Lifecycle effects of a recession on health behaviors: Boom, bust, and recovery in Iceland

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ABSTRACT

This study uses individual-level longitudinal data from Iceland, a country that experienced a severe economic crisis in 2008 and substantial recovery by 2012, to investigate the extent to which the effects of a recession on health behaviors are lingering or short-lived and to explore trajectories in health behaviors from pre-crisis boom, to crisis, to recovery. Health-compromising behaviors (smoking, heavy drinking, sugared soft drinks, sweets, fast food, and tanning) declined during the crisis, and all but sweets continued to decline during the recovery. Health-promoting behaviors (consumption of fruit, fish oil, and vitamins/minerals and getting recommended sleep) followed more idiosyncratic paths. Overall, most behaviors reverted back to their pre-crisis levels or trends during the recovery, and these short-term deviations in trajectories were probably too short-lived in this recession to have major impacts on health or mortality. A notable exception is for binge drinking, which declined by 10% during the 2 crisis years, continued to fall (at a slower rate of 8%) during the 3 recovery years, and did not revert back to the upward pre-crisis trend during our observation period. These lingering effects, which directionally run counter to the pre-crisis upward trend in consumption and do not reflect price increases during the recovery period, suggest that alcohol is a potential pathway by which recessions improve health and/or reduce mortality.

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1. Introduction

Pioneering work by Ruhm (2000) found that although there is considerable evidence that long-term economic growth promotes population health, short-term down-turns in economic activity counter-intuitively lead to reduced mortality. That study was based on data from the U.S. but appears to reflect a more global phenomenon; e.g., Gerdtham and Ruhm (2006) found that mortality increased during high employment or strong economic conditions in 23 Organization for Economic Cooperation and Development countries. The increasingly robust finding of lower mortality rates during economic down-turns spawned a wave of studies investigating the relationships between business cycles and health that was no doubt fueled by the Great Recession in the U.S. and many other developed countries. A number of studies have

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examined effects on health behaviors, an important potential pathway.

As pointed out by Burgard et al. (2013), the Great Recession was noteworthy in terms of its severity, and the effects of such a deep downturn may differ from those of milder past recessions. Overall, the pre-Great Recession literature indicates that mortality and morbidity are lower during economic downturns, but that mental health appears to deteriorate during periods of higher unemployment (see Catalano et al., 2011; Modrek et al., 2013), and there appears to be little consensus on the directional effects of business cycles on any health behavior, including smoking, binge drinking, and food choices (see Ásgeirsdóttir et al., 2014). However, studies of the Great Recession in the U.S. and other developed countries have revealed no effects (Barrett and O'Sullivan, 2013; Tekin et al., 2013) or procyclical effects (Urbanos-Garrido and López-Valcárcel, 2015) on self-assessed health, and mixed effects on mortality. Although van Gool and Pearson (2014) continued to find procyclical effects of poor economic conditions in countries on mortality in the context of the Great Recession, others found that this relationship no longer appeared to hold in the U.S. (Ruhm, 2013) or across countries (Toffolutti and Suhrcke, 2014), and yet another study from the U.S. found a strong association between unemployment and mortality before the Great Recession, but a marginally positive relationship during the last decade of the 2000s, among individuals age 65 and over (McInerney and Mellor, 2012). Finally, studies have continued to find a procyclical relationship between economic conditions and mental health in the context of the Great Recession (e.g., Ruhm, 2013; Toffolutti and Suhrcke, 2014; Urbanos-Garrido and López-Valcárcel, 2015; van Gool and Pearson, 2014).

Studies of the effects of the Great Recession on health behaviors represent a loose patchwork. In the U.S., Compton et al. (2014) found positive associations between individuals' employment status and substance use (alcohol, tobacco, and illicit drugs) during the Great Recession; Antillón et al. (2014) found that higher state unemployment rates during the Great Recession were associated with better sleep (less sleeplessness); and Smith et al. (2014) found that state unemployment rates (before and during the Great Recession) had no association with individuals' time spent cooking or eating away from home. Examining 23 European countries, Toffolutti and Suhrcke (2014) found no aggregate effects of unemployment during the Great Recession on alcohol consumption, although in countries with a low level of "social protection", high unemployment was related to lower alcohol consumption. In Ireland, Barrett and O'Sullivan (2013) found that smoking was lower during the Great Recession than in the pre-crisis years (2006–2007) among adults age 50+. All of these studies were based on repeat cross-sectional data; that is, they did not observe the same individuals over time.

It is useful to distinguish between individual-specific and more general effects of recessions. For example, individuals may experience job loss, asset loss, or income loss, which may affect their health behaviors. However, more broad-based aspects of recessions–such as changes in prices or availability of goods, public expenditures on healthcare, pollution, and congestion–that affect the population at large can also lead to changes in health behaviors or health. The most straightforward strategy for disentangling the two effects is the use of individual level longitudinal data that spans a time period during which a clearly defined recession occurred.

A few studies examined the unemployment-health relationship using individual-level longitudinal data, considering associations between changes in employment status and changes in health status. Böckerman and Ilmakunnas (2009), using pre-Great Recession Finnish data, found that although those who are not employed had worse self-assessed health, transitions into and out of employment were not associated with that outcome. Granados et al. (2014), using a U.S. panel from 1979 to 1997 (pre-Great Recession), found that high state unemployment rates were associated with lower mortality risk, confirming the findings of most previous studies.

Three recent studies used individual-level longitudinal data to study the effects of labor-market conditions or own unemployment on health behaviors during long time periods that included the Great Recession. Colman and Dave (2014), used two longitudinal datasets from the U.S. (PSID 1999–2009 and NLSY 1998–2010) in fixed- and random-effects estimations of the effects of own job loss on body-weight related behaviors (including cigarette smoking); the authors found evidence that job loss increased smoking among women (but not men) but decreased the number of cigarettes per day among smokers, and that job loss decreased fast food consumption. Latif (2014), using Canadian panel data from 1994 to 2009, found that higher provincial unemployment rates were associated with more binge drinking, but had no impact on the probability of being a smoker. However, none of these studies explicitly investigated effects of the Great Recession.

Ásgeirsdóttir et al. (2014) used individual-level longitudinal data to estimate effects of the 2008 economic crisis in Iceland on a large set of health-compromising and health-promoting behaviors. Observing the same individuals one year before and one year after the crisis, they found that the macroeconomic shock led to reductions in seven different health-compromising behaviors (including binge drinking and smoking), as well as a number of health-promoting behaviors such as consumption of fruit and vegetables. The authors also found that for binge drinking, smoking, consumption of sugared soft drinks, fruit and vegetable consumption, and getting recommended sleep, the broad context of the macroeconomic downturn (such as price changes) appeared to be more important than changes in individual-level factors, including work hours, mortgage debt, real income, real assets, and mental health. Using the same data and research design, similar results were found by Ólafsdóttir and Ásgeirsdóttir (2015) for other measures of alcohol consumption (including frequency of drinking) and by Ólafsdóttir et al. (2015) for other measures of smoking (including smoking intensity). For sweets, indoor tanning, fast food consumption, and consumption of fish oil,

Ásgeirsdóttir et al. (2014) found that the individual factors explained half (for fish oil) or more of the change in consumption between the pre-crisis and crisis periods.

As far as we know, no research to date has investigated the effects of economic recession on health or health behaviors beyond the immediate aftermath of the recession or after the decline has ended or reversed. In particular, it is not known whether the effects of a recession on individuals' health behaviors are short-lived or enduring. If the effects represent mere "blips" in people's health behavior trajectories, the long-term effects of recessions on health – at least through the health behavior channel – are unlikely to be consequential. On the other hand, if the effects on health behaviors persist even after economic recovery, the long-term effects of recessions on health through individuals' health behaviors could be more substantial.

In this study, we address this knowledge gap using longitudinal data from Iceland, a country that has experienced a partial recovery from a severe economic crisis, and examining a number of different health behaviors of adults at three points in time—during the boom period leading up to the crisis, during the depths of the crisis, and after the economy had to a significant extent recovered. In particular, we expand the Ásgeirsdóttir et al. (2014) study by examining essentially the same set of health behaviors but adding a third important time point, 2012, occurring after partial but significant economic recovery. As far as we know, this is the first study to investigate effects of recovery from deep recession on health behaviors or to explicitly consider whether the effects of recessions on health behaviors are short-lived or lingering. It is necessary to understand whether shifts in behaviors due to recession are temporary or persistent in order to understand the implications for longer-term mortality and morbidity.

2. The Icelandic context

The effects of the Great Recession on health and health behaviors have occurred in different structural, cultural, geographic, and policy contexts. For example, van Gool and Pearson (2014) considered the role of changes in health expenditures across countries including the U.S., France, Germany, Ireland, Iceland and Spain; Toffolutti and Suhrcke (2014) considered the role of overall social protection expenditures across countries; and Ásgeirsdóttir et al. (2014) explored the role of recession-induced price changes in Iceland. In this section, we describe the circumstances surrounding the boom, bust, and recovery in Iceland, to put the setting of the current study in context.

In 2001, the Icelandic krona became a floating currency (Kallestrup, 2008). With Iceland taking big steps toward becoming a modernized economy, foreign capital started flowing into the country. The global financial crisis hit Iceland hard in 2008 and resulted in a collapse of the nation's banking system. As a result, capital flowed out of the country until capital controls were implemented in late November 2008 (Grønn and Fredholm, 2013). Before the crisis, the country had been experiencing a boom; in the
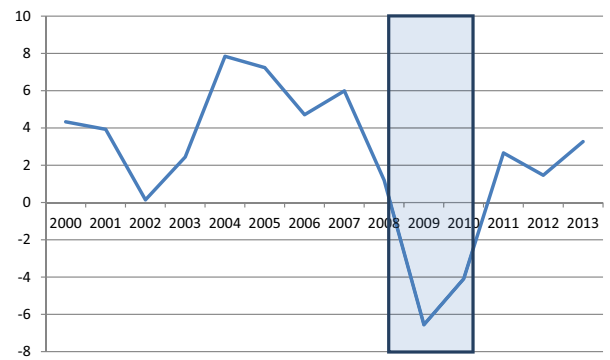

Fig. 1. Annual GDP Growth in Iceland (based on constant local currency), 2000–2013. Source: World Bank. Accessed on January 20, 2015 from: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/countries?cid=GPD_30&display=default.

four years leading up to the crisis, GDP growth averaged over 6% annually (Fig. 1). In the first year following the crisis, 2009, GDP declined by 6.5%. Based on World Bank estimates, Iceland's post-crisis rate of economic decline was not only larger than that in the United States or Britain, it was also larger than the declines in especially hard-hit countries such as Spain and Ireland (World Bank, 2014a). The recovery in Iceland also took place quickly, with a post-crisis average annual GDP growth rate of over 2%. Based on World Bank figures, GDP growth in Iceland in 2012 was above the corresponding rate in other hard-hit countries such as Spain and Ireland, and was also above the rates in less severely affected countries such as Germany and France.

Icelandic economists attribute the quick recovery to three main factors: Flexible exchange rates, a flexible labor market, and capital controls (see Ólafsdóttir and Einarsdóttir, 2013; Guðmundsson, 2013). Specific labor-market factors that are credited with preventing mass layoffs were lower nominal wages, fewer work hours, and less overtime. Iceland's dramatic recovery was lauded in international news stories. For example, Spiegel Online International credited Iceland's recovery as being "the fastest recovery on record" (Mingels, 2014, p. 2), Forbes referred to the recovery in Iceland as "a success story" deemed "fascinating" (Greenstein, 2013, p. 1 and 2), and Dow Jones reported that Iceland is "coming back strongly" (Duxbury, 2014). Based on the GDP growth statistics, domestic analyses, and news reports, it is clear that in a short period of time Iceland's economy went from boom to bust to substantial recovery.

As in many countries during the Great Recession, Iceland's unemployment rate more than doubled during the crisis (Fig. 2). The pre-crisis unemployment rate was extremely low (less than 2% in 2007), so the large percentage increase during the crisis resulted in a much lower unemployment rate than similar percentage increases in other hard-hit countries such as Ireland and Spain (World Bank, 2014b), which saw employment rates well over 10%. But while those other countries experienced deflation during the worst years of the recession, Iceland experienced substantial price increases, largely due to the
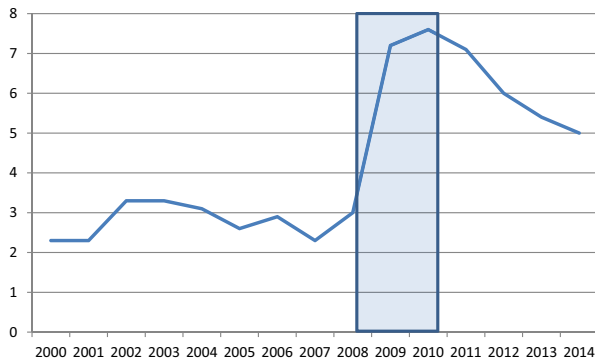
Fig. 2. Annual Unemployment Rate in Iceland, 2000–2014. *Source:* Statistics Iceland. Accessed on January 29, 2015 from: http://www.statice.is/?PageID=1191&src=https://rannsokn.hagstofa.is/pxen/Dialog/varval.asp?ma=VIN01002%26ti=Activity±rate%2C±unemployment%2C±labor±force±and±working±hours±-±yearly±1991-2013%26path=./Database/vinnumarkadur/rannsoknir/%26lang=1%26units=Number/percent.

devaluation of the Icelandic krona by about 36% in exchange markets. Consumer prices jumped over 12% between 2007 and 2008 and then another 12% between 2008 and 2009 (Fig. 3). The rise in the price level is also reflected in real wages, which fell by over 10% between their peak in 2007 and trough in 2010 (Fig. 4). These large price increases not only reduced purchasing power, but also resulted in increased debt obligations for many Icelanders as many mortgages and other debts were in foreign currencies (Ásgeirsdóttir et al., 2014). By 2010, overall consumer price increases reverted back to pre-crisis trends, and real wages returned to their pre-boom level.

It is important to note that in terms of GDP, the recovery was far from complete, as unemployment in 2012 was still relatively high, at around 6% compared to the peak of about 7.5% and the pre-recession mean of about 2.5%. However, a dramatic turnaround was heralded, likely reflecting the quick rebound of price increases to pre-crisis levels. The stabilization of prices likely restored consumer confidence
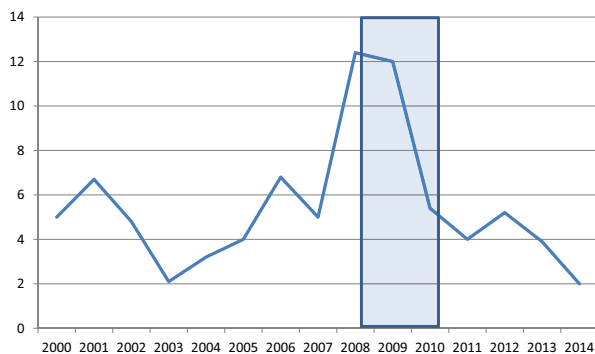

Fig. 3. Consumer Price Index in Iceland, Annual Changes, 2000–2014. *Source:* Statistics Iceland. Accessed on January 20, 2015 from: http://www.statice.is/?PageID=2932&src=https://rannsokn.hagstofa.is/pxen/Dialog/varval.asp?ma=VIS01000%26ti=Changes+in+the+consumer+price+index+from+1988%26path=./Database/visitolur/neysluverd/%26lang=1%26units=Indices%20and%20annualized%20rates.
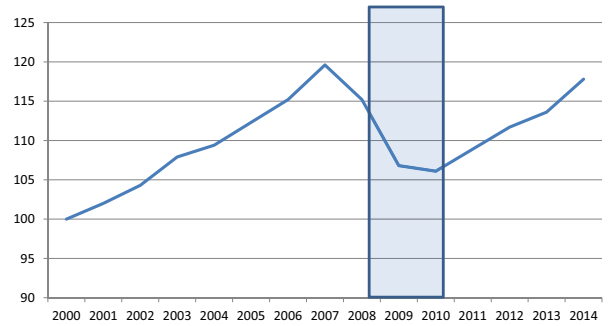

Fig. 4. Annual Average Real Wage Index in Iceland, 2000–2013. *Source:* Statistics Iceland. Accessed on January 29, 2015 from: http://www.statice.is/?PageID=1251&src=https://rannsokn.hagstofa.is/pxen/Dialog/varval.asp?ma=VIS04004%26ti=Real+wages%2C+index+1989-2014+++++++++++++++++++++++++++++++++++++++%26path=./Database/visitolur/launavisitala/%26lang=1%26units=Index/percent.

and could have interacted with even small changes in labor supply and household income to affect consumer behavior. Furthermore, while the crisis was unanticipated, there may have been anticipation effects of future increases in income and price stabilization as the recovery started to take effect.

As discussed in the literature (see Ásgeirsdóttir et al., 2014), deep recessions can affect individuals' health and health behaviors through their own circumstances, such as unemployment, or through society-wide factors such as environmental changes or changes in prices. In Iceland, while certain individuals may have become unemployed as a result of the crisis, all residents confronted large price increases, and most experienced a drop in real wages. Overall, in a relatively short period of 5 years, Icelanders experienced economic boom, then bust, then substantial recovery, with potential society-wide effects in addition to effects through changes in certain people's circumstances. These features make the Icelandic situation ideal for an individual-level longitudinal analysis of the effects of macroeconomic changes on health behaviors, which can change quickly but may take a long time to be reflected in health outcomes.

3. Data

The data used for this study come from a health and lifestyle survey "Heilsa og líðan" (Health and Wellbeing) carried out by the Directorate of Health in Iceland (previously the Public Health Institute of Iceland) in 2007, 2009, and 2012. The survey contained questions about health, illnesses, use of drugs, smoking and drinking, diet, health care, height and weight, accidents, exercise, sleep, quality of life, and other lifestyle related issues, as well as demographics and work-related factors such as work hours and income. A stratified random sample of 9807 Icelanders, ranging in age from 18 to 79 years of age, was drawn. Questionnaires were mailed at the end of October or the beginning of November in each of the survey years and almost all of the respondents returned them by the end of the given year. The net response rate in 2007 was 60.8%. Participants from 2007 who agreed to be

contacted again also received the 2009 questionnaire; 69.3% of the 2007 respondents participated in 2009. In 2012, 3246 of respondents from the original sample completed questionnaires. This represents 88.7% of those who had agreed to be contacted again for that last wave. A total of 3238 individuals, or 33.0% of the original sample, participated in all three waves of the survey.

Due to the stratification in the sampling process, the sample is somewhat older than the adult population of Iceland overall and more likely to live outside the capital region. There were six age groups by two residential groups, forming a total of 12 strata and all results presented here use sample weights to make the sample nationally representative (Jónsson et al., 2011; Guðlaugsson et al., 2014).

4. Measures

We consider 10 different health behaviors for which information was collected at all three survey waves (2007, 2009, and 2012). These include measures of substance use, diet, indoor tanning, and sleep, and largely correspond to those considered by Ásgeirsdóttir et al. (2014) for 2009 compared to 2007, with certain exceptions as noted.

For substance use, we coded individuals as smokers if they answered the question "Do you smoke?" with a yes, and as heavy drinkers if they provided information indicating at least once per month in response to the question "How often during the past 12 months, if ever, have you consumed at least 5 alcoholic drinks in one day?"[4] For dietary behaviors, we used responses to questions about how often individuals consumed various categories of food to construct measures of daily (vs. less than daily) consumption of sugar-containing soft drinks and sweets[5], weekly (vs. less than weekly) consumption of fast food (either at a fast-food restaurant or by taking home prepared foods), and daily (vs. less than daily) consumption of fruit, fish-liver oil or fish-oil capsules, and vitamins or minerals[6]. Finally, we used responses to questions about how often within the last 12 months respondents sunbathed with indoor tanning lamps or tanning beds while "scantily dressed in order to receive as much sun or radiation as possible" and how many hours a night they generally slept to create measures of indoor tanning (ever, vs. never, in the past 12 months) and optimal sleep (7–9 h of sleep per night, vs. more or less than that, based on the U.S. Centers for Disease Control and Prevention (2012) recommendation for optimal amount of sleep). Smoking, heavy drinking, sugared soft drinks, sweets, fast food, and tanning are categorized as health-compromising behaviors, and fruit, fish-liver oil, vitamins/minerals, and optimal sleep are categorized as health promoting behaviors[7].

Our models include the following time-varying socio-demographic characteristics: marital status, cohabitation status[8], household composition (other adult(s) besides partner, any children), homeownership, and rural residence (area of fewer than 1000 inhabitants), and we explore the roles of employment, income, and mental health as pathways through which the crisis may have impacted health behaviors.

The measures of labor-market activity are based on two questions. In the first, respondents were asked to describe their work arrangements. We coded individuals as not working if they answered, "I do not work." In the second, respondents were asked how many hours they generally spend each week doing paid work. They were given 13 response options, including 0, less than 1 (coded as 1), ten categories ranging from 1–3 h to 50–59 h, and a top category of 60 h or more. We used the mid-points of each of the 1–3 through 50–59 ranges and coded responses of 60 h or more as 60.

We measured income using the following question: "In what range do you estimate the total income of all household members (e.g. spouse, children and parents) in your household (including yourself) to have been generally…within the past month or within the past 12 months." The respondents were told that this amount should include "all pre-tax income, such as salaries, overtime, differentials, bonuses, interest and dividends, grants/benefits, and pensions." Icelandic benefits come in multiple forms including child benefits, housing benefits, and interest relief. The benefits generally depend on the individual's labor-market income. In the survey, the response choices for income were in ten categories measured in millions of krona, ranging from "less than 0.9 million krona" and going up to a top category of "more than 18 million krona." Mid-points of the indicated ranges were used, with a top-code for the highest category. Individuals living alone were not asked this question. For those individuals, we used the responses to a question on individual income and coded those responses similarly. The price level in Iceland rose by 27% between 2007 and 2009 and by 44% between 2007 and 2012. To investigate changes in real income, we standardized to 2007 krona. That is, 2007 real income was equal to 2007 nominal income but 2009 real income was

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[4] Having five or more drinks on one day is slightly different than the U.S. Centers for Disease Control's definition of "binge drinking," which is drinking five or more drinks in one sitting. Source: http://www.cdc.gov/alcohol/fact-sheets/binge-drinking.htm (accessed on January 20, 2015).

[5] The question asks about "sweets or chocolate."

[6] We do not consider the consumption of vegetables, which was examined by Ásgeirsdóttir et al. (2014) for 2007 and 2009, because the relevant question wording changed in 2012, precluding the construction of comparable measures across the three surveys. In addition, we consider vitamins or minerals, whereas the Ásgeirsdóttir et al. study used a measure that also considered supplements.

[7] See Lustig et al. (2012) for a discussion of consumption of sugar (not limited to soft drinks) as a health-compromising behavior. According to the U.S. Centers for Disease Control and Prevention (2013), indoor tanning has been linked with skin cancers (including melanoma, the deadliest type) and cancers of the eye. Fish oil has been studied as a protective factor for heart health and believed to be a health-promoting product since it was found that Greenland Inuit people have lower risk of heart disease despite having high-fat diets (Mayo Clinic, 2015). Consumption of fish oil has a rich tradition in Iceland, where one of the country's explicit food-based dietary guidelines is to consume fish oil or other Vitamin D sources daily (see Jeppesen et al., 2011).

[8] We include indicators for being married and for cohabiting with a partner but not being married, both compared to neither married nor cohabiting.

2009 nominal income divided by 1.27 and 2012 real income was 2012 nominal income divided by 1.44.

We created a measure of "anxiety or poor mental health" based on responses to the following two questions: (1) "Has having any of the following conditions interfered with your daily life in the past 12 months?" One of the response choices was anxiety. (2) "What is your general assessment of your mental health? Do you feel that it is very good, good, fair or poor?" If the respondent reported that anxiety interfered with his/her daily life in the past 12 months or that he/she considered his/her mental health to be poor, we coded him/her as having anxiety or poor mental health. We found that all results were insensitive to all alternative measures of mental health that could be created from the data.

Finally, in certain analyses, we include measures of the respondent's sex, age, and education. Education attainment is measured at 2009 and categorized as the U.S. equivalents of high school education or less, some college education (but not a college degree), and at least an undergraduate degree[9].

5. Methods

We exploit the economic crisis of 2008 in Iceland and the subsequent swift and substantial reversal that followed to investigate the lifecycle effects of a deep recession on health behaviors. Using 2007, 2009 and 2012 data, we estimate individual fixed-effects models, which implicitly control for all unobserved time-invariant individual-level characteristics and account for cross-period correlation in standard errors. In these models, we estimate each of the 10 health behaviors, with the key variables of interest being an indicator for 2009 to capture the effects of the crisis compared to 2007 (pre-crisis) and an indicator for 2012 to capture the effects of the recovery compared to the pre-crisis level. We estimate models without any covariates, with the set of time-varying covariates described earlier, and with both time-varying covariates and potential mediators (work hours, real household income, and mental health) to assess the extent to which those factors appear to explain the effects of the year indicators. For each outcome, we estimate models for our main analysis sample (those completing 2007, 2009, and 2012 interviews who have non-missing data on the outcome or any of the time-varying covariates or potential mediators), as well as for the subgroup of working age adults (25–61 years). Due to varying rates of missing data on outcome variables, the sample sizes are slightly different across outcomes.

To assess the potential importance of sample selection as a result of missing right-hand data items, we also estimate unadjusted models for the sample of respondents who participated in all three waves and had non-missing

data on the outcome, but may or may not have had missing data on right-hand variables. We compare results from that "full sample" to those from the main analysis sample (defined above), which is generally about one-third the size of the corresponding full sample.

Most studies of the effects of economic downturns have used such before-and-after designs, but with repeat cross-sectional, rather than longitudinal, data. As such, controlling for potential compositional changes in the population represents a key methodological challenge. Our study uses individual-level longitudinal data, allowing us to control for person-specific effects as well as relevant time-varying factors. Thus, compositional selection does not complicate our study. However, our study is potentially subject to other methodological challenges or sources of confounding: pre-existing trends in health behaviors, potentially confounding changes in factors unrelated to the crisis, aging of the sample, and sample attrition.

5.1. Pre-existing trends

Relevant trend data are available for four of the outcomes of interest. Trends in the percentage of the population 18 and over that smokes daily, pure alcohol sales per capita for individuals age 15 and above, consumption of sweets (i.e., candy, chocolate) per capita, and fruit consumption per capita, are presented in Figs. 5–8, respectively. From these figures, it is clear that the consumption of alcohol, fruit, and sweets were increasing before the crisis but subsequently declined.
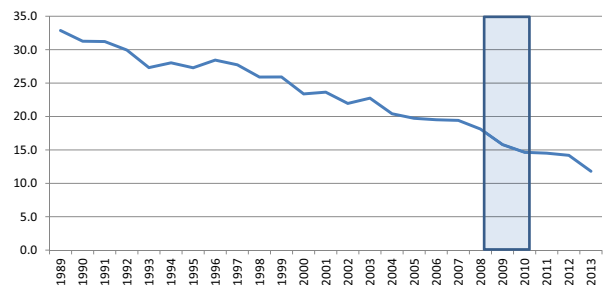
Fig. 5. Percentage of Icelanders Age 18+ Who Smoke Every Day, 1989–2013. *Source:* Directorate of Health in Iceland. Accessed January 30, 2015 from: http://www.landlaeknir.is/tolfraedi-og-rannsoknir/tolfraedi/allt-talnaefni/.
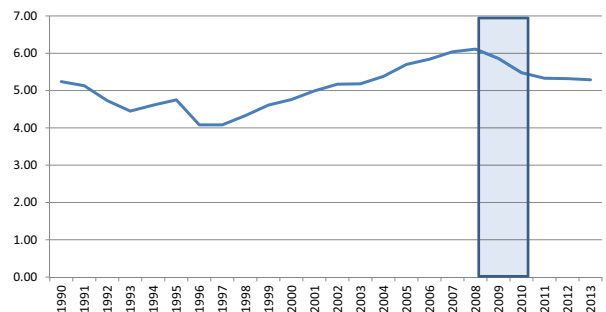
Fig. 6. Alcohol Sales Per Capita Age 15+ (Liters of Pure Alcohol) in Iceland, 1990–2013. *Source:* Directorate of Health in Iceland. Accessed January 30, 2015 from: http://www.landlaeknir.is/tolfraedi-og-rannsoknir/tolfraedi/allt-talnaefni/.

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[9] The question on education attainment was improved between waves and asked differently in 2009 than in 2007. Thus, we chose to treat education as time-invariant based first and foremost on the 2009 answers. Given the wide age range of individuals we are examining over a time period of five years, treating educational attainment as time-invariant seems reasonable, particularly for sub-analyses of working-age adults.

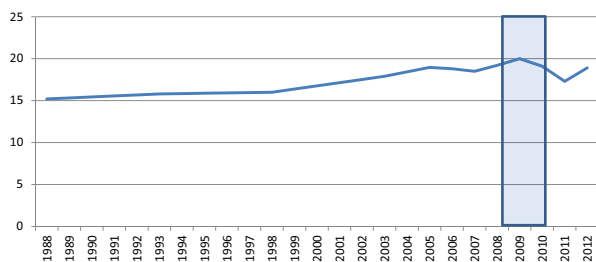**Fig. 7.** Per Capita Annual Consumption of Sweets in Iceland, kg/person/year, 1988–2012. *Source:* Directorate of Health in Iceland. Accessed on January 20, 2014 from: http://www.landlaeknir.is/tolfraedi-og-rannsoknir/tolfraedi/allt-talnaefni/
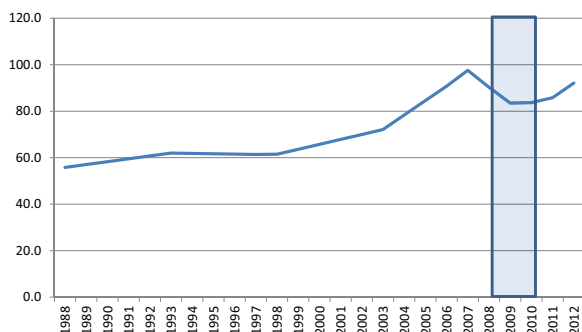Note: Values are reported once per 5 years until 2006. Values for other years are interpolated.

Fig. 8. Annual Fruit Consumption in Iceland, kg per Capita, 1988–2012 **Sources**: 1998–2010: The Directorate of Health Institute in Iceland. Accessed on January 20, 2015 from: http://www2.lydheilsustod.is/rannsoknir/matur-mataraedi-holdafar/frambod-og-sala-a-matvoru/nr/2905 2011–2012: The Directorate of Health Institute in Iceland. Accessed on January 20, 2014 from: http://www.landlaeknir.is/tolfraedi-og-rannsoknir/tolfraedi/allt-talnaefni/
Note: Values are reported once per 5 years until 2006. Values for other years are interpolated.

Alcohol and fruit consumption declined during the crisis (late 2008 through 2009), while the consumption of sweets appears to have experienced a delayed reaction, with the decline taking place after 2009. Smoking had been declining prior to the crisis, but appeared to decline more rapidly during the crisis than during the years leading up to it. These sharp reductions did not persist into the early recovery period (2010–2012). For smoking, there was a very slight decline during the early recovery, which was less than the decline during the crisis; for alcohol, there was a leveling off; and for fruit and sweets, the decline in consumption completely reversed. These aggregate statistics do not provide a picture of the effects of the crisis and recovery on individual behaviors, as the trends may be confounded by other changes. However, they provide valuable context for interpreting the findings vis-à-vis these 4 health behaviors. For the other 6 behaviors, we are not able to contextualize our analyses in this way.

5.2. Potentially confounding changes

As discussed by Ásgeirsdóttir et al. (2014), Iceland enacted a smoking ban in restaurants and bars on June 1,

2007 – five months prior to the first survey. However, those authors cited evidence that although smoking bans may impact the quantity of consumption, they do not appear to impact smoking prevalence. Thus, the smoking ban in restaurants and bars in Iceland is not expected to have affected smoking prevalence in the country. In addition, it could not explain the recovery effects for smoking or the crisis or recovery effects for most other behaviors, which were not subject to legislative changes. The only other potentially relevant structural change of which we are aware was for indoor tanning; beginning in 2011, the government enacted a ban on indoor tanning for those under 18 years of age[10]. Although this law does not directly apply to individuals in the age range we are studying, the number of tanning salons dropped by 12, or 17%, between 2009 and 2012[11]. At about the same time, Denmark, which has strong connections to Iceland, launched a skin cancer prevention campaign and saw a large decline in indoor tanning use (Køster et al., 2011). These laws and policies, and publicity surrounding them, may have increased public awareness about the health risks of indoor tanning and led to general declines in indoor tanning in Iceland that were independent of the crisis. As such, it will be important to consider our estimates of the longer-term effects of the crisis on indoor tanning (i.e., the effects of the crisis during the recovery period, which is when the bulk of the policy change took place) in light of these potentially confounding changes.

5.3. Aging of the sample

Given our reliance on longitudinal rather than repeat cross-sectional data, observed crisis and recovery effects could theoretically be picking up aging effects. That is, every single individual in the sample aged two years between 2007 and 2009 and three years between 2009 and 2012, and health behaviors can change with age, particularly at very young and old adult ages. Following Ásgeirsdóttir et al. (2014), we addressed this issue two ways (1) estimating pooled probit models with standard errors clustered on individuals that control for age and other covariates, and (2) conducting analyses on the subsample of adults who were of working age (25–61 in 2007)[12], a group for whom periods of 2–3 years should normally have small effects on behaviors.

5.4. Attrition

Although the sampling weights adjust for attrition and non-response based on gender, age, and residence to produce nationally representative data, there may be some

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[10] Source: http://www.althingi.is/altext/stjt/2010.082.html. Accessed on January 20, 2015.
[11] Source: http://hagstofa.is/Hagtolur/Fyrirtaeki-og-velta/Fyrirtaeki. Accessed on January 20, 2015.
[12] Most young adults have completed their schooling by age 25 and the standard age to receive retirement pensions in Iceland is 67. Source: http://www.ssa.gov/policy/docs/progdesc/ssptw/2010-2011/europe/iceland.html (accessed on January 20, 2014). Individuals who were under 62 in November of 2007 were under 67 in November of 2012.

important, unaccounted for, differences between stayers (respondents who completed all three surveys) and leavers (those completed the initial survey in 2007 but did not complete the 2009 and 2012 surveys) that could bias our estimates. Weighted and unweighted differences between the two groups are presented in Appendix Table A1. In the weighted sample, stayers were older and were more likely to be married, to have a child in the household, to be homeowners, to be in good or very good health, to be working, and to be professionals. In the unweighted sample, there are few significant differences between leavers and stayers, but the pattern was almost identical to that for the weighted sample. Our analyses of the working-age subsample should attenuate many of these differences.

6. Results

Health behaviors and other characteristics (weighted means) of our full analysis sample (those participating in all three survey waves and who had non-missing data on key analysis variables) and the subsample of working-age (25–61 years old in 2007) are presented in Table 1 for 2007, 2009, and 2012. Except for daily sweets, all health-compromising behaviors declined during the crisis (between 2007 and 2009) and continued to decline during the recovery (between 2009 and 2012). Fruit consumption declined between 2007 and 2009, but then increased beyond their pre-crisis level during the recovery. Recommended sleep increased between 2007 and 2009, but declined during the recovery, while use of fish oil and vitamins/minerals remained constant or increased during the crisis and continued to increase during the recovery. Patterns for the working-age sample are similar to those for the full sample.

The proportions that were married increased over time. Not surprisingly, the mean number of hours worked declined during the crisis and then increased during the recovery, but as of 2012 had not reverted back to the pre-crisis (boom) level. The proportion of the working-age sample that was employed declined during the crisis and then increased, although not quite up to the pre-crisis level. For the full sample, the proportion that was employed fell during the crisis, but did not recover during our observation period, suggesting that some older people may have decided to retire during the crisis. Real income dropped precipitously during the crisis and recovered somewhat afterward, but by 2012 was still well below the pre-crisis level. Finally, consistent with much research discussed earlier, anxiety or poor mental health increased during the crisis and then decreased during the recovery but did not revert to its boom level. Overall, these data confirm what we found in the aggregate statistics – that the economy in Iceland had recovered substantially but not completely by the end of 2012 – as well as with findings of Ball (2014) that labor-force participation does not fully revert back to pre-recession levels, even after economies recover.

In Tables 2 and 3, we present estimates from 4 linear fixed-effects regressions for each of the 10 health-related behaviors (health-compromising behaviors are in Table 2; health-promoting behaviors are in Table 3). For all models,

coefficients are presented for 2009 (crisis) and 2012 (recovery) indicators, with 2007 (pre-crisis) as the reference year. We used 2007 (pre-crisis) as the reference year because we are interested in comparing short- (2009) and longer-term (2012) effects of the crisis. However, it is also possible to obtain estimates for the recovery period by subtracting the coefficient of the 2009 indicator from that of the 2012 indicator, and we show p-values for that particular comparison (i.e., from tests for significant differences between the 2009 and 2012 coefficients) for each model. All of the estimates are from fixed-effects models, which implicitly control for time-invariant individual-level characteristics – even those that cannot be observed.

For each behavior, the estimates in Panels 1 and 2 of Tables 2 and 3 are from models that include no covariates (that is, the only right-hand-side variables are indicators for 2009 and 2012) for the full and main analysis samples (defined earlier and in table notes), respectively. Estimates from Panel 1 are very similar to those from Panel 2, suggesting that data loss as a result of missing right-hand side variables is not consequential for our analyses.

For each behavior, Panel 3 in Tables 2 and 3 shows estimates from models that include time-varying covariates: married, cohabiting with a partner but not married, child(ren) in the household, living with an adult other than a partner, homeownership, and residing in a rural area. The coefficients of the year indicators in these regressions capture the short- and longer-term effects of the crisis on individuals' health behaviors. Panel 4 shows estimates from models that also include a set of potential mediating factors that capture the most obvious ways that economic conditions would be expected to affect individuals' circumstances – hours worked, real income, and mental health[13]. As such, the models in Panels 3 and 4 of Tables 2 and 3 net out the impacts of the crisis as it (potentially) affected individual subjects and the coefficients reflect the effects of economic conditions net of those individual-level effects[14].

We guide the reader through the results for one behavior in detail (smoking, in Table 2). When no covariates are included in the fixed-effects regression based on our analysis sample (Panel 2), we find that individuals were 2.9 percentage points less likely to smoke in 2009 compared to 2007 (Row 2a) and 4.9 percentage points less likely to smoke in 2012 compared to 2007 (Row 2b). Both coefficients are significant at the 1% level, as is the difference between the two (Row 2c). When we add the time-varying covariates, the coefficients of the 2009 and 2012 indicators change little (Rows 3a & b, compared to Rows 2a & b). Finally, adding the potential mediating factors (Rows 4a & b) results in substantial reductions of

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[13] In other models, not shown but available on request, we used an indicator for employed rather than hours worked. Results were similar.
[14] Questions about assets were not included in the 2012 survey, so we are unable to account for changes in real assets as Ásgeirsdóttir et al. (2014) did for 2009 vs. 2007.

Table 1
Sample means (weighted).

	Full sample 18–79 years			Working age 25–61 years		
	2007	2009	2012	2007	2009	2012
Health-compromising behaviors						
Currently smokes	0.20	0.17	0.15	0.23	0.19	0.17
5+ Alcoholic drinks in 1 day at least 1 time/month (past year)	0.21	0.19	0.17	0.19	0.16	0.16
Daily sugared soft drink	0.09	0.08	0.06	0.08	0.06	0.06
Daily sweets	0.09	0.07	0.09	0.10	0.07	0.09
Weekly fast food	0.34	0.29	0.27	0.32	0.25	0.23
Indoor tanning (past 12 mos.)	0.21	0.18	0.11	0.19	0.15	0.09
Health-promoting behaviors						
Daily fruit	0.38	0.35	0.43	0.38	0.36	0.44
Daily fish oil	0.35	0.40	0.47	0.34	0.38	0.45
Daily vitamins	0.31	0.31	0.38	0.32	0.31	0.36
Gets recommended sleep (7–9 h/night)	0.74	0.77	0.75	0.73	0.77	0.74
Time-varying covariates						
Married	0.50	0.55	0.57	0.56	0.61	0.64
Cohabiting	0.24	0.21	0.20	0.25	0.20	0.17
Neither married nor cohabiting	0.26	0.24	0.23	0.29	0.19	0.19
Child(ren) in household	0.44	0.43	0.44	0.56	0.54	0.52
Lives with adult other than partner	0.28	0.25	0.24	0.26	0.24	0.26
Lives in rural area	0.10	0.10	0.11	0.10	0.10	0.11
Homeowner	0.78	0.78	0.79	0.85	0.85	0.85
Potential mediators						
Hours of work, mean	30.5	28.8	29.7	35.3	33.8	34.1
Currently working	0.83	0.79	0.79	0.91	0.88	0.89
Real household income (millions of 2007 krona/year), mean	7.02	5.63	5.89	7.58	6.08	6.32
Anxiety or poor mental health	0.27	0.30	0.29	0.28	0.31	0.30

Notes: Full sample includes respondents who participated in all three interviews (2007, 2009, and 2011), had non-missing data on time-varying covariates and potential mediators, and, for the health behavior means, had non-missing data for the particular behavior. Exchange rate was about 125 krona to the U.S. dollar at the end of November 2012. *Source:* http://www.cb.is/exchange-rate/ (accessed on January 20, 2015). Thus, 1 million krona translates to about $8000 U.S.

the coefficients of the 2009 and 2012 indicators (to 1.8 and 3.9 percentage points, respectively), suggesting that the effects on smoking operated to some extent through those channels.

For convenience to the reader, for each behavior, we indicate the percentage of the change in the effects of the crisis (between each pair of survey years) that resulted from including the individual-level factors (both time-varying covariates and mediators) in the model (Panel 5). For 2009 vs. 2007 and 2012 vs. 2007, the percentage of the change is computed by subtracting the coefficient for a given behavior in a given year in the model with no covariates (Panel 2; Row a or b) from the corresponding coefficient in Panel 4 (model which includes both time-varying covariates and mediators), dividing by the former, and multiplying by 100. For 2012 vs. 2009, we take the difference in coefficients between 2012 and 2009 in Panel 2, subtract the corresponding difference in coefficients in Panel 4, divide by the Panel 2 difference, and multiply by 100[15].

We find that individual-level changes in circumstances accounted for about 38% of the decrease in smoking

between 2007 and 2009 (Row 5a), and about 20% of the decrease in smoking between 2007 and 2012 (Row 5b). For the other health-compromising behaviors, individual-level changes explain less than one-quarter of the effects. For smoking, we find that the only statistically significant mediator is household income (see Appendix Table A2 for estimated effects of the crisis on the mediators and Appendix Tables A3 and A4 for estimated effects of each of the individual mediators on health behaviors).

Table 2 confirms the findings by Ásgeirsdóttir et al. (2014) – who did not restrict their sample to individuals who completed surveys in 2012 in addition to 2007 and 2009 – that all of the health-compromising behaviors declined between 2007 and 2009. In addition, we find that 5 of those 6 behaviors continued to decline between 2009 and 2012.

For 3 of the health-compromising behaviors – smoking, binge drinking, and consumption of sweets – we are able to place our findings in context vis-à-vis pre-crisis trends due to the availability of national consumption time-series data (Figs. 5–7). For smoking, the percentage of the population that smoked daily declined about 3.8 per year from 1989 until the crisis, by 8.9 per year during the crisis period from 2007 to 2010, and by about 1.6 per year during the recovery years between 2010 and 2012 (Fig. 5). Using our dichotomous measure of whether a person was a smoker, we found that the likelihood of smoking declined

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[15] These values are only meaningful when the coefficient in Panel 2 is statistically different from zero and when the absolute value of the coefficient is smaller in Panel 4 than in Panel 2.

Table 2

Short- and longer-term effects of economic crisis in Iceland on health-compromising behaviors—Fixed-effects models.

	Smoking	Heavy drinking	Daily sugared soft drink	Daily sweets	Weekly fast food	Indoor tanning
Full sample						
1. No covariates						
a. Effect of 2009 indicator	−0.032***	−0.011*	−0.011***	−0.011**	−0.028***	−0.029***
b. Effect of 2012 indicator	−0.043***	−0.018***	−0.014***	0.003	−0.034***	−0.064***
c. p-Value for difference between 2009 and 2012	0.016	0.262	0.478	0.005	0.308	<0.001
R-squared	0.012	0.001	0.002	0.001	0.005	0.024
N (person years)	**9381**	**9396**	**9447**	**9464**	**9509**	**9099**
Analysis sample, with:						
2. No covariates						
a. Effect of 2009 indicator	−0.029***	−0.021**	−0.012	−0.022***	−0.053***	−0.032***
b. Effect of 2012 indicator	−0.049***	−0.039***	−0.026***	−0.008	−0.072***	−0.101***
c. p-Value for difference between 2009 and 2012	0.008	0.060	0.076	0.099	0.099	<0.001
R squared	0.014	0.006	0.005	0.003	0.014	0.044
3. Time-varying covariates						
a. Effect of 2009 indicator	−0.029***	−0.021**	−0.013*	−0.021***	−0.053***	−0.032***
b. Effect of 2012 indicator	−0.048***	−0.036***	−0.027***	−0.008	−0.071***	−0.100***
c. p-Value for difference between 2009 and 2012	0.010	0.109	0.056	0.109	0.126	<0.001
R squared	0.016	0.021	0.009	0.008	0.023	0.061
4. Time-varying covariates plus mediators						
a. Effect of 2009 indicator	−0.018**	−0.021*	−0.010	−0.025***	−0.041***	−0.034***
b. Effect of 2012 indicator	−0.039***	−0.036***	−0.025***	−0.011	−0.061***	−0.101***
c. p-value for difference between 2009 and 2012	0.010	0.098	0.055	0.101	0.109	<0.001
R squared	0.021	0.022	0.009	0.009	0.028	0.063
N (person years)	**6438**	**6495**	**6498**	**6486**	**6555**	**6111**
5. % Of change in behavior explained by time-varying covariates & mediators						
a. 2009 vs. 2007	37.9	0.0	n/a	n/a	22.6	n/a
b. 2012 vs. 2007	20.4	7.7	3.8	n/a	15.3	0.0
c. 2012 vs. 2009	n/a	16.7	n/a	0.0	n/a	2.9

Notes: Sample weights are applied. Figures for effects of 2009 and 2012 indicators are regression coefficients. Full sample consists of respondents who participated in all three interviews (2007, 2009, and 2012) and had non-missing data on the outcome, but may or may not have had missing data on right hand variables. Analysis sample consists of respondents completing all 3 interviews who had non-missing data on the outcome and all of the time-varying covariates and potential mediators. Time-varying covariates are married, cohabiting, lives with adult other than partner, lives in rural area, and homeowner. Mediators are hours of work, real income, and anxiety or poor mental health. The percentage of the change in the effects of the crisis that resulted from including the time-varying covariates and mediators is computed by subtracting the coefficient for a given behavior in a given year in Model 2 from the corresponding coefficient in Model 4, dividing by the former, and multiplying by 100. n/a = base year coefficient is not statistically significant, so "percent of change" calculation is not meaningful, or coefficient in Panel 4 is larger than coefficient in Panel 2.

*** $p < 0.10$.
** $p < 0.05$.
* $p < 0.01$.

during the crisis years (in the range of 4.5 to 7.3% per year, depending on which model is considered) and then at a rate slightly above the pre-crisis rate (3.5 to 3.9% per year) during the recovery[16]. The national data and our regression results, together, indicate that the crisis led to a brief accelerated decline in smoking but that smoking resumed its more moderate pre-crisis rate of decline as the recovery took hold.

For alcohol, the national statistics show that consumption of pure alcohol per capita (ages 15 and above) fell between 1990 and 1996, rose from 1997 to the crisis, by about 4% per year, and then declined during the crisis and post-crisis years (by 3.1 and 1.5%, per year, respectively) (Fig. 6). We found that the likelihood of binge drinking declined dramatically during the crisis years (5% per year, regardless of the model considered) and then continued to fall at a slower rate (about 2–3% per year) during the recovery but did not revert back to the pre-crisis upward trend[17].

The consumption of sweets displayed an even different trajectory, increasing by about 1.2% from 1988 until the crisis, rising and then falling during the crisis, decreasing sharply during the recovery, and then reverting back to its pre-crisis level (Fig. 7).

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[16] For crisis years, for a given model we take the coefficient for 2009, divide by the 2007 mean for the behavior, and annualize by dividing by 2 to reflect the fact that it is a 2-year period. For post-crisis years, we take the coefficient for 2012, subtract the 2009 coefficient, divide by the 2009 mean, and then divide by 3 to reflect that it is a 3-year period.

[17] In additional models (not shown), we estimated frequency of consumption of alcoholic beverages as an alternative dependent variable. Results confirmed that alcohol consumption fell both during the crisis and during the recovery, holding constant both time-varying covariates and mediators.

Table 3

Short- and longer-term effects of economic crisis in Iceland on health-promoting behaviors—Fixed-effects models.

	Daily fruit	Daily fish oil	Daily vitamins	Recommended sleep
Full sample				
1. No covariates				
a. Effect of 2009 indicator	−0.034[***]	0.035[***]	0.002	0.026[***]
b. Effect of 2012 indicator	0.024[**]	0.112[***]	0.084[***]	0.001
c. *p*-Value for difference between 2009 and 2012	<0.001	<0.001	<0.001	0.002
R squared	0.006	0.029	0.017	0.002
N (person years)	**9545**	**9482**	**9326**	**9529**
Analysis sample, with:				
2. No covariates				
a. Effect of 2009 indicator	−0.027[**]	0.042[***]	0.002	0.028[**]
b. Effect of 2012 indicator	0.054[***]	0.117[***]	0.067[***]	0.002
c. *p*-Value for difference between 2009 and 2012	<0.001	<0.001	<0.001	0.031
R squared	0.013	0.028	0.011	0.002
3. Time-varying covariates				
a. Effect of 2009 indicator	−0.029[**]	0.045[***]	0.001	0.026[**]
b. Effect of 2012 indicator	0.049[***]	0.121[***]	0.066[***]	−0.002
c. *p*-Value for difference between 2009 and 2012	<0.001	<0.001	<0.001	0.023
R squared	0.015	0.031	0.014	0.005
4. Time-varying covariates plus mediators				
a. Effect of 2009 indicator	−0.039[***]	0.039[***]	−0.004	0.029[**]
b. Effect of 2012 indicator	0.041[***]	0.117[***]	0.063[***]	−0.000
c. *p*-Value for difference between 2009 and 2012	<0.001	<0.001	<0.001	0.018
R squared	0.017	0.032	0.016	0.011
N (person years)	**6522**	**6462**	**6333**	**6507**
5. % of change in behavior explained by time-varying covariates & mediators				
a. 2009 vs. 2007	n/a	7.1	n/a	n/a
b. 2012 vs. 2007	24.1	0.0	6.0	n/a
c. 2012 vs. 2009	1.2	n/a	n/a	n/a

Notes: Sample weights are applied. Figures for effects of 2009 and 2012 indicators are regression coefficients. Full sample consists of respondents who participated in all three interviews (2007, 2009, and 2012) and had non-missing data on the outcome, but may or may not have had missing data on right hand variables. Analysis sample consists of respondents completing all 3 interviews who had non-missing data on the outcome and all of the time-varying covariates and potential mediators. Time-varying covariates are married, cohabiting, lives with adult other than partner, lives in rural area, and homeowner. Mediators are hours of work, real income, and anxiety or poor mental health. The percentage of the change in the effects of the crisis that resulted from including the time-varying covariates and mediators is computed by subtracting the coefficient for a given behavior in a given year in Model 2 from the corresponding coefficient in Model 4, dividing by the former and multiplying by 100. n/a = base year coefficient is not statistically significant, so "percent of change" calculation is not meaningful, or coefficient in Panel 4 is larger than coefficient in Panel 2.

[***] $p < 0.10$.

[**] $p < 0.05$.

[*] $p < 0.01$.

Because pre-2007 trend data for other health-compromising behaviors are not available, it is difficult to assess whether our estimated post-crisis declines in soft drinks, fast food, and tanning represent lingering effects of the crisis or reversions to pre-crisis trends. For fast food and soft drinks, we can (imperfectly) explore this issue by considering trends in the United States. According to data from a Gallup poll (Dugan, 2013), the consumption of fast food at least weekly decreased in the U.S. by about 2% annually between 2003 and 2006. If the U.S. statistics are indicative of a global trend that included Iceland, our estimated annual decline of about 8% in Iceland between 2007 and 2009 would represent a deviation in the long-term trend (i.e., a steeper decline), but the decline between 2009 and 2012 of about 2% would be consistent with the ongoing trend. Thus, based on the available evidence, it appears the effects of the crisis on fast food consumption in Iceland were short lived. Similarly, sugared soft drink consumption declined in the U.S. between 2003 and 2007

(Kit et al., 2013). If Iceland's trend was similar to that in the U.S., then the decline in soft drink consumption in Iceland between 2007 and 2012 suggests that the effects of the crisis on soft drink consumption were short lived. For tanning, we cannot determine, or even speculate, whether the crisis effects were lingering or short lived because of the lack of trend data as well as the policy changes described earlier.

For health-promoting behaviors (Table 3), the crisis and recovery played out in behavior-specific ways. Daily consumption of fruit declined between 2007 and 2009 (Row 2a or 3a), but by 2012 had increased beyond its 2007 level (Row 2b or 3b). Comparing the relevant figures from the same sets of rows: Daily fish-oil consumption was higher in 2009 than in 2007 and higher still in 2012; daily vitamin/mineral consumption did not change between 2007 and 2009, but increased by almost 7 percentage points by 2012; and recommended sleep increased between 2007 and 2009, but reverted back to its pre-

crisis level by 2012. In all specifications for each of the 4 health-promoting behaviors, the effects of 2012 were significantly different from those of 2009 (Row 2c or 3c), indicating that the crisis and recovery were characterized by distinct phases in individuals' health-promoting behavior trajectories. The time-varying covariates and mediating factors explain about one quarter of the 2012 effect (vs. 2007) on daily consumption of fruit, but otherwise those factors explain little of the effects of the full crisis and recovery period on health-promoting behaviors (Row 5b).

Fruit consumption is the only health-promoting behavior for which we have available pre-crisis trend data. Like sweets, consumption of fruit had been increasing during the pre-crisis years, but even more dramatically. Annual consumption of fruit increased by about 3.5% per year between 1988 and the crisis, but decreased by 4.9% per year during the crisis and then increased by 5% per year during the recovery (Fig. 8). We found that the likelihood of consuming fruit daily decreased substantially during the crisis years (in the range of 3.6 to 5.1% per year, depending on which model is considered) and then rose by about 7–8% per year during the recovery. Overall, it appears that, like for smoking and sweets, the crisis induced a short term response in terms of fruit consumption that quickly reverted back to its pre-crisis trajectory. In contrast, for alcohol (the only other behavior for which we have information on pre-crisis trends) the crisis appeared to induce a change in the direction of the trajectory.

We estimated supplementary models that limited the sample to individuals who were of working age (between 25 and 61 years old in 2007), the group that should be most affected by changes in employment and for whom the 2–3 years of aging between survey waves should not have large average effects on health behaviors, as well as models that used a pooled probit specification that included controls for 2007 age, 2007 age squared, sex, and 2009 education. The results for the former, which are shown in Appendix Tables A5 and A6, are generally similar to those in Tables 2 and 3, suggesting that the aging of the main sample is not confounding our estimates. The results for the latter, which are shown in Appendix Tables A7 and A8, are quite similar to those from the fixed-effects models, providing a robustness check vis-à-vis functional form. In addition, these models indicate that while age is a significant determinant of many of the behaviors, controlling for age in the models does not substantively change the estimated effects of the year indicators, further suggesting that the estimated effects of the crisis in our fixed-effects models in Tables 2 and 3 are not substantially confounded by the aging of the sample by 2–5 years.

Finally, we estimated supplementary models for subgroups of the population – urban residents, individuals with no change in marital status, individuals who were employed as professionals, males, females, individuals with a high school education or less, college graduates, and individuals over age 50 years – as well as models using an unbalanced sample (that is, using all potential observations, whether the respondent participated in all 3 waves or only 2), models that include employment rather than hours of work as a mediator, and models that include the main set of mediators one at a time, (not shown; available upon request). The results for urban residents and for individuals who did not change marital status were very similar to those in Tables 2 and 3 because most individuals did not change marital status during the observation period and the vast majority of residents of Iceland live in Reykjavik. The results for individuals employed as professionals were also very similar to those in Tables 2 and 3 despite the relatively select sample. The magnitudes were generally larger for males than females, a finding which, for binge drinking, is broadly consistent with emerging literature suggesting that young men may be most vulnerable to substance abuse effects of recessions (Modrek et al., 2013). Relative to individuals with at least a college education, those with a high school education had larger declines in smoking and smaller declines in binge drinking. The latter – the smaller decline in binge drinking among the less educated than among the higher educated, despite similar pre-crisis means – is an intriguing finding that is worthy of further exploration. For those over age 50, magnitudes were smaller for binge drinking, fast food, and indoor tanning than for the full sample—a finding that is not surprising, given that the older cohort was less likely to engage in these behaviors before the crisis. The unbalanced sample estimates were very similar to those for the balanced sample. Including employment (rather than hours of work) had little impact on the estimated effects of the crisis and recovery on health behaviors, and models including the main set of mediators one at a time suggest that household income plays a larger mediating role than either hours worked or mental health.

7. Effects in context

We found little evidence that the observed effects of the crisis on most health behaviors operated through individual-level changes in hours worked (or alternatively, employment), real household income, or mental health, although all of these were strongly affected by the crisis. We therefore consider the potential role of more general aspects of the Icelandic economic crisis that may underlie the observed effects. A very prominent aspect of this particular crisis was prices. Currency fluctuations have always had a major impact on the lives of Icelanders, as the small and open economy relies heavily on imported goods and has its own currency[18]. Table 4 summarizes the relevant price changes during the crisis and recovery periods in Iceland. Data were available from official statistics from Iceland for overall prices, as well as for prices of tobacco, alcohol, sweets, soft drinks, and fruit. Prices for fish-oil products were collected directly from the Icelandic company *Lysi Ltd.*, which is the manufacturer of most fish oils sold in Iceland; these figures pertain to wholesale prices of 240 ml bottles of cod oil, which is the main fish oil sold as a consumer product.

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[18] The value of Iceland's imports is about half that of the country's GDP. Source: http://data.worldbank.org/indicator/NE.IMP.GNFS.ZS (accessed on January 3, 2015).

Table 4
Price changes in Iceland.

	% Increase between 2007 and 2009	% Increase between 2009 and 2012
Overall	27.3	12.8
Tobacco	40.4	18.3
Alcohol	48.7	13.0
Sweets	49.9	2.2
Soft drinks	57.1	8.5
Fruit	91.8	6.5
Fish oil	21.0	26.0

Notes: Source (for all but fish oil): Statistics Iceland. Accessed on January 20, 2015 from: http://www.statice.is/?PageID=2932&src=https:// rannsokn.hagstofa.is/pxen/Dialog/varval.asp?ma=VIS01303%26ti= Consumer±price±index%2C±subindices±from±2002%26path=./Database/ visitolur/neysluverdundir/%26lang=1%26units=Indices. Fish oil prices obtained from Lysi Ltd. via personal communication on November 25, 2014.

Overall prices increased by over 27% between 2007 and 2009. Except for fish oil, prices of all of the health-related goods in Table 4 increased by more than the overall price level between 2007 and 2009, a finding that is consistent with the declines in consumption of those goods during that period. The increased consumption of fish oil is also consistent with the decreased real price of that good. It seems likely that price increases played a major role in the effects of the crisis on health behaviors.

Prices appeared to play a much less consistent role during the recovery than during the crisis. For alcohol, consumption fell by 8% relative to its 2009 mean between 2009 and 2012, while the relative price increase (that compared to the overall price level) was close to zero. Thus, the significant drop in alcohol consumption during the recovery period cannot be explained by a price increase. For tobacco, the relative price increased substantially and consumption declined, while for sweets and fruit relative prices decreased and consumption rose. Thus, for smoking, sweets, and fruit, consumption changes followed the law of demand with respect to price changes. For soft drinks and fish oil, this was not the case; both the relative price and consumption of fish oil increased, while both the relative price and consumption of soft drinks decreased. Overall, it appears that price changes explain consumption changes during the recovery for smoking, sweets, and fruit. However, it is clear that for alcohol, soft drinks, and fish oil, factors other than prices were at work the recovery period.

Anecdotes exist about Icelanders reassessing their values and going "back to basics" as a result of the crisis. For example, there reportedly has been a return to the hobby of knitting traditional Icelandic sweaters (Helgadóttir, 2011; Mingels, 2014), increased attention to the importance of local community ties rather than material success (Willson and Gunnlaugsdóttir, 2014), and an increase in community participation (Guðbjörnsdóttir and Davíðsdóttir, 2014). For most health-compromising behaviors, we would expect that a "back to basics" movement would result in decreased consumption between 2009 and 2012. We found that this was this case, and also that consumption of fruit, fish oil, and vitamins increased between 2009 and 2012, providing some first-order support for the back to basics hypothesis.

However, we did not find increases in recommended sleep, and in supplementary analyses using responses to survey questions about how many hours per week individuals spend visiting with family or friends and engaging in arts and crafts, we found no evidence of increases between 2009 and 2012[19].

8. Conclusion

In this study, we used individual-level longitudinal data from Iceland, a country that has experienced a partial recovery from a severe economic crisis, to investigate the extent to which the effects of a recession on a large set of health behaviors are lingering or short-lived. That is, we explored trajectories in health behaviors from pre-crisis boom, to crisis, to recovery. As far as we know, this is the first study to explicitly consider the life cycle of a recession on health behaviors—a necessary undertaking for understanding the importance of health behaviors as channels of effects between recessions and health outcomes. We observed the same individuals at three highly relevant time points, allowing us to control for person-specific effects and relevant time-varying factors, explore potential mediating factors, and estimate separate crisis and recovery effects. We feel reasonably confident in ruling out important competing explanations—most notably, the aging of the sample, potential confounding trends, sample attrition, and underlying trends in health behaviors. This is a strong research design compared to much of the existing literature. Only Ásgeirsdóttir et al. (2014) used this design, but that study did not consider the recovery period or persistence of effects, which is an important substantive contribution of our study.

All of the health-compromising behaviors examined (smoking, heavy drinking, sugared soft drinks, sweets, fast food, and tanning) declined during the crisis, and all of those other than sweets continued to decline during the recovery. For health-promoting behaviors, the patterns varied considerably by behavior. Fruit consumption declined during the crisis, but sharply reversed course during the recovery to exceed its pre-crisis level. Fish-oil consumption increased during the crisis and kept increasing during the recovery. Vitamin/mineral consumption did not change during the crisis, but increased during the recovery. Recommended sleep increased during the crisis, but reverted back to its pre-crisis level during the recovery. For smoking, alcohol, sweets, and fruit, we were able to place these changes within the context of pre-crisis trends and found that: (1) Although there were sharp and substantial declines in smoking, sweets, and fruit consumption during the crisis, these behaviors largely resumed their pre-crisis trajectories (a decline for smoking and increases for sweets and fruit), but (2) the crisis led to a sharp reduction in binge drinking, which was opposite in direction from the underlying positive trend for alcohol consumption and which tapered off somewhat but lingered and remained negative during the recovery period. For soft drinks and fast food, we were

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[19] The questions about amount of time individuals spend visiting with family or friends and engaging in arts and crafts were asked in 2009 and 2012, but not in 2007. It is possible that there were increases in these activities immediately following the crisis in 2008.

able to place our estimates only in a much looser context (trends in the U.S.); based on this information, it appears that the crisis effects for these behaviors were short-lived. For tanning, the lack of trend data in concert with the potentially confounding policy effects precludes us from interpreting the large "recovery effects" as evidence that the crisis had lingering effects on that health behavior.

We found little evidence that the observed effects of the crisis on most health behaviors operated through individual-level changes in hours worked (or alternately, employment), real household income, or mental health, although all of these were strongly affected by the crisis. These factors, together, appeared to play the strongest mediating roles for smoking, sweets, fast food, and fruit, but even for these behaviors, substantial proportions of the crisis and recovery effects remained unexplained. Price changes appeared to be an important mechanism during the crisis and may be an important mechanism during the recovery for smoking, sweets, and fruit. However, price changes cannot explain the declines in binge drinking and soft drink consumption or the increase in fish oil consumption during the recovery. There is anecdotal evidence of a national shift toward a more basic lifestyle that may play a role and warrants further exploration.

It is difficult to reconcile our findings from the past literature on the effects of recessions on health behaviors for several reasons. As indicated earlier: (1) The pre-Great Recession literature reveals no consistent directional relationships between recessions and any health behavior. (2) The Great Recession was distinctive in terms of its severity, and it is not clear that findings vis-à-vis health and health behaviors from studies of business cycles or less severe recessions would be relevant in that context. (3) The literature on health behaviors in the context of the Great Recession is small and quite specific (e.g., Barrett and O'Sullivan (2013) focused on a specific age group (50+) and Antillón et al. (2014) focused on quality of sleep as opposed to optimal sleep), with very few studies on any one behavior. (4) No previous study has looked at recovery after a recession for the same individuals. Studies of the Great Recession have specifically focused on effects of the recession, and studies of business cycles have implicitly treated upswings and downswings as symmetrical, not allowing for recovery after recessions to have different impacts than recessions after booms. In our study, we observed all respondents during both the crisis and the subsequent recovery. (5) Not all economic downturns involve large price changes as in Iceland, and studies of recessions on health behaviors in other settings have not explored the relative mediating roles of labor supply, household income, mental health, and prices. It is possible that labor supply, household income, and mental health play more or less important mediating roles relative to prices in other settings.

All of that said, our findings for the effects of the crisis are largely consistent with those of Compton et al. (2014), which found positive associations between individuals' employment status and both alcohol and tobacco use during the Great Recession in the U.S., and Colman and Dave (2014), which found

that job loss led to decreased fast food consumption over years spanning the Great Recession (our smoking results are not directly comparable to those of Colman and Dave). However, they stand in contrast to findings of Latif (2014), which used Canadian panel data from 1994 to 2009 (a period that only marginally intersected with the Great Recession) and found that higher provincial unemployment rates were associated with more binge drinking, but had no impact on the probability of being a smoker. Finally, our findings for 2007–2009 are clearly consistent with those of Ásgeirsdóttir et al. (2014), which were based on the same data and largely the same health behaviors. As far as we know, there are no previous studies of longer-term effects of economic crisis or effects of recovery from deep crisis to which we can relate our findings.

As discussed above, although we found strong crisis effects on behaviors, we also found that most behaviors reverted back to their pre-crisis levels or trajectories during the recovery. These short-term deviations from previous levels and trends, if true crisis and recovery effects and not the result of confounding trends or variation in the data that we did not account for, were probably too short-lived to have major impacts on health or mortality. If smoking, soft drinks, sweets, fast food, fruit, fish oil, or sleep[20] (all behaviors with significant crisis effects that appear to have moderated as economy recovered) are important pathways between recessions and health or mortality, our results suggest that this would be the case only in situations that do not rebound as quickly as in Iceland or perhaps in places that have more limited economic and social safety nets than in Iceland. Our findings for alcohol are more suggestive of a health behavior underlying some of the relationship between recessions and health or mortality. Alcohol consumption in Iceland declined dramatically during the crisis years, continued to fall (at a slower rate) during the recovery, and did not revert back to the pre-crisis upward trend during the observation period. These lingering effects, which directionally run counter to the pre-crisis upward trend in consumption and do not reflect price increases during the recovery period, suggest that alcohol is a potential pathway by which recessions could improve health (through reductions in alcohol-related morbidity) or reduce mortality (through reduced morbidity or alcohol-induced accidents). Future research is needed to explore the role of alcohol in the recession-health relationship in other contexts as well as the mechanisms underlying relationships between macroeconomic conditions and health behaviors.

Acknowledgements

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[20] The longer-term effects of the crisis on tanning are unclear because of the potentially confounding policy changes discussed earlier.

Appendix A

Tables A1–A8.

Table A1
Characteristics of 2007 survey participants (ages 18–79 years), by attrition status.

Sample characteristics (measured in 2007)	Weighted		Unweighted	
	Leavers (did not complete all 3 interviews)	Stayers (completed all 3 interviews)	Leavers (did not complete all 3 interviews)	Stayers (completed all 3 interviews)
Age	40.07***	41.96***	43.78***	45.30***
Male	0.45	0.43	0.45	0.46
Married	0.41***	0.50***	0.57***	0.63***
Cohabiting	0.22	0.24	0.21	0.19
Child(ren) in household	0.38***	0.44***	0.52	0.51
Lives with adult other than partner	0.36***	0.28***	0.29	0.27
Lives in rural area	0.11	0.10	0.17	0.15
Homeowner	0.64***	0.78***	0.81***	0.87***
Good or very good health status	0.78***	0.82***	0.78***	0.82***
Working	0.77***	0.83***	0.87***	0.92***
Occupation				
Professional	0.42***	0.55***	0.46***	0.54***
Clerical	0.09	0.08	0.09	0.08
Service	0.19***	0.13***	0.13**	0.10**
Farm/fish	0.05**	0.04**	0.08***	0.05***
Skilled trade	0.18**	0.14**	0.17	0.17
Unskilled trade	0.08*	0.07*	0.08	0.07

Notes: p-Values are from *t*-tests for differences in means between leavers and stayers.
The sample size used in the weighted sample is slightly smaller than the unweighted sample because of missing weights. Sample size varies for each characteristic because all available data were used.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table A2
Short- and longer-term effects of economic crisis in Iceland on hours of work, real household income, and anxiety or poor mental health—Fixed-effects models ($N = 6711$ person years).

	Hours of work		Real household income		Anxiety or poor mental heath	
2009 indicator	−1.694***	−1.861***	−1.396***	−1.400***	0.029**	0.030**
2012 indicator	−0.825	−1.078*	−1.132***	−1.163***	0.014	0.017
R squared	0.003	0.009	0.129	0.182	0.002	0.003
Time-varying covariates	No	Yes	No	Yes	No	Yes

Notes: Sample weights are applied. Figures are regression coefficients for effects of the crisis (2009 and 2012 indicator) relative to 2007. Time-varying covariates are married, cohabiting, lives with adult other than partner, and lives in rural area.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table A3
Estimated effects of mediators on health-compromising behaviors—Fixed-effects models.

	Smoking	Heavy drinking	Daily sugared soft drink	Daily sweets	Weekly fast food	Indoor tanning
Hours of work	0.000	0.001	−0.000	−0.000	0.001*	0.000
Real household income (millions of 2007 krona/year)	0.008***	−0.001	0.002	−0.002	0.007*	−0.000
Anxiety or poor mental health	−0.003	−0.005	−0.001	0.003	−0.026	0.030*
R squared	0.021	0.022	0.009	0.009	0.028	0.063
N (person years)	**6438**	**6495**	**6498**	**6486**	**6555**	**6111**

Notes: Sample weights are applied. Figures presented are regression coefficients of the mediators from the models in the last rows of Tables 2 & 3. That is, for each behavior, all mediators are included in the same model that also controls for time-varying covariates (married, cohabiting, lives with adult other than partner, homeowner and lives in rural area).
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table A4

Estimated effects of mediators on health-promoting behaviors—Fixed-effects models.

	Daily fruit	Daily fish oil	Daily vitamins	Recommended sleep
Hours of work	0.001	−0.001	−0.001	0.001***
Real household income (millions of 2007 krona/year)	−0.008**	−0.003	−0.001	−0.000
Anxiety or poor mental health	−0.013	0.009	0.030	−0.046***
R squared	0.017	0.032	0.016	0.011
N (person years)	**6522**	**6462**	**6333**	**6507**

Notes: Sample weights are applied. Figures presented are regression coefficients of the mediators from the models in the last rows of Tables 2 and 3. That is, for each behavior, all mediators are included in the same model that also controls for time-varying covariates (married, cohabiting, lives with adult other than partner, homeowner, and lives in rural area).

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

Table A5

Short- and longer-term effects of economic crisis in Iceland on health-compromising behaviors—Fixed-effects models for subsample aged 25–61 years.

	Smoking	Heavy drinking	Daily sugared soft drink	Daily sweets	Weekly fast food	Indoor tanning
Analysis sample, with						
No covariates						
Effect of 2009 indicator	−0.040***	−0.026**	−0.017**	−0.026***	−0.069***	−0.037***
Effect of 2012 indicator	−0.054***	−0.028**	−0.022***	−0.012	−0.094***	−0.094***
p-Value for difference between 2009 and 2012	0.109	0.865	0.509	0.145	0.050	<0.001
R squared	0.017	0.004	0.004	0.004	0.024	0.039
Time-varying covariates						
Effect of 2009 indicator	−0.041***	−0.027***	−0.016*	−0.026***	−0.069***	−0.040***
Effect of 2012 indicator	−0.055***	−0.029***	−0.021**	−0.013	−0.094***	−0.100***
p-Value for difference between 2009 and 2012	0.111	0.799	0.534	0.159	0.047	<0.001
R squared	0.021	0.014	0.009	0.008	0.034	0.058
Time-varying covariates plus mediators						
Effect of 2009 indicator	−0.029***	−0.020*	−0.013	−0.028***	−0.066***	−0.039***
Effect of 2012 indicator	−0.045***	−0.023**	−0.018**	−0.014*	−0.092***	−0.099***
p-Value for difference between 2009 and 2012	0.111	0.790	0.534	0.156	0.046	<0.001
R squared	0.025	0.018	0.009	0.009	0.035	0.059
N (person years)	**4503**	**4539**	**4512**	**4491**	**4536**	**4257**

Notes: Analysis sample consists of respondents completing all 3 interviews who had non-missing data on the outcome and all of the time-varying covariates and potential mediators. Time-varying covariates are married, cohabiting, lives with adult other than partner, lives in rural area, and homeowner. Mediators are hours of work, real income, and anxiety or poor mental health.

*** $p < 0.10$.

** $p < 0.05$.

* $p < 0.01$.

Table A6

Short- and longer-term effects of economic crisis in Iceland on health-promoting behaviors—Fixed-effects models for subsample aged 25–61 years.

	Daily fruit	Daily fish oil	Daily vitamins	Recommended sleep
Analysis sample, with:				
No covariates				
Effect of 2009 indicator	−0.024	0.046***	−0.004	0.034**
Effect of 2012 indicator	0.059***	0.113***	0.048***	0.006
p-Value for difference between 2009 and 2012	<0.001	<0.001	0.001	0.049
R squared	0.014	0.025	0.006	0.003
Time-varying covariates				
Effect of 2009 indicator	−0.025*	0.048***	−0.005	0.029**
Effect of 2012 indicator	0.056***	0.115***	0.045***	−0.003
p-Value for difference between 2009 and 2012	<0.001	<0.001	0.002	0.031
R squared	0.018	0.029	0.010	0.007
Time-varying covariates plus mediators				
Effect of 2009 indicator	−0.032**	0.037**	−0.017	0.034**
Effect of 2012 indicator	0.050***	0.106***	0.035**	0.002
p-Value for difference between 2009 and 2012	<0.001	<0.001	0.002	0.030

Table A6 (*Continued*)

	Daily fruit	Daily fish oil	Daily vitamins	Recommended sleep
R squared	0.019	0.031	0.014	0.012
N (person years)	**4512**	**4467**	**4428**	**4503**

Notes: Sample weights are applied. Figures for effects of 2009 and 2012 indicators are regression coefficients. Analysis sample consists of respondents completing all 3 interviews who had non-missing data on the outcome and all of the time-varying covariates and potential mediators. Time-varying covariates are married, cohabiting, lives with adult other than partner, lives in rural area, and homeowner. Mediators are hours of work, real income, and anxiety or poor mental health.

*** $p < 0.10$.
** $p < 0.05$.
* $p < 0.01$.

Table A7
Pooled probit results—effects of economic crisis in Iceland on health-compromising behaviors.

	Smoking	Heavy drinking	Daily sugared soft drink	Daily sweets	Weekly fast food	Indoor tanning
	ME	ME	ME	ME	ME	ME
2009 Indicator	−0.026***	−0.012	−0.003	−0.019***	−0.027**	−0.013
2012 Indicator	−0.044***	−0.016	−0.004	−0.001	−0.004	−0.058***
Age	0.013***	−0.009***	−0.006***	−0.001	−0.022***	−0.010***
Age squared	−0.000***	0.000*	0.000	0.000	0.000**	0.000
Male	−0.019	0.191***	0.040***	−0.012	0.161***	−0.082***
High school or less	0.176***	0.027	0.085***	−0.022	−0.030	0.128***
Some college	0.099***	−0.011	0.044**	−0.008	0.049	0.110***
Undergraduate degree	0.037	−0.014	0.002	0.010	0.046	0.035
Pseudo *R* squared	0.028	0.071	0.099	0.017	0.159	0.143
N	**6432**	**6486**	**6629**	**6480**	**6549**	**6108**

Notes: Sample weights are applied. "2009 indicator" captures the effect of the crisis (relative to 2007). ME = marginal effect.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table A8
Pooled probit results—Effects of economic crisis in Iceland on health-promoting behaviors.

	Daily fruit	Daily fish oil	Daily vitamins	Recommended sleep
	ME	ME	ME	ME
2009 indicator	−0.039***	0.027*	−0.009	0.026**
2012 indicator	0.029**	0.077***	0.041***	−0.002
Age	0.007*	−0.002	−0.001	0.001
Age squared	−0.000	0.000***	0.000**	−0.000
Male	−0.206***	−0.060***	−0.219***	−0.020
High school or less	−0.111***	−0.088***	−0.048	−0.111***
Some college	−0.069**	−0.047	−0.017	−0.063**
Undergraduate degree	−0.018	−0.025	−0.045	−0.043
Pseudo *R* squared	0.048	0.072	0.062	0.006
N	**6516**	**6456**	**6327**	**6498**

Notes: Sample weights are applied. "2009 indicator" captures the effect of the crisis (relative to 2007). ME = marginal effect.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

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