BS ritgerð

í hagfræði

The Effect of Economic Conditions on Cardiovascular Disease

Dagný Ósk Ragnarsdóttir

Leiðbeinendur: Tinna Laufey Ásgeirsdóttir og Þórhildur Ólafsdóttir

Hagfræðideild

Júní 2012

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Félagsvísindasvið Háskóla Íslands.

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Rannsókn þessi er 12 ECTS eininga lokaverkefni til BS-gráðu í hagfræði við Hagfræðideild Háskóla Íslands. Hún snýr að hagfræðilegri greiningu á sambandi efnahagsástands og tíðni hjartasjúkdóma á Íslandi. Leiðbeinendur mínir voru Tinna Laufey Ásgeirsdóttir, doktor í hagfræði og lektor við Hagfræðideild Háskóla Íslands og Þórhildur Ólafsdóttir, doktorsnemi í hagfræði við Háskóla Íslands og færi ég þeim bestu þakkir fyrir aðstoðina. Einnig vil ég þakka Lýðheilsustöð fyrir aðgang að gögnunum, Helga R. Magnússyni fyrir yfirlestur og bróður mínum Róberti Kjaran Ragnarssyni fyrir aðstoð við uppsetningu.

Abstract

The relationship between economic conditions and health has been widely researched, but the literature shows mixed results. In this paper the relationship between cardiovascular disease and economic conditions is used, with focus on changes caused by the Icelandic economic collapse in 2008. Furthermore, potential mediators in this relationship are looked at. The data used come from the health and lifestyle survey "Heilsa og líðan Íslendinga", which was carried out by the Public Health Institute of Iceland in 2007 and 2009. The sample is a stratified random sample of 9,807 individuals 18-79 years old and a total of 42.1% answered the questionnaire in both 2007 and 2009. Logit analyses were used to examine if there was a relationship between the economic conditions and the probability of having a cardiovascular disease or condition. The crisis is positively related to hypertension and total cardiovascular disease in males but no statistically significant relationship was found for females. The mediation analyses indicate mediation through changes in working hours and stress level for males in the relationship between the crisis and hypertension, and between the crisis and total cardiovascular disease. For males, changes in income partly explain the increased probability of having any cardiovascular disease or condition after the crisis.

Útdráttur

Samband efnahagsástands og heilsu hefur verið töluvert rannsakað, en niðurstöður þessara rannsókna eru ekki einróma. Sumir halda því fram að heilsa versni í uppsveiflum á meðan aðrir vilja meina að heilsa sé verri í niðursveiflum. Í þessari rannsókn verður samband íslensku efnahagskreppunnar og hjartasjúkdóma skoðað. Ennfremur verða möguleg miðlunaráhrif könnuð. Gögnin sem notast er við eru fengin úr heilsu- og lífstílskönnuninni „Heilsa og líðan Íslendinga" sem framkvæmd var af Lýðheilsustöð árin 2007 og 2009. Úrtakið er lagskipt tilviljanakennt úrtak 9.807 einstaklinga á aldrinum 18-79 ára og samtals svöruðu 42,1% upphaflega úrtaksins könnuninni bæði árið 2007 og árið 2009. Logit greiningar voru notaðar til þess að kanna hvort marktækt samband væri á milli efnahagskreppunnar og líkinda þess að vera með hjartasjúkdóm eða -einkenni. Hjá körlum fundust jákvæð marktæk tengsl á milli kreppunnar og háþrýstings annars vegar og kreppunnar og hjartasjúkdóma og -einkenna í heild hins vegar. Ekkert marktækt samband fannst hjá konum. Hjá körlum gáfu miðlunargreiningar til kynna miðlun í gegnum vinnustundir og streitu í sambandinu á milli kreppunnar og háþrýstings annars vegar og kreppunnar og hjartasjúkdóma og -einkenna í heild hins vegar. Breytingar á tekjum útskýra einnig að hluta til auknar líkur á meðal karla á því að vera með hjartasjúkdóm eða -einkenni eftir kreppu.

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1 Introduction

The association between economic changes and health has gotten considerable attention, which is being further fuelled by the recent global recession. Cardiovascular disease is the leading cause of death in the world (WHO, 2011) and therefore an interesting health condition to investigate in relation to economic changes. In Iceland, as in the rest of the western world, the mortality rate for cardiovascular disease has been decreasing, despite still being the leading cause of death (Icelandic Heart Association, 2008; Kesteloot, Sans, & Kromhout, 2006). In Iceland there is evidence of a downward trend in cardiovascular morbidity as well, but between 1981 and 2004 the rate of new incidence of coronary disease for individuals aged 25-74 lowered by 26% for males and 25% for females. Average blood pressure has also declined, but between 1967 and 2007 blood pressure among 45-65 year olds lowered by 9.3% and 15.3%, for males and females respectively (Icelandic Heart Association, 2008).

In early October 2008 the Icelandic economy suffered a major shock when the Icelandic banking system collapsed and marked the beginning of an economic crisis. Unlike a business cycle downswing, the crisis was a crash that affected the entire population of Iceland. It is a part of a complex global financial crisis but has hit Iceland particularly hard, especially due to its relatively large banking sector (Iceland Chamber of Commerce, 2011). The crisis has affected people in many ways. Following the crisis hundreds of firms declared bankruptcy (Statistics Iceland, n.d.-c, n.d.-d), the consumer price index (CPI) rose from 272.7 in 2007 to 344.6 in 2009 (Statistics Iceland, n.d.-b), and the unemployment rate rose from 2.3% in 2007 to 7.2% in 2009 (Statistics Iceland, n.d.-a). Along with the financial consequences of a dramatic economic shock like this, it could affect both psychological and/or physical wellbeing of the inhabitants.

The literature on the association between health and economic conditions shows mixed results. Researchers have both focused on health with regard to own economic and labour-market conditions, as well as how the economic conditions of society at large affect health. The most common proxy used for ambient economic conditions is the unemployment rate but factors such as deviations from GDP trends and changes in

GDP have also been used. Studies have, for example, documented the detrimental effects of own unemployment or involuntary job loss on health, as well as higher mortality risk among those who are unemployed or have lost a job, independent of the unemployment rate (Eliason & Storrie, 2009a; Gallo et al., 2004; Gerdtham & Johannesson, 2003; Junankar, 1991; Koziel, Lopuszanska, Szklarska, & Lipowicz, 2010; Martikainen, 1990; Moser, Fox, Goldblatt, & Jones, 1986; Strully, 2009). Several of these studies did, however, not find unemployment to affect cardiovascular morbidity or cardiovascular mortality (Eliason & Storrie, 2009b; Gerdtham & Johannesson, 2003; Moser et al., 1986). Other studies have focused on how health is affected by economic fluctuations and business cycles. Using aggregate data, older studies have concluded that economic downturns have a negative effect on health (Brenner, 1971, 1979; Brenner & Mooney, 1983; Bunn, 1979). It was thought that high unemployment rates were not only threatening through their negative financial consequences on individuals, but also a risk factor for population health and mortality rates. However, later work has provided evidence of increased mortality when unemployment rates fall (Gerdtham & Ruhm, 2006; Neumayer, 2004; Ruhm, 2000, 2003, 2007; Tapia Granados, 2005a, 2005b; Tapia Granados & Ionides, 2011), although other recent studies have found a counter-cyclical relationship between economic conditions and mortality (Economou, Nikolaou, & Theodossiou, 2008; Gerdtham & Johannesson, 2005).

Research has shown especially mixed results on the relationship between economic conditions and cardiovascular disease. Economic downturns vary in length and magnitude, and institutional settings vary between countries. To get a better understanding of why the results differ, it is important to add to the literature and explore this relationship under various circumstances. This paper aims to add to the growing literature on the relationship between economic conditions and cardiovascular disease. Other studies have mainly focused on how economic changes affect cardiovascular mortality rates but in this paper the focus will be on cardiovascular morbidity. The main objective of the paper is to investigate the potential relationship between the Icelandic economic collapse of 2008 and cardiovascular disease using panel data collected in 2007 and 2009. Furthermore, I will look at possible mediators of this relationship using logit models as well as fixed-effects analyses.

The current study shows different results for males and females. For females no statistically significant relationship was found between the crisis and any cardiovascular disease or condition. For males a positive statistically significant relationship was found between hypertension and the crisis as well as between total cardiovascular disease and the crisis. The mediation analyses indicate that changes in working hours, stress level, and income partly explain increased probability of hypertension and total cardiovascular disease in men after the crisis.

2 Literature review

There are different theories and empirical findings on the relationship between economic fluctuations and health outcomes, some suggesting that recessions have a negative effect on health while others say that health deteriorates in economic upturns. Stress and decline in financial resources are the main hypothesised reasons why health might deteriorate during economic downturns. The availability of medical services could decrease during a recession and the financial strain associated with unemployment can cause individuals to be less likely to seek medical service when needed. The decline in financial resources can also lead to unhealthy diets and therefore increase susceptibility to illness. Those who become unemployed not only lose materially but also lose psychosocial assets such as personal status and social relationships (Brenner, 1971; Economou et al., 2008; Eliason & Storrie, 2009a; Gallo et al., 2004; Junankar, 1991; Neumayer, 2004). The anxiety and stress associated with job loss and the fear of losing a job is detrimental to health and could lead to conditions such as cardiovascular disease. Individuals may also resort to smoking and excessive consumption of alcohol to cope with the stress associated with unemployment or job insecurity (Eliason & Storrie, 2009a; Junankar, 1991; Neumayer, 2004).

However, in some utility maximising models economic downturns can instead have a positive effect on health and economic upturns have a negative effect (although in models like this, permanently higher income is likely to be associated with health improvements). There are at least three reasons why health might deteriorate during temporary upturns. First, when the opportunity cost of time rises individuals work more and less time is spent on medical check-ups, exercise and cooking nutritious meals. Second, health may be considered an input into the production of goods and services. With increased working hours, job-related stress will increase and could have a negative effect on health. However, people may be willing to draw on their health stock to a greater extent at a time when the labour-market rewards for drawing on health are greater. Third, due to a temporary increase in income, individuals could engage in riskier behaviour and might increase their consumption of goods such as alcohol and tobacco that can be costly (Economou et al., 2008; Gerdtham & Ruhm, 2006; Neumayer, 2004; Ruhm, 2000). The increase in job-related stress might also lead to increased consumption of these health damaging goods (Neumayer, 2004).

These different perspectives on how health and mortality are affected by changes in the economy need not to be inconsistent with each other. An economic downturn, for example, could have both positive and negative effects on health. Whether the overall effect is positive or negative then depends on the relative strength of the effects (Neumayer, 2004).

Several studies have examined the relationship between unemployment and mortality, independent of the unemployment rate. Moser, Fox, and Jones (1984) investigated this relationship in England and Wales in 1971-1981 using the OPCS Longitudinal Study. They found higher overall mortality for men who were seeking work in 1971 and died between 15 and 64 years of age, but no statistically significant increase in cardiovascular mortality was found for the same group (Moser et al., 1986). Using the same data, Junankar (1991) found similar results after controlling for social class and geographical regions and argues that unemployment affects mortality. Martikainen (1990) controlled for age, socioeconomic status, marital status, and health in a study on Finnish men. His results show an excess mortality of unemployed males that cannot be fully explained by the control variables. Furthermore, mortality due to circulatory diseases was relatively high among unemployed men.

Using a large data set of individuals aged 20-64 Gerdtham and Johannesson (2003) analysed the effect of unemployment on mortality in Sweden. The individuals were followed up for 10-17 years and were all initially in the same health state, but differed with respect to employment status. The results show a highly significant negative effect of unemployment, increasing the risk of mortality by 46%. However, they found no significant effect of unemployment on cardiovascular mortality.

Other studies have focused on how changes in unemployment rates affect the association between unemployment and health outcomes. Martikainen and Valkonen (1996) studied the relationship between unemployment and mortality during economic changes in Finland. They found mortality rates for those who experience unemployment to be higher than for employed individuals. They also show that the association between unemployment and mortality is weaker when national unemployment is high. Martikainen and Valkonen explain this by two factors. First, when the economy is in good condition and the unemployment rate is low, those who are unemployed might be characterised by lifestyle habits associated with poorer health. As the unemployment rate increases, healthier people become unemployed and unemployment will be less dependent on pre-existing characteristics. Second, effects such as stress and anxiety might be less pronounced for the jobless when more people are also unemployed. Using Swedish data, Henriksson, Lindblad, Agren, Nilsson-Ehle, and Rastam (2003) examined the association between unemployment and cardiovascular risk factors in particular and found similar results.

Studies have also documented the negative effects of job loss on health. In a U.S. study individuals that had lost their jobs were more likely to report their self-assessed health in negative terms (Strully, 2009). Another study on U.S. data investigated the relationship between involuntary job loss and myocardial infarction and stroke among older workers. The findings indicate that job loss is a risk factor for cardiovascular disease (Gallo et al., 2004). Eliason and Storrie (2009a) examined the causal effect of job loss due to establishment closures in Sweden on total and cause-specific mortality. Their results show that during the first four years following job loss, all-cause mortality risk for men increased by 44%. In another study they focused on the impact of job loss on non-fatal health events. To some extent they found evidence that job losers are at higher risk of hospitalisation. However, they found no evidence of increased risk of cardiovascular disease (Eliason & Storrie, 2009b).

Other research has focused on the effect of economic changes on health. Brenner (1971, 1979) explored the relationship between economic changes and mortality using aggregate time-series data. He found that economic downturns are associated with increased mortality from cardiovascular disease as well as increased overall mortality. Bunn (1979) investigated the link between ischemic heart disease mortality and the business cycle in Australia and got results consistent with Brenner's findings. However, Brenner's work has been criticised on the grounds of methodological weaknesses (Stern, 1983; Wagstaff, 1985).

More recent aggregate level analysis was made by Ruhm (2000). He examined how health responds to business cycle fluctuations by estimating fixed-effect models for a panel of the United States over the period 1972-1991. His study provides evidence that temporary downturns reduce mortality. The unemployment rate is negatively and significantly correlated with both total mortality and eight of the ten specific causes of death he examined. A one percentage point increase in the state unemployment rate is associated with a 0.5-0.6% decrease in total mortality as well as a similar decrease in cardiovascular mortality.

Ruhm (2003) used individual data from the 1972-1981 U.S. National Health Interview Surveys and examined how health status and medical care utilisation fluctuate with changes in economic conditions within a state. His results show that physical health deteriorates when the economy temporarily improves. These effects were particularly pronounced for men, employed individuals, and persons of prime working age. His results also show some evidence of increased use of medical care when the economy strengthens.

Ruhm (2004, 2007) has also studied how temporary changes in economic conditions affect the relative risk of death from coronary heart disease and acute myocardial infarction in the United States, using panel data of the 20 largest states over the 1979-1998 period. He examined the effect of a 2.5% increase in the unemployment rate and found it to lead to a 1.9% reduction in coronary heart disease mortality.

Miller, Page, Stevens, and Filipski (2009) followed Ruhm's (2000) methods using U.S. data over the period 1978-2004 and got similar results. The main purpose of their study was to explore what causes mortality rates to increase during economic upturns. As the greatest effects are found for children and the elderly, they deduce that the pro-cyclical mortality pattern is mainly explained by externalities associated with the business cycle but not by "own" factors such as changes in individual's own work or health behaviours.

Edwards (2008) studied mortality in the United States by individual characteristics during the 1980s and 1990s and found overall mortality to be pro-cyclical. When examining who is hurt by pro-cyclical mortality he got mixed results, especially among working-age males. He found weak evidence that disadvantaged groups were relatively more exposed to pro-cyclical mortality. Using education as an indicator of permanent socioeconomic status his results show the opposite. Those with higher education were more likely to be negatively affected by economic upturns, while those with little education experienced counter-cyclical mortality.

Ruhm's original analysis has also been repeated using data from outside the United States (Economou et al., 2008; Gerdtham & Ruhm, 2006; Neumayer, 2004; Tapia Granados, 2005b). Neumayer (2004) analysed data for German states over the period 1980-2000. He found both the total mortality rate and mortality from some major causes of death, including cardiovascular disease, to be lower in recessions.

A study on data for Spanish provinces during the years 1980-1997 also confirms Ruhm's results, but unemployment in Spain fluctuated between 7-24% during the period of the study. The results show that mortality is lower when unemployment rises, with a 0.11% reduction in mortality per 1% increase in province unemployment. However, mortality due to cardiovascular disease was only found to be slightly pro-cyclical (Tapia Granados, 2005b).

Gerdtham and Ruhm (2006) used data for 23 OECD countries over the years 1960-1997 and examined the relationship between macroeconomic conditions and deaths. They found a 1% fall in the national unemployment rate to raise both total mortality and cardiovascular mortality by 0.4%. These results also support Ruhm's previous findings (Gerdtham & Ruhm, 2006).

The patterns of pro-cyclical mortality have become a relatively standard finding. However, not all recent literature reports this pro-cyclical relationship. Stuckler, Basu, Suhrcke, Coutts, and McKee (2009) investigated how changes in economic conditions affected mortality in 26 European Union countries in the years 1970-2007. Their results show no consistent evidence that mortality rates increased or decreased during economic downturns but they found mortality to be more sensitive to economic downturns in countries with weaker social systems. They found a statistically significant increase in ischemic heart disease mortality when the unemployment rate rose, only for males 30-44 years old.

Unlike Ruhm (2000) and others mentioned that extended and improved upon Ruhm's analysis (Gerdtham & Ruhm, 2006; Neumayer, 2004; Tapia Granados, 2005b), Economou et al. (2008) found a strong positive relationship between economic downturns and mortality. They examined the effects of national unemployment rates on mortality rates using a panel data of 13 European Union countries and found that a 1% increase in unemployment rates was associated with a decrease of 2.18 deaths per 100,000 individuals. Their results also show a clear positive association between unemployment rates and deaths due to ischemic heart disease (Economou et al., 2008).

A counter-cyclical fluctuation of mortality has also been found in Sweden. Gerdtham and Johannesson (2005) explored the relationship between business cycles and mortality risk at the individual level using six different proxies for business cycles. They found a significant counter-cyclical relationship for four of the business cycle indicators on mortality for men but no effect for women. For mortality due to cardiovascular disease they found a counter-cyclical relationship for three of the business cycle indicators, for men only.

In an aggregate level study on Swedish regional data in 1987-2003 Svensson (2007) focused on the association between economic fluctuations and heart attacks. Significant counter-cyclical relationship was found among those aged 20-49 but no significant effect overall. In another study he explored the relationship between the regional unemployment rate and both total and cause-specific mortality for a longer period of time, 1976-2005. Overall his results show no significant effect of changes in the unemployment rate on mortality. Cardiovascular mortality decreased with lower unemployment rate but most other cause-specific results were non-significant (Svensson, 2010).

The difference in government institutions and regulations between countries could be one reason for different health outcomes in short-term economic fluctuations. When examining the relationship between macroeconomic conditions and deaths in the OECD, Gerdtham and Ruhm (2006) found the pro-cyclical relationship between economic conditions and health to be weaker for countries with extensive social welfare systems. The Swedish welfare state, for example, is one of the most developed in the world with generous income support for the unemployed (Gerdtham & Johannesson, 2003; Tapia Granados & Ionides, 2011).

Tapia Granados and Ionides (2011) did find pro-cyclical mortality in Sweden. They found total mortality in Sweden in 1968-2003 to have positive correlations with GDP and negative correlations with the unemployment rate. In regressions modelling lagged effects of GDP growth on cardiovascular mortality they only found positive and statistically significant effects at lag one.

In Iceland, only one study has focused on the relationship between economic conditions and cardiovascular disease. Changes in attendance at emergency departments in Reykjavík immediately following the Icelandic economic collapse in October 2008 were examined in this study. In the week after the economic collapse, a 26% overall increase in visits was observed in the cardiac emergency department compared with the average weekly attendance in the weeks before the collapse. The increase in visits was particularly high among women, or 40%. However, this study only shows the shock effect of the collapse rather than the effect of an economic downturn (Guðjónsdóttir et al., 2011).

To summarise, previous literature shows that the relationship between economic changes and incidence due to cardiovascular disease is not clear. The common belief is that health declines during economic contractions. A part of the literature is consistent with this. However, other evidence indicates that health improves during economic downturns. The results from studies focusing on how cardiovascular health is affected by changes in economic conditions are even more conflicting. An overview of previous studies can be seen in Table 1.

Table 1. Overview of previous studies on the relationship between health and economic conditions

Researcher (year)	Better health in upturns		Better health in downturns		Country
	Total	CVD	Total	CVD	
Brenner (1971, 1979)	x	x			US, UK
Bunn (1979)		x			Australia
Ruhm (2000, 2003, 2004, 2007)			x	x	US
Miller et al. (2009)			x	x	US
Neumayer (2004)			x	x	Germany
Tapia Granados (2005)[a]			x	x	Spain
Gerdtham & Ruhm (2006)			x		OECD
Edwards (2008)			x		US
Stuckler et al. (2009)[b]		x	x		EU
Economou et al. (2008)	x	x			EU
Gerdtham & Johannesson (2005)[c]	x	x			Sweden
Svensson (2007, 2010)[d]	-	x	-		Sweden
Tapia Granados & Ionides (2011)[e]			x	x	Sweden

[a] CVD: weak relationship

[b] Total: overall no effect, but a weak effect for 15-29 year old males CVD: only for 30-44 year old males

[c] Only for males

[d] Total: no effects. CVD: only for 20-49 years old (both incidence and mortality)

[e] CVD: only at lag 1

3 Data

The data used in this study come from the health and lifestyle survey "Heilsa og líðan Íslendinga" which was carried out by the Public Health Institute of Iceland in 2007 and again in 2009. The survey contains questions regarding health, use of drugs, illnesses, smoking, drinking, dental care, diet, height and weight, exercise, accidents, stress, quality of life, and other lifestyle related factors, as well as work related issues and demographics (Jónsson, Guðlaugsson, Gylfason, & Guðmundsdóttir, 2011).

A stratified random sample of 9,807 individuals 18-79 years old was drawn and consists of citizens with enough knowledge of the Icelandic language to respond to the questionnaire. The number of individuals receiving the questionnaire in 2007 was 9,711, or 4.8% of the population. All the participants in the 2007 survey that agreed on participating again received a 2009 version of the questionnaire. In 2007 the net-response rate was 60.9% which corresponds to 5,909 returned questionnaires. The response rate in 2009 was 69.3% which corresponds to 4,092 returned questionnaires. Thus, 42.1% of the original sample answered the questionnaire both in 2007 and 2009 (Jónsson et al., 2011).

Due to deliberate over sampling in some strata, the sample consists of relatively older individuals than the population census and relatively more people living outside the capital region, as can be seen comparing the survey data to census data in Table 2.

Table 2. Representation by age and residence

	Capital region		Outside the capital region	
Age	**% in census**	**% in sample**	**% in census**	**% in sample**
18-29	15.1	9.6	8.5	9.6
30-39	12.4	8.0	6.3	9.0
40-49	12.8	8.0	7.6	8.1
50-59	11.2	8.0	6.6	8.1
60-69	7.1	8.1	4.4	8.0
70-79	4.9	8.0	3.2	8.1

Reference: Jónsson et al., 2011.

Summary statistics for the variables used can be found grouped by year in Tables 3 and 4, for males and females respectively. The summary statistics only include individuals that answered the questionnaire in both 2007 and 2009. To examine if changes between years in each variable were statistically significant, t-tests were carried out and are reported in the same tables.

Cardiovascular diseases and conditions: A question on diseases and illnesses included four types of cardiovascular diseases and conditions: *coronary thrombosis*, *coronary disease*, *stroke* and *hypertension*. There were three response options: “yes, have got it now”, “have had it before but not now” and “no, never had it”. Binary variables were constructed for each cardiovascular condition, taking the value 1 if an individual answered that he or she had the condition now and 0 otherwise. Due to how few individuals had coronary thrombosis, coronary disease or stroke, another binary variable was made, taking the value 1 if an individual had *coronary thrombosis, coronary disease or stroke* and 0 otherwise. A binary variable was also constructed for all of the four possible conditions grouped together, *total cardiovascular disease*, taking the value 1 if an individual had any cardiovascular condition and 0 otherwise.

The crisis: The economic crisis is modelled with the time variable t, which represents two different time points, the year 2007 and the year 2009. This variable takes the value 1 for the year 2009 and 0 for the year 2007, but as mentioned before the Icelandic banking sector collapsed in October 2008.

Stress: A shortened version of the Perceived Stress Scale (PSS) was used to measure stress. It is a measure of the degree to which situations in an individual’s life are judged as stressful (Cohen, Kamarck, & Mermelstein, 1983). It consists of four questions about feelings and thoughts during the last month and five possible answers ranging from “never” to “very often”. The score for each question ranges from 0-4, thus the overall score ranges from 0-16 for the four questions, with 16 being the highest level of stress.

Income: Annual individual income refers to all income before taxes. It was reported in ten categories in the survey, from less than 900 thousand ISK a year to over 8.4 million ISK a year, but the median of each category was found and the variable used as continuous. The inflation rate between 2007 and 2009 was 27%. To report income in real terms the data from 2007 was multiplied by 1.27. Individual real income was scaled to million ISK.

Working hours: Question on how many hours individuals spent on paid work each week was used to construct a variable on working hours. The question did not differentiate between individuals working full time and those working part time. Working hours were reported in thirteen categories in the survey, ranging from 0 hours per week up to 60 hours or more per week. The median of each category was found and working hours per week then scaled to working hours per day. The variable was used as continuous.

Education: Questions on the highest level of education an individual had completed were used to construct educational variables. In 2007 respondents could choose from eight answers but in 2009 two other response options were added. Due to the increased quality in answers with the improvement of the question, answers from 2009 are used with imputations from 2007 in cases of missing 2009 responses. Similar education levels were combined and five educational groups constructed. The group *educ1* includes those who had finished primary or secondary school, *educ2* includes those who had finished vocational master or journeyman certificate, *educ3* those who had finished high school or equivalent, *educ4* those who had finished technical graduate or undergraduate degree, and *educ5* those who had finished a master's degree or Ph.D. *Educ3* is used as the base category.

BMI: The body mass index (BMI) was used to calculate body weight. BMI is used to classify underweight, overweight, and obesity in adults and is defined as an individual's body weight in kilograms divided by the square of his or her height in meters. The optimal BMI level lies between 18.5 and 24.9. Individuals with BMI under 18.5 are considered underweight. Individuals with BMI between 25 and 29.9 are considered overweight and those with BMI 30 or more are considered obese (WHO, n.d.-a). Overweight and obesity are major risk factors for cardiovascular disease (WHO, n.d.-b). A dummy variable was created for each BMI category and optimal BMI is used as the base group.

Demographics: The demographics variables consist of questions about age, gender, marital status, number of children and residence. Gender is used to categorise the data and is a binary variable indicating whether a respondent is male or female. Five dummy variables are used for marital status, but age and number of children are continuous variables. Two dummy variables, urban and rural, are used for residence. An area is defined here as urban if it has 5000 or more residents, and rural otherwise.

Table 3. Summary statistics for males answering both waves

	Males						
	2007			2009			t-test 2007/2009
Variable	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**p-value**
Age	54.695	15.542	1885	56.643	15.510	1887	0.0001
1 if coronary thrombosis (CT)	0.022	0.147	1755	0.031	0.174	1771	0.1036
1 if coronary disease (CD)	0.032	0.176	1745	0.045	0.208	1762	0.0412
1 if stroke	0.005	0.071	1759	0.007	0.085	1779	0.4073
1 if CT, CD or stroke	0.045	0.208	1794	0.057	0.232	1817	0.0996
1 if hypertension	0.219	0.414	1780	0.246	0.431	1800	0.0559
1 if any cardiovascular disease	0.238	0.426	1821	0.274	0.446	1831	0.0118
1 if single	0.101	0.302	1886	0.085	0.279	1865	0.0810
1 if steady	0.032	0.177	1886	0.032	0.177	1865	0.9762
1 if married or cohabiting	0.809	0.394	1886	0.809	0.394	1865	0.9993
1 if divorced	0.039	0.194	1867	0.047	0.212	1865	0.2243
1 if widowed	0.021	0.144	1886	0.027	0.163	1865	0.2220
Number of children	2.561	1.593	1874	2.620	1.589	1867	0.2578
Real income	5.147	2.813	1811	4.186	2.297	1810	0.0000
Working hours	4.333	3.542	1643	3.951	3.471	1585	0.0020
BMI	27.386	4.265	1846	27.456	3.959	1848	0.6041
1 if underweight	0.004	0.061	1887	0.003	0.056	1891	0.7783
1 if optimal	0.271	0.444	1887	0.258	0.437	1891	0.3553
1 if overweight	0.503	0.500	1887	0.516	0.500	1891	0.4356
1 if obese	0.225	0.417	1887	0.226	0.419	1891	0.9040
PSS	3.796	2.766	1825	3.990	2.778	1822	0.0342
1 if urban	0.620	0.486	1874	0.617	0.486	1863	0.8610
1 if rural	0.380	0.486	1874	0.383	0.486	1863	0.8610
1 if educ1	0.307	0.461	1775	0.307	0.461	1785	
1 if educ2	0.288	0.453	1775	0.287	0.453	1785	
1 if educ3	0.175	0.380	1775	0.174	0.379	1785	
1 if educ4	0.142	0.349	1775	0.144	0.351	1785	
1 if educ5	0.088	0.283	1775	0.088	0.283	1785	

Table 4. Summary statistics for females answering both waves

	Females						
	2007			2009			t-test 2007/2009
Variable	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**p-value**
Age	51.750	16.551	2172	53.681	16.543	2146	0.0001
1 if coronary thrombosis (CT)	0.008	0.090	1954	0.009	0.095	1998	0.7801
1 if coronary disease (CD)	0.022	0.147	1940	0.025	0.157	1976	0.5191
1 if stroke	0.004	0.064	1950	0.005	0.070	2012	0.6848
1 if CT, CD or stroke	0.027	0.163	1977	0.029	0.169	2034	0.6773
1 if hypertension	0.245	0.430	2028	0.265	0.441	2046	0.1464
1 if any cardiovascular disease	0.253	0.435	2052	0.270	0.444	2074	0.2123
1 if single	0.100	0.301	2171	0.083	0.276	2124	0.0528
1 if steady	0.038	0.192	2171	0.041	0.199	2124	0.5919
1 if married or cohabiting	0.730	0.444	2171	0.718	0.450	2124	0.3573
1 if divorced	0.059	0.235	2148	0.067	0.250	2124	0.2695
1 if widowed	0.076	0.264	2171	0.091	0.287	2124	0.0689
Number of children	2.527	1.571	2161	2.579	1.548	2120	0.2781
Real income	3.365	2.188	2046	2.919	1.718	2017	0.0000
Working hours	3.446	2.939	1838	3.283	2.935	1802	0.0935
BMI	27.223	5.412	2100	27.402	5.456	2076	0.2867
1 if underweight	0.007	0.083	2172	0.006	0.075	2149	0.5814
1 if optimal	0.370	0.483	2172	0.353	0.478	2149	0.2328
1 if overweight	0.349	0.477	2172	0.362	0.481	2149	0.3376
1 if obese	0.277	0.447	2172	0.282	0.450	2149	0.6986
PSS	4.282	2.831	2104	4.541	2.997	2028	0.0044
1 if urban	0.646	0.478	2128	0.656	0.475	2088	0.4971
1 if rural	0.354	0.478	2128	0.344	0.475	2088	0.4971
1 if educ1	0.464	0.499	2049	0.464	0.499	2033	
1 if educ2	0.035	0.184	2049	0.034	0.182	2033	
1 if educ3	0.215	0.411	2049	0.216	0.412	2033	
1 if educ4	0.220	0.414	2049	0.219	0.414	2033	
1 if educ5	0.065	0.247	2049	0.065	0.247	2033	

4 Methods

The relationship between the timing of responses, and the six different dependent variables previously described was estimated using logit models on a pooled sample of both waves. The dependent variables are *coronary thrombosis*; *coronary disease*; *stroke*; *hypertension*; *coronary thrombosis, coronary disease or stroke;* and *total cardiovascular disease*. Due to the rareness of coronary thrombosis, coronary disease and stroke the main focus will be on the last three. Changes in BMI, working hours, stress level, and income will also be studied as possible mediators in the relationship between the crisis and the dependent variables. A pooled model was chosen due to the importance of being able to control for age. However, possible mediators were also examined using fixed-effects analyses.

Sample weights were used in all the estimations due to oversampling of older individuals and individuals living outside the capital region. Marginal effects were calculated after all the logit estimations. In logit models the assumption of homoskedasticity is violated and thus robust standard errors that are adjusted for clustering on individuals are reported with the results from all of the models. Due to a higher rate of cardiovascular morbidity among males than females and gender differences in labour-market behaviour, all estimations were done separately for gender. All econometric analysis was conducted using the statistical software Stata 11.0 (StataCorp, 2009).

The relationship between cardiovascular diseases and conditions and the crisis is assumed to be of the following form:

$$C_{it} = \beta X_{it} + \alpha t + \varepsilon_{it}$$

where C_{it} indicates *coronary thrombosis*; *coronary disease*; *stroke*; *hypertension*; *coronary thrombosis, coronary disease or stroke;* or *total cardiovascular disease*. It is a binary variable in all cases, measuring the probability of having a cardiovascular disease or a condition for individual i in year t, equalling 1 if an individual has a particular cardiovascular disease or condition but 0 otherwise. *t* includes two time points, the year

2007 and the year 2009, with 1 representing the crisis of 2009. Thus, α captures the relationship between the crisis and each dependent variable and is therefore the main parameter of interest. α will be looked at as a causal effect of the crisis on the dependent variables rather than only a relation, since the crisis is an exogenous shock and reverse causality unlikely. β is a scalar of the parameter associated with X_{it}, but X_{it} is a matrix of a constant term and an individual's characteristics that include: age, age squared, marital status, number of children, residence, and education. When possible mediators are examined, X_{it} also includes some of the following variables; BMI, working hours, stress level, or income. In the mediation analyses it is hypothesised that the crisis causes a change in BMI, working hours, stress level, or income, which in turn causes a change in the probability of having a cardiovascular disease or condition. Finally ε_{it} is the individual specific error term. All the above models were also estimated where only age is controlled for.

5 Results

From the summary statistics for males in Table 3 it can be seen that without controlling for other factors there are statistically significant increase in the means of *coronary disease*; *hypertension*; *coronary thrombosis, coronary disease or stroke;* and *total cardiovascular disease* from 2007 to 2009. As can be seen from the summary statistics for females in Table 4, however, none of the changes in cardiovascular diseases or conditions are statistically significant.

First, models for all of the six dependent variables were estimated separately where only age was controlled for. All point estimates show marginal effects. Results from these models are reported in Table 5 for both genders. They show no statistically significant effect of the crisis on any of the cardiovascular diseases or conditions, neither individually nor grouped together.

Table 5. Logit analyses where only age is controlled for

	Males				Females			
	dy/dx	Robust SE		N	dy/dx	Robust SE		N
Coronary thrombosis:				3512				3943
t	0.0002	0.0007			-0.0001	0.0002		
age	0.0004	0.0001	***		0.0001	0.0000	**	
Coronary disease:				3494				3907
t	0.0023	0.0020			-0.0010	0.0015		
age	0.0008	0.0001	***		0.0006	0.0001	***	
Stroke:				3524				3953
t	0.0001	0.0002			-0.0010	0.0014		
age	0.0001	0.0000	*		0.0001	0.0000	***	
Hypertension:				3566				4065
t	0.0105	0.0083			0.0035	0.0063		
age	0.0062	0.0003	***		0.0079	0.0003	***	
Coronary thrombosis, coronary disease or stroke:				3638				4117
t	0.0128	0.0086			-0.0011	0.0066		
age	0.0069	0.0004	***		0.0081	0.0004	***	
Total cardiovascular disease:				3597				4065
t	0.0008	0.0017			-0.0023	0.0019		
age	0.0009	0.0001	***		0.0007	0.0001	***	

* p<0.10, ** p<0.05, *** p<0.01

Due to how few individuals had *coronary thrombosis*, *coronary disease* or *stroke*, estimates from analyses where the effect of the crisis on these dependent variables was examined show very unreliable results. The effect of the crisis on coronary thrombosis, coronary disease and stroke separately were all statistically insignificant, for both males and females. From now on in the paper, results from analyses where *coronary thrombosis*, *coronary disease,* or *stroke* is the dependent variable are only reported together, but for completeness sake the results where they are estimated separately are reported in Appendix 1.

Results from logit models estimating the effect of the crisis, taking account of age, age squared, number of children, marital status, education and residence, on *hypertension*; *coronary thrombosis, coronary disease or stroke*; and *total cardiovascular disease* can be seen in Table 6 for males and in Table 7 for females. The results show a statistically significant positive relationship between the crisis and *hypertension* for males at the 10% significance level, increasing the probability of having hypertension by 1.39% following the crisis. For females the point estimate is positive but not statistically significant. For both genders the relationship between age and hypertension is statistically significant, where the probability of having hypertension increases with higher age at a slightly diminishing rate. This shows the importance of using a model specification that can adequately account for age, to separate the effect of the aging of the sample from the crisis effect. Males that have finished primary or secondary school are less likely to have hypertension than those who have finished high school or equivalent, and as well are both men and women that have a technical- or undergraduate degree.

The crisis shows no statistically significant effect on *coronary thrombosis, coronary disease or stroke* in males or females. The coefficient is low but positive for males. However, for females the coefficient is negative which, in contrast to the results for men, suggests a lower probability of having coronary thrombosis, coronary disease or stroke in 2009 than in 2007, but these effects are not statistically significant (p-value=0.253). With age the probability of having *coronary thrombosis, coronary disease or stroke* for males increases and is statistically significant. For males there is a positive statistically significant relationship between age and *coronary thrombosis, coronary* *disease or stroke*. At the 10% significance level, divorced men are less likely to have *coronary thrombosis, coronary disease or stroke* than married or cohabiting men. Females that have low education are significantly more likely to have *coronary thrombosis, coronary disease or stroke* than females with a high school education.

Overall, the crisis had a statistically significant effect on *total cardiovascular disease* in males, increasing the probability of having any cardiovascular disease or condition between 2007 and 2009 by 1.66%. For females there is also a positive effect but only non-significant. For both genders there is a positive statistically significant relationship between age and *total cardiovascular disease*. The probability of having any cardiovascular disease or condition is lower for divorced men than married or cohabiting men. The same holds for men that have only finished primary or secondary school or have a technical- or undergraduate degree compared to those that only have finished high school or equivalent. Females holding a technical- or undergraduate degree have a statistically significant lower probability of having any cardiovascular disease or condition than those that have finished high school or equivalent.

Table 6. Logit analyses for males

	Males								
Dependent variable:	**Hypertension**			**Coronary thrombosis, coronary disease or stroke**			**Total cardiovascular disease**		
	dy/dx	Robust SE		dy/dx	Robust SE		dy/dx	Robust SE	
t	0.0139	0.0079	*	0.0006	0.0009		0.0166	0.0082	**
Age	0.0197	0.0036	***	0.0018	0.0004	***	0.0204	0.0036	***
Age squared	-0.0001	0.0000	***	0.0000	0.0000	***	-0.0001	0.0000	***
No. of children	-0.0040	0.0053		-0.0003	0.0004		-0.0044	0.0053	
1 if single	0.0068	0.0366		-0.0013	0.0027		0.0077	0.0373	
1 if steady	-0.0244	0.0406		0.0032	0.0048		-0.0260	0.0413	
1 if divorced	-0.0330	0.0245		-0.0030	0.0016	*	-0.0401	0.0242	*
1 if widowed	-0.0043	0.0339		0.0011	0.0036		-0.0064	0.0336	
1 if educ1	-0.0476	0.0199	**	0.0063	0.0040		-0.0474	0.0206	**
1 if educ2	-0.0282	0.0202		0.0031	0.0028		-0.0262	0.0210	
1 if educ4	-0.0560	0.0233	**	0.0022	0.0035		-0.0578	0.0241	**
1 if educ5	-0.0525	0.0234	**	-0.0012	0.0024		-0.0567	0.0240	**
1 if urban	0.0076	0.0135		-0.0006	0.0012		0.0060	0.0136	
N	3292			3322			3353		
Pseudo R squared	0.1190			0.1820			0.1320		

* p<0.10, ** p<0.05, *** p<0.01

Table 7. Logit analyses for females

Dependent variable:	Females								
	Hypertension			Coronary thrombosis, coronary disease or stroke			Total cardiovascular disease		
	dy/dx	Robust SE		dy/dx	Robust SE		dy/dx	Robust SE	
t	0.0060	0.0062		-0.0025	0.0022		0.0013	0.0065	
Age	0.0139	0.0032	***	-0.0004	0.0005		0.0144	0.0032	***
Age squared	-0.0001	0.0000	**	0.0000	0.0000	*	-0.0001	0.0000	**
No. of children	0.0081	0.0051		-0.0008	0.0010		0.0073	0.0052	
1 if single	0.0510	0.0378		0.0005	0.0064		0.0512	0.0381	
1 if steady	-0.0408	0.0345		-0.0017	0.0078		-0.0336	0.0365	
1 if divorced	0.0090	0.0263		0.0148	0.0106		0.0173	0.0276	
1 if widowed	0.0062	0.0213		0.0030	0.0043		0.0146	0.0227	
1 if educ1	-0.0006	0.0167		0.0172	0.0087	**	0.0064	0.0173	
1 if educ2	0.0373	0.0465		0.0106	0.0180		0.0363	0.0471	
1 if educ4	-0.0372	0.0196	*	0.0009	0.0066		-0.0373	0.0200	*
1 if educ5	-0.0571	0.0241	**				-0.0611	0.0245	**
1 if urban	-0.0100	0.0131		-0.0007	0.0131		-0.0095	0.0132	
N	3740			3430			3780		
Pseudo R squared	0.1680			0.1490			0.1680		

* p<0.10, ** p<0.05, *** p<0.01

Possible mediators in the relationship between the crisis and cardiovascular diseases and conditions were examined. BMI, stress level, working hours, and income were added to the logit models separately to shed light on their possible role in explaining the relationship between economic circumstances and cardiovascular disease or condition. A mediation effect is found if adding these variables to the models reduces the magnitude of the relationship between the crisis and the dependent variables. The results for males are reported in Table 8 and for females in Table 9 where coefficients are again reported as marginal effects.

First, results of the mediation effects on *hypertension* are looked at. Excluding mediators in the model the point estimate for the crisis is 0.0139 for males and 0.0060 for females, although the female estimation effect is not statistically significant. By adding BMI to the model the point estimate for the crisis becomes slightly higher for males, or 0.0148, and is statistically significant but for females the point estimate lowers to 0.0050. Thus, the increased probability of having hypertension from 2007 to 2009 does not seem to be explained by a change in weight for either men or women. Including working hours in the model the point estimate for the crisis becomes 0.0072 for females but lowers to 0.0105 for males. This indicates that changes in working hours explain 24.5% of the crisis effect on hypertension in males. When stress level is included in the model the point estimate lowers to 0.0109 for males. This reduction indicates that around 21.6% of the crisis effect on hypertension in males is explained by increased stress. For females the point estimate lowers to 0.0043. The point estimates remain fairly stable for both genders when income is added to the model. However, for males it slightly lowers and loses statistical significance which indicates some mediation through income.

The relationship between *coronary thrombosis, coronary disease or stroke* and the crisis is non-significant in all models, with or without possible mediators, for both genders. For males the point estimate for the crisis is very low, or 0.0006, in the model excluding possible mediators and for females the point estimate is -0.0025. There is not a large change in the coefficients when BMI is added to the model. When working hours are added to the model the point estimates slightly lower for both genders. Adding stress level to the model has as little as no effect for males but for females the point estimate reduces to -0.0036. Including income in the model lowers the point estimate to 0.001 for males and -0.0029 for females.

The effect of the crisis on *total cardiovascular disease*, or coronary thrombosis, coronary disease, stroke, and hypertension, was examined. For males the point estimate for the crisis is 0.0166 and statistically significant at the 10% significance level but for females 0.0013 and non-significant. When BMI is included in the model for men the point estimate remains fairly stable but lowers for females. Adding working hours to the model causes the point estimate for the crisis to increase for females. For males the point estimate lowers to 0.0115 which indicates that 30.7% of the crisis effect is explained by working hours. Including stress level in the model reduces the magnitude of the relationship between the crisis and *total cardiovascular disease*. For females the coefficient becomes negative. For men stress level explains 16.9% of the increased probability of having any cardiovascular disease or condition after the crisis. The probability of having any cardiovascular disease or condition after the crisis reduces to 1.44% when income is included in the model. Thus, income partly explains the increased probability of having any cardiovascular disease or condition after the crisis, or around 13.3% of the crisis effect. For females the point estimate remains similar but not statistically significant.

Potential mediators were also examined using fixed-effects analyses. The results from these analyses are reported in Appendix 2.

Table 8. Logit analyses for males, including possible mediators

	Males								
Dependent variable:	**Hypertension**			**Coronary thrombosis, coronary disease or stroke**			**Total cardiovascular disease**		
	dy/dx	Robust SE		dy/dx	Robust SE		dy/dx	Robust SE	
Without mediators:									
t	0.0139	0.0079	*	0.0006	0.0009		0.0166	0.0082	**
BMI included:									
t	0.0148	0.0077	*	0.0004	0.0008		0.0169	0.0079	**
1 if underweight				0.1709	0.2128		0.1345	0.2061	
1 if overweight	0.0501	0.0170	***	0.0015	0.0013		0.0527	0.0170	***
1 if obese	0.2020	0.0360	***	0.0055	0.0030	*	0.2113	0.0358	***
Working hours included:									
t	0.0105	0.0083		0.0003	0.0008		0.0115	0.0085	
Working hours	-0.0002	0.0020		-0.0003	0.0002		-0.0010	0.0021	
Stress level (PSS) included:									
t	0.0109	0.0081		0.0005	0.0008		0.0138	0.0084	
PSS	0.0045	0.0026	*	0.0006	0.0003	**	0.0065	0.0026	**
Income included:									
t	0.0134	0.0085		0.0001	0.0009		0.0144	0.0087	*
Income	0.0012	0.0031		-0.0007	0.0004	*	-0.0003	0.0032	

Controlled for: age, age squared, number of children, marital status, education and residence.

* p<0.10, ** p<0.05, *** p<0.01

Table 9. Logit analyses for females, including possible mediators

Dependent variable:	Females								
	Hypertension			Coronary thrombosis, coronary disease or stroke			Total cardiovascular disease		
	dy/dx	Robust SE		dy/dx	Robust SE		dy/dx	Robust SE	
Without mediators:									
t	0.0060	0.0062		-0.0025	0.0022		0.0013	0.0065	
BMI included:									
t	0.0050	0.0060		-0.0025	0.0021		0.0002	0.0063	
1 if underweight	-0.0450	0.0573					-0.0547	0.0542	
1 if overweight	0.0598	0.0174	***	0.0039	0.0037		0.0568	0.0172	***
1 if obese	0.1779	0.0267	***	0.0076	0.0051		0.1787	0.0265	***
Working hours included:									
t	0.0072	0.0063		-0.0031	0.0023		0.0022	0.0067	
Working hours	-0.0039	0.0022	*	-0.0004	0.0005		-0.0045	0.0023	**
Stress level (PSS) included:									
t	0.0043	0.0063		-0.0036	0.0022		-0.0009	0.0067	
PSS	0.0040	0.0021	**	0.0013	0.0004	***	0.0048	0.0021	**
Income included:									
t	0.0059	0.0066		-0.0029	0.0022		0.0009	0.0069	
Income	-0.0044	0.0037		0.0002	0.0011		-0.0048	0.0038	

Controlled for: age, age squared, number of children, marital status, education and residence.

* p<0.10, ** p<0.05, *** p<0.01

6 Discussion

In the current study the relationship between several cardiovascular diseases and conditions and the economic crisis in Iceland has been examined, using survey data collected by the Public Health Institute of Iceland in 2007 and 2009. The main results suggest that there is a positive relationship between the crisis and cardiovascular diseases and conditions, mainly hypertension, in males. The crisis does not seem to have any statistically or practically significant effect on cardiovascular diseases and conditions in females. The mediation analyses show that income partly explains increased probability of hypertension and total cardiovascular disease in men after the crisis. They also suggest that working hours and stress are explanatory factors in the relationship between the crisis and hypertension as well as total cardiovascular disease.

The literature on the relationship between economic conditions and cardiovascular disease has been mixed. As seen in the literature review, very few studies have focused on measures of cardiovascular health other than mortality. Therefore a direct comparison to results of other studies is subject to different outcome measures. The results from the current study are inconsistent with findings from the United States, Germany, Spain and a study on OECD countries (Gerdtham & Ruhm, 2006; Miller et al., 2009; Neumayer, 2004; Ruhm, 2000, 2004, 2007; Tapia Granados, 2005a) that find mortality due to cardiovascular disease to be lower in economic downturns. However, the results support findings from Stuckler et al. (2009) and Economou et al. (2008) from the European Union, as well as findings from Gerdtham and Johannesson (2005) and Svensson (2007, 2010) from Sweden, where cardiovascular mortality (and heart attacks) was found to be counter-cyclical. Possible explanation for differences between countries might be differences in social welfare systems, but the social welfare system in Iceland is more similar to the one in Sweden, for example, than in the United States. As in the current study, Stuckler et al. (2009) and Gerdtham and Johannesson (2005) only find an economic downturn to affect cardiovascular health among males. Guðjónsdóttir et al. (2011) showed an increase in visits to the cardiac emergency in Iceland in the weeks after the economic collapse in October 2008, which is consistent with the current study, although they only examined the short-term shock effect of the collapse. However, their results show this increase to be particularly high among females, while the current study only finds statistically significant relationship between the crisis and cardiovascular disease among males. The current study supports the idea that cardiovascular health worsens in recessions. Stressful event such as the swift economic collapse in Iceland in 2008 might affect the risk of cardiovascular events. The findings support that and suggest that increased stress, fewer hours of work, and decline in financial resources could be mediating factors in the relationship between the crisis and cardiovascular morbidity among men.

The current study has both its strengths and limitations. Every recession is unique, but the data give an opportunity to study the effects of a deep and sharp recession on cardiovascular diseases and conditions which is quite different from other studies that mainly have studied the effects of business cycle fluctuations or minor recessions. Furthermore, most other studies have only examined the effects of economic conditions on cardiovascular disease mortality, which only captures one aspect of cardiovascular health and is therefore likely to understate the full effects. Strength of this study is that it captures the effect of the crisis on cardiovascular morbidity. However, as seen in the introduction there has been a downward trend in cardiovascular incidence rates for the past few decades and therefore the results from the current study might underestimate the crisis effect.

A limitation of the study is that the data used come from a self-report questionnaire. Low response rate is also one of the main limitations of this study. Only 42.1% of the original sample answered the questionnaire in both 2007 and 2009, or 4092 individuals in total. This is especially inconvenient in the light of how few individuals had coronary thrombosis, coronary disease or stroke. Low response rate may also introduce bias into the results, although there are not major indications of selection into the sample based on matching averages. The data only include two time points, the year 2007 and the year 2009, but further effects of the economic crisis might take longer to emerge.

In recent future it might be interesting to repeat the health and lifestyle survey and examine if there have been any further changes in cardiovascular health and how these changes have been. It is clear that further research is needed before a clear picture of the relationship between economic conditions and cardiovascular disease emerges. In that context, it is important to examine the effects of recessions of different magnitudes on cardiovascular disease, as well as within different institutional settings.

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Appendix 1

Table 10. Logit analyses for coronary thrombosis, coronary disease and stroke

				Males					
Dependent variable:	**Coronary thrombosis**			**Coronary disease**			**Stroke**		
	dy/dx	Robust SE		dy/dx	Robust SE		dy/dx	Robust SE	
Without mediators:									
t	-0.00001	0.00041		0.00112	0.00096		0.00000	0.00001	
BMI included:									
t	-0.00005	0.00040		0.00094	0.00078		0.00000	0.00001	
1 if underweight	0.00929	0.01304		0.13554	0.18568				
1 if overweight	0.00165	0.00119		0.00173	0.00123		0.00000	0.00001	
1 if obese	0.00311	0.00259		0.00484	0.00296		0.00001	0.00002	
Working hours included:									
t	-0.00001	0.00035		0.00078	0.00086				
Working hours	-0.00019	0.00016		-0.00013	0.00014				
Stress level (PSS) included:									
t	-0.00011	0.00040		0.00100	0.00079		0.00000	0.00001	
PSS	0.00015	0.00017		0.00051	0.00025	**	0.00000	0.00000	
Income included:									
t	-0.00012	0.00045		0.00062	0.00092		0.00000	0.00001	
Income	-0.00020	0.00027		-0.00057	0.00037		0.00000	0.00000	
				Females					
Without mediators:									
t	-0.00004	0.00010		-0.00109	0.00162		-0.00003	0.00003	
BMI included:									
t	-0.00004	0.00010		-0.00112	0.00157				
1 if underweight									
1 if overweight	0.00002	0.00014		0.00120	0.00227				
1 if obese	0.00015	0.00031		0.00607	0.00401				
Working hours included:									
t	-0.00001	0.00002		-0.00162	0.00179		-0.00002	0.00001	*
Working hours	0.00000	0.00000		-0.00042	0.00049		0.00000	0.00000	
Stress level (PSS) included:									
t	-0.00003	0.00007		-0.00206	0.00154		-0.00004	0.00002	
PSS	0.00003	0.00004		0.00103	0.00037	***	0.00000	0.00000	
Income included:									
t	-0.00005	0.00012		-0.00154	0.00169		-0.00001		
Income	-0.00006	0.00010		-0.00053	0.00090		0.00001		

Controlled for: age, age squared, number of children, marital status, education and residence.

* p<0.10, ** p<0.05, *** p<0.01

Appendix 2

Fixed-effects methods make it possible to control for time-invariant individual heterogeneity. However, fixed-effects logit models turned out not to be very suitable for the data and linear probability fixed-effects models were used instead. A linear probability analysis was conducted and compared with the results from the logit models. The main results from the linear probability models are very similar to the ones from the logit models, and can be seen in Table 11 for both males and females.

When the data was estimated with linear probability fixed-effects models the magnitude of the crisis effect became larger in almost all estimations. The results for both genders are reported in Table 12. For males the effect of the crisis on *hypertension* and *total cardiovascular disease* is statistically significant as in the logit models but the effect of the crisis on *coronary thrombosis, coronary disease or stroke* becomes statistically significant as well. For females no statistically significant crisis effect was found in the logit models but in the fixed-effects models the effect of the crisis is larger and very statistically significant for both *hypertension* and *total cardiovascular disease*. Unobserved individual fixed effects, which are controlled for in the fixed-effects models, might explain some of the differences in the magnitude of the crisis effect between models. However, the larger crisis effects in the fixed-effects model might also be due to the aging of the sample.

In the fixed-effects models there is indication of mediation through working hours and stress in the relationship between the crisis and the three dependent variables; *hypertension*; *coronary thrombosis, coronary disease or stroke*; and *total cardiovascular disease* for males. Income also explains some of the increased probability of *hypertension* and *total cardiovascular disease* in males. The mediation analyses show small mediation effects through changes in BMI, working hours, stress level, and income on *hypertension* and *total cardiovascular disease* in women.

Table 11. Linear probability analyses, including possible mediators

Dependent variable:	Males: Hypertension			Males: Coronary thrombosis, coronary disease or stroke			Males: Total cardiovascular disease		
	dy/dx	SE		dy/dx	SE		dy/dx	SE	
Without mediators:									
t	0.0139	0.0091		0.0021	0.0038		0.0168	0.0093	*
BMI included:									
t	0.0151	0.0092		0.0017	0.0037		0.0174	0.0094	*
1 if underweight	-0.1470	0.0252	***	0.2030	0.1830		0.0731	0.1840	
1 if overweight	0.0417	0.0148	***	0.0034	0.0042		0.0434	0.0149	***
1 if obese	0.1930	0.0270	***	0.0196	0.0085	**	0.1990	0.0271	***
Working hours included:									
t	0.0105	0.0098		0.0002	0.0041		0.0113	0.0100	
Working hours	-0.0003	0.0025		-0.0020	0.0011	*	-0.0013	0.0026	
Stress level (PSS) included:									
t	0.0110	0.0093		0.0026	0.0037		0.0143	0.0096	
PSS	0.0058	0.0033	*	0.0033	0.0012	***	0.0080	0.0033	**
Income included:									
t	0.0131	0.0099		-0.0009	0.0042		0.0139	0.0101	
Income	0.0011	0.0036		-0.0030	0.0014	**	-0.0008	0.0037	
Females									
Without mediators:									
t	0.0051	0.0070		-0.0037	0.0034		-0.0004	0.0073	
BMI included:									
t	0.0045	0.0071		-0.0038	0.0034		-0.0010	0.0073	
1 if underweight	-0.0201	0.0327		-0.0074	0.0048		-0.0295	0.0323	
1 if overweight	0.0497	0.0154	***	0.0038	0.0045		0.0462	0.0153	***
1 if obese	0.1720	0.0207	***	0.0112	0.0061	*	0.1720	0.0207	***
Working hours included:									
t	0.0062	0.0075		-0.0051	0.0034		0.0001	0.0078	
Working hours	-0.0050	0.0025	**	-0.0007	0.0008		-0.0057	0.0025	**
Stress level (PSS) included:									
t	0.0031	0.0073		-0.0064	0.0034	*	-0.0031	0.0076	
PSS	0.0041	0.0024	*	0.0025	0.0009	***	0.0049	0.0024	**
Income included:									
t	0.0042	0.0077		-0.0046	0.0034		-0.0017	0.0080	
Income	-0.0059	0.0038		0.0001	0.0013		-0.0062	0.0038	

Controlled for: age, age squared, number of children, marital status, education and residence.

* p<0.10, ** p<0.05, *** p<0.01

Table 12. Linear probability fixed-effects analyses, including possible mediators

Dependent variable:	Hypertension			Coronary thrombosis, coronary disease or stroke			Total cardiovascular disease		
Males									
	dy/dx	Robust SE		dy/dx	Robust SE		dy/dx	Robust SE	
Without mediators:									
t	0.0175	0.0093	*	0.0074	0.0040	*	0.0236	0.0096	**
BMI included:									
t	0.0179	0.0093	*	0.0074	0.0040	*	0.0241	0.0095	**
1 if underweight	-0.0055	0.0095		0.2250	0.1800		0.2190	0.1780	
1 if overweight	-0.0051	0.0268		-0.0008	0.0045		-0.0088	0.0270	
1 if obese	0.0439	0.0443		0.0180	0.0140		0.0352	0.0453	
Working hours included:									
t	0.0159	0.0102		0.0051	0.0042		0.0194	0.0105	*
Working hours	-0.0029	0.0031		-0.0002	0.0014		-0.0031	0.0031	
Stress level (PSS) included:									
t	0.0152	0.0094		0.0071	0.0040	*	0.0207	0.0097	**
PSS	0.0008	0.0034		0.0023	0.0019		0.0018	0.0035	
Income included:									
t	0.0160	0.0107		0.0079	0.0045	*	0.0221	0.0110	**
Income	-0.0020	0.0053		0.0006	0.0014		-0.0017	0.0054	
Females									
Without mediators:									
t	0.0337	0.0070	***	-0.0013	0.0036		0.0259	0.0074	***
BMI included:									
t	0.0329	0.0070	***	-0.0013	0.0036		0.0256	0.0074	***
1 if underweight	0.0040	0.0216		-0.0022	0.0093		0.0091	0.0200	
1 if overweight	0.0366	0.0198	*	0.0021	0.0111		0.0219	0.0219	
1 if obese	0.0531	0.0291	*	0.0074	0.0171		0.0521	0.0324	
Working hours included:									
t	0.0328	0.0073	***	-0.0023	0.0032		0.0239	0.0078	***
Working hours	-0.0023	0.0026		-0.0005	0.0007		-0.0021	0.0027	
Stress level (PSS) included:									
t	0.0328	0.0070	***	-0.0034	0.0037		0.0244	0.0076	***
PSS	0.0000	0.0027		-0.0003	0.0011		0.0008	0.0029	
Income included:									
t	0.0318	0.0072	***	-0.0004	0.0034		0.0241	0.0077	***
Income	-0.0048	0.0042		0.0024	0.0025		-0.0046	0.0045	

Controlled for: number of children, marital status, and residence.

* p<0.10, ** p<0.05, *** p<0.01