 if divorced	0,004		0,005	0,446
1 if widowed	0,007		0,007	0,271
1 if employee	-0,002		0,003	0,324
1 if employer	-0,003		0,002	0,198
1 if student	-0,015	***	0,004	0,000
1 if on leave	0,010		0,007	0,173
1 if ill or incapable to work	0,035	***	0,006	0,000
1 if pensioned	-0,004		0,004	0,303
1 if unemployed	-0,004		0,005	0,365
1 if disabled	0,042	***	0,006	0,000
1 if experiences work-related stress	0,005	**	0,002	0,011
1 if experiences stress related to personal life	0,012	***	0,003	0,000
1% significant level = ***, 5% significant level = **, 10% significant level = *				

Table A.1.

Ordered probit regression	Male	N= 2680	
Predict; fair health status (outcome 2)			
Variable	**dy/dx**	**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	-0,047 **	0,020	0,019
1 if income from 280000-459000 ISK	-0,080 ***	0,022	0,000
1 if income from 460000-619000 ISK	-0,127 ***	0,026	0,000
1 if income more than 620000 ISK	-0,110 ***	0,031	0,000
Age	-0,007 **	0,003	0,022
Age squared	0,000 ***	0,000	0,001
Body mass index	0,029 ***	0,007	0,000
Body mass index squared	0,000 **	0,000	0,019
Children	-0,007	0,005	0,158
1 if smoking	0,042 ***	0,015	0,006
1 if drinks alcohol more than 3-4 times a week	-0,025	0,019	0,184
1 if finished college	-0,029	0,023	0,213
1 if finished vocational school	-0,042 ***	0,015	0,004
1 if finished technical graduate degree	-0,087 ***	0,028	0,002
1 if finished graduate degree	-0,065 ***	0,023	0,004
1 if finished postgraduate degree	-0,089 ***	0,028	0,001
1 if finished PhD	-0,106 ***	0,036	0,004
1 if in a relationship	-0,040	0,035	0,253
1 if cohabitating with a partner	-0,028	0,026	0,282
1 if married	-0,017	0,024	0,474
1 if divorced	0,028	0,037	0,443
1 if widowed	0,052	0,047	0,271
1 if employee	-0,017	0,017	0,321
1 if employer	-0,021	0,016	0,192
1 if student	-0,101 ***	0,025	0,000
1 if on leave	0,067	0,048	0,167
1 if ill or incapable to work	0,241 ***	0,032	0,000
1 if pensioned	-0,026	0,025	0,298
1 if unemployed	-0,031	0,034	0,363
1 if disabled	0,291 ***	0,033	0,000
1 if experiences work-related stress	0,035 ***	0,013	0,008
1 if experiences stress related to personal life	0,083 ***	0,015	0,000
1% significant level = ***, 5% significant level = **, 10% significant level = *			

Table A.2.

Ordered probit regression	Male	N= 2680	
Predict; good health status (outcome 3)			
Variable	**dy/dx**	**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,003	0,002	0,172
1 if income from 280000-459000 ISK	0,005	0,003	0,122
1 if income from 460000-619000 ISK	0,008	0,005	0,106
1 if income more than 620000 ISK	0,007	0,005	0,119
Age	0,000	0,000	0,164
Age squared	0,000	0,000	0,119
Body mass index	-0,002	0,001	0,105
Body mass index squared	0,000	0,000	0,152
Children	0,000	0,000	0,274
1 if smoking	-0,003	0,002	0,136
1 if drinks alcohol more than 3-4 times a week	0,002	0,002	0,290
1 if finished college	0,002	0,002	0,319
1 if finished vocational school	0,003	0,002	0,131
1 if finished technical graduate degree	0,006	0,004	0,126
1 if finished graduate degree	0,004	0,003	0,136
1 if finished postgraduate degree	0,006	0,004	0,116
1 if finished PhD	-0,037	0,033	0,266
1 if in a relationship	0,003	0,003	0,340
1 if cohabitating with a partner	0,002	0,002	0,358
1 if married	0,001	0,002	0,513
1 if divorced	-0,002	0,003	0,477
1 if widowed	-0,003	0,004	0,356
1 if employee	0,001	0,001	0,384
1 if employer	0,001	0,001	0,293
1 if student	0,007	0,004	0,109
1 if on leave	-0,004	0,004	0,270
1 if ill or incapable to work	-0,016 *	0,009	0,088
1 if pensioned	0,002	0,002	0,365
1 if unemployed	0,002	0,003	0,424
1 if disabled	-0,019 *	0,011	0,090
1 if experiences work-related stress	-0,002	0,002	0,146
1 if experiences stress related to personal life	-0,005 *	0,003	0,095
1% significant level = ***, 5% significant level = **, 10% significant level = *			

Table A.3.

Ordered probit regression	Male	N= 2680	
Predict; excellent health status (outcome 4)			
Variable	**dy/dx**	**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,051 **	0,022	0,018
1 if income from 280000-459000 ISK	0,086 ***	0,024	0,000
1 if income from 460000-619000 ISK	0,137 ***	0,028	0,000
1 if income more than 620000 ISK	0,119 ***	0,033	0,000
Age	0,008 **	0,003	0,022
Age squared	0,000 ***	0,000	0,001
Body mass index	-0,031 ***	0,008	0,000
Body mass index squared	0,000 **	0,000	0,019
Children	0,007	0,005	0,157
1 if smoking	-0,045 ***	0,016	0,006
1 if drinks alcohol more than 3-4 times a week	0,027	0,021	0,184
1 if finished college	0,031	0,025	0,212
1 if finished vocational school	0,046 ***	0,016	0,003
1 if finished technical graduate degree	0,094 ***	0,030	0,002
1 if finished graduate degree	0,070 ***	0,024	0,004
1 if finished postgraduate degree	0,096 ***	0,030	0,001
1 if finished PhD	0,154 **	0,072	0,032
1 if in a relationship	0,043	0,038	0,253
1 if cohabitating with a partner	0,030	0,028	0,282
1 if married	0,019	0,026	0,474
1 if divorced	-0,030	0,040	0,443
1 if widowed	-0,056	0,051	0,270
1 if employee	0,019	0,019	0,321
1 if employer	0,023	0,018	0,192
1 if student	0,109 ***	0,027	0,000
1 if on leave	-0,072	0,052	0,168
1 if ill or incapable to work	-0,260 ***	0,034	0,000
1 if pensioned	0,028	0,027	0,298
1 if unemployed	0,033	0,037	0,363
1 if disabled	-0,314 ***	0,034	0,000
1 if experiences work-related stress	-0,038 ***	0,014	0,008
1 if experiences stress related to personal life	-0,089 ***	0,016	0,000
1% significant level = ***, 5% significant level = **, 10% significant level = *			

Table A.4.

Probit regression	Male		N= 2680	
Dependent variable is binomial health variable				
Variable	**dy/dx**		**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,069	**	0,028	0,012
1 if income from 280000-459000 ISK	0,105	***	0,031	0,001
1 if income from 460000-619000 ISK	0,211	***	0,040	0,000
1 if income more than 620000 ISK	0,176	***	0,045	0,000
Age	0,007		0,005	0,110
Age squared	0,000	**	0,000	0,011
Body mass index	-0,025	**	0,011	0,017
Body mass index squared	0,000		0,000	0,232
Children	0,013	*	0,007	0,057
1 if smoking	-0,040	*	0,023	0,082
1 if drinks alcohol more than 3-4 times a week	0,055	*	0,030	0,070
1 if finished college	0,065	*	0,038	0,088
1 if finished vocational school	0,050	**	0,021	0,018
1 if finished technical graduate degree	0,111	**	0,045	0,014
1 if finished graduate degree	0,098	***	0,036	0,007
1 if finished postgraduate degree	0,020		0,040	0,610
1 if finished PhD	0,159	***	0,055	0,004
1 if in a relationship	0,066		0,053	0,215
1 if cohabitating with a partner	0,045		0,039	0,257
1 if married	0,058	*	0,035	0,100
1 if divorced	0,050		0,054	0,354
1 if widowed	-0,007		0,061	0,910
1 if employee	0,020		0,026	0,443
1 if employer	0,021		0,025	0,404
1 if student	0,145	***	0,042	0,001
1 if on leave	0,015		0,081	0,849
1 if ill or incapable to work	-0,305	***	0,047	0,000
1 if pensioned	0,010		0,035	0,785
1 if unemployed	0,033		0,052	0,531
1 if disabled	-0,378	***	0,044	0,000
1 if experiences work-related stress	-0,060	***	0,021	0,004
1 if experiences stress related to personal life	-0,083	***	0,022	0,000
Wald chi2(32) = 426,22	1% significant level =		***	
Prob > chi2 = 0.0000	5% significant level =		**	
Pseudo R2 = 0.1977	10% significant level =		*	

Table A.5.

APPENDIX B

This appendix contains ordered probit regression and binomial probit regressions for females that are described in section 4.

Ordered probit regression	Female		N= 3084	
Predict; poor health status				
Variable	**dy/dx**		**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	-0,004	*	0,002	0,073
1 if income from 280000-459000 ISK	-0,013	***	0,003	0,000
1 if income from 460000-619000 ISK	-0,014	***	0,006	0,009
1 if income more than 620000 ISK	-0,011		0,007	0,109
Age	-0,001	***	0,000	0,002
Age squared	0,000	***	0,000	0,000
Body mass index	0,005	***	0,001	0,000
Body mass index squared	0,000	***	0,000	0,000
Children	0,000		0,001	0,634
1 if smoking	0,011	***	0,003	0,000
1 if drinks alcohol more than 3-4 times a week	-0,005		0,004	0,284
1 if finished college	-0,006	*	0,004	0,087
1 if finished vocational school	-0,006	**	0,003	0,028
1 if finished technical graduate degree	0,001		0,008	0,889
1 if finished graduate degree	-0,012	***	0,003	0,000
1 if finished postgraduate degree	-0,014	***	0,005	0,009
1 if finished PhD	-0,006		0,011	0,554
1 if in a relationship	-0,004		0,005	0,461
1 if cohabitating with a partner	-0,007	*	0,004	0,054
1 if married	-0,006	*	0,004	0,100
1 if divorced	-0,008		0,005	0,110
1 if widowed	-0,009	*	0,005	0,069
1 if employee	-0,006	**	0,003	0,047
1 if employer	-0,004		0,003	0,295
1 if student	-0,008	**	0,003	0,011
1 if on leave	-0,007		0,006	0,245
1 if ill or incapable to work	0,037	***	0,006	0,000
1 if pensioned	-0,001		0,004	0,813
1 if unemployed	0,001		0,004	0,793
1 if disabled	0,050	***	0,006	0,000
1 if experiences work-related stress	0,006	***	0,002	0,005
1 if experiences stress related to personal life	0,015	***	0,003	0,000
1% significant level = ***, 5% significant level = **, 10% significant level = ***				

Table B.1.

Ordered probit regression	Female	N= 3084	
Predict; fair health status			
Variable	**dy/dx**	**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	-0,026 *	0,014	0,069
1 if income from 280000-459000 ISK	-0,076 ***	0,019	0,000
1 if income from 460000-619000 ISK	-0,085 ***	0,031	0,007
1 if income more than 620000 ISK	-0,066	0,041	0,108
Age	-0,009 ***	0,003	0,002
Age squared	0,000 ***	0,000	0,000
Body mass index	0,029 ***	0,004	0,000
Body mass index squared	0,000 ***	0,000	0,000
Children	-0,002	0,004	0,634
1 if smoking	0,067 ***	0,014	0,000
1 if drinks alcohol more than 3-4 times a week	-0,028	0,026	0,283
1 if finished college	-0,036 *	0,021	0,084
1 if finished vocational school	-0,036 **	0,016	0,025
1 if finished technical graduate degree	0,007	0,049	0,889
1 if finished graduate degree	-0,068 ***	0,017	0,000
1 if finished postgraduate degree	-0,081 ***	0,029	0,006
1 if finished PhD	-0,043	0,084	0,606
1 if in a relationship	-0,021	0,029	0,460
1 if cohabitating with a partner	-0,043 *	0,022	0,053
1 if married	-0,035 *	0,021	0,095
1 if divorced	-0,048	0,030	0,105
1 if widowed	-0,054 *	0,029	0,064
1 if employee	-0,033 **	0,016	0,043
1 if employer	-0,022	0,020	0,292
1 if student	-0,046 ***	0,018	0,010
1 if on leave	-0,040	0,034	0,243
1 if ill or incapable to work	0,222 ***	0,028	0,000
1 if pensioned	-0,005	0,023	0,813
1 if unemployed	0,007	0,026	0,793
1 if disabled	0,296 ***	0,027	0,000
1 if experiences work-related stress	0,039 ***	0,013	0,003
1 if experiences stress related to personal life	0,087 ***	0,013	0,000
1% significant level = ***, 5% significant level = **, 10% significant level = ***			

Table B.2.

Ordered probit regression	Female		N= 3084	
Predict; good health status				
Variable	**dy/dx**		**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,002		0,002	0,150
1 if income from 280000-459000 ISK	0,007	**	0,003	0,038
1 if income from 460000-619000 ISK	0,007	*	0,004	0,075
1 if income more than 620000 ISK	0,006		0,004	0,182
Age	0,001	*	0,000	0,060
Age squared	0,000	**	0,000	0,043
Body mass index	-0,002	**	0,001	0,023
Body mass index squared	0,000	**	0,000	0,035
Children	0,000		0,000	0,644
1 if smoking	-0,006	**	0,003	0,033
1 if drinks alcohol more than 3-4 times a week	0,002		0,002	0,326
1 if finished college	0,003		0,002	0,166
1 if finished vocational school	0,003		0,002	0,103
1 if finished technical graduate degree	-0,001		0,004	0,889
1 if finished graduate degree	0,006	**	0,003	0,042
1 if finished postgraduate degree	0,007	*	0,004	0,071
1 if finished PhD	-0,003		0,020	0,885
1 if in a relationship	0,002		0,003	0,480
1 if cohabitating with a partner	0,004		0,002	0,127
1 if married	0,003		0,002	0,165
1 if divorced	0,004		0,003	0,173
1 if widowed	0,005		0,003	0,143
1 if employee	0,003		0,002	0,132
1 if employer	0,002		0,002	0,334
1 if student	0,004	*	0,002	0,081
1 if on leave	0,003		0,003	0,297
1 if ill or incapable to work	-0,019	**	0,009	0,024
1 if pensioned	0,000		0,002	0,814
1 if unemployed	-0,001		0,002	0,792
1 if disabled	-0,026	**	0,011	0,022
1 if experiences work-related stress	-0,003	*	0,002	0,064
1 if experiences stress related to personal life	-0,008	**	0,003	0,027
1% significant level = ***, 5% significant level = **, 10% significant level = ***				

Table B.3.

Ordered probit regression	Female	N= 3084	
Predict; excellent health status			
Variable	**dy/dx**	**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,028 *	0,015	0,069
1 if income from 280000-459000 ISK	0,082 ***	0,020	0,000
1 if income from 460000-619000 ISK	0,092 ***	0,034	0,007
1 if income more than 620000 ISK	0,071	0,044	0,107
Age	0,009 ***	0,003	0,002
Age squared	0,000 ***	0,000	0,000
Body mass index	-0,031 ***	0,005	0,000
Body mass index squared	0,000 ***	0,000	0,000
Children	0,002	0,005	0,633
1 if smoking	-0,072 ***	0,015	0,000
1 if drinks alcohol more than 3-4 times a week	0,030	0,028	0,283
1 if finished college	0,039 *	0,022	0,083
1 if finished vocational school	0,039 **	0,018	0,024
1 if finished technical graduate degree	-0,007	0,053	0,889
1 if finished graduate degree	0,074 ***	0,019	0,000
1 if finished postgraduate degree	0,087 ***	0,032	0,006
1 if finished PhD	0,053	0,115	0,646
1 if in a relationship	0,023	0,031	0,460
1 if cohabitating with a partner	0,046 *	0,024	0,052
1 if married	0,038 *	0,023	0,096
1 if divorced	0,052	0,032	0,106
1 if widowed	0,058 *	0,032	0,064
1 if employee	0,035 **	0,017	0,042
1 if employer	0,023	0,022	0,292
1 if student	0,050 ***	0,019	0,010
1 if on leave	0,043	0,037	0,242
1 if ill or incapable to work	-0,240 ***	0,030	0,000
1 if pensioned	0,006	0,024	0,813
1 if unemployed	-0,007	0,028	0,793
1 if disabled	-0,320 ***	0,026	0,000
1 if experiences work-related stress	-0,042 ***	0,014	0,003
1 if experiences stress related to personal life	-0,094 ***	0,013	0,000
1% significant level = ***, 5% significant level = **, 10% significant level = ***			

Table B.4.

Probit regression	Female	N= 3084	
Dependent variable is binomial health variable			
Variable	**dy/dx**	**Std. Err.**	**P>|z|**
1 if income from 142000-279000 ISK	0,024	0,022	0,269
1 if income from 280000-459000 ISK	0,059 **	0,029	0,040
1 if income from 460000-619000 ISK	0,129 **	0,059	0,029
1 if income more than 620000 ISK	0,092	0,068	0,174
Age	0,009 **	0,004	0,022
Age squared	0,000 ***	0,000	0,001
Body mass index	-0,027 ***	0,007	0,000
Body mass index squared	0,000 **	0,000	0,048
Children	0,006	0,007	0,353
1 if smoking	-0,071 ***	0,020	0,001
1 if drinks alcohol more than 3-4 times a week	0,023	0,040	0,555
1 if finished college	0,068 **	0,033	0,039
1 if finished vocational school	0,088 ***	0,025	0,000
1 if finished technical graduate degree	-0,013	0,074	0,857
1 if finished graduate degree	0,095 ***	0,028	0,001
1 if finished postgraduate degree	0,079 *	0,048	0,095
1 if finished PhD	0,090	0,130	0,486
1 if in a relationship	0,033	0,045	0,468
1 if cohabitating with a partner	0,047	0,034	0,166
1 if married	0,044	0,032	0,164
1 if divorced	0,063	0,044	0,151
1 if widowed	0,092 **	0,044	0,037
1 if employee	0,056 **	0,023	0,016
1 if employer	0,001	0,032	0,968
1 if student	0,039	0,029	0,188
1 if on leave	0,131 **	0,064	0,041
1 if ill or incapable to work	-0,307 ***	0,043	0,000
1 if pensioned	0,013	0,033	0,692
1 if unemployed	0,040	0,045	0,375
1 if disabled	-0,370 ***	0,035	0,000
1 if experiences work-related stress	-0,064 ***	0,021	0,002
1 if experiences stress related to personal life	-0,125 ***	0,019	0,000
Wald chi2(32) = 511,32	1% significant level =		***
Prob > chi2 = 0.0000	5% significant level =		**
Pseudo R2 = 0.2166	10% significant level =		*

Table B.5.

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