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Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2012-001386
Article Type:	Research
Date Submitted by the Author:	26-Apr-2012
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Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Public health, Epidemiology, Mental health, Health economics, Addiction
Keywords:	PUBLIC HEALTH, Adult psychiatry < PSYCHIATRY, EPIDEMIOLOGY, MENTAL HEALTH, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

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Abstract

Objective To determine whether the strains of a national economic collapse affect smoking secession and risk of smoking relapse in the population.

Design A population-based, prospective cohort study based on a mail survey (*Health and Wellbeing in Iceland*) assessed in 2007 and 2009.

Setting National mail survey

Participants Representative cohort (n=3755) of Icelandic adults.

Main outcome measure Smoking status.

Results A significant reduction in the prevalence of smoking was observed from 2007 (pre-collapse) to 2009 (post-collapse) in both males (17.4% to 14.8%; P 0.01) and females (20.0% to 17.5%; P 0.01) in the cohort (n= 3755). An increase in perceived stress levels from pre- to post-collapse was associated with the risk of smoking relapse (odds ratio 2.08; 95% confidence interval 1.32, 3.30), as was an increase in income from pre- to post-collapse among males (OR 6.53; 95% CI 1.58, 26.95). Conversely, male former smokers experiencing a reduction in income were less likely to relapse (OR 0.23; 95% CI 0.08, 0.62). Regarding the propensity of pre-collapse smokers to quit in the period after the collapse, female smokers were less likely to quit compared to males (OR 0.67; 95% CI 0.52, 0.87).

Conclusions In line with on-going secular trend, the overall prevalence of smoking continued to decrease following the 2008 economic crisis in Iceland. Increase in psychological stress and income during the period 2007-2009 were strongly associated with having relapsed in 2009, particularly among men.

Article Summary

Article Focus

- An examination on the association between economic crises and smoking behaviours, i.e. is a change in income related to a change in smoking status?
- What is the role of stress change on an individual's propensity to relapse or quit smoking?

Key Messages

- Evidence for the association between increased income and increased risk of smoking relapse following an economic collapse.
- Evidence for an association between decreased income and decreased risk of relapse.
- Gender differences in smoking—represented by higher female prevalence rates and decreased likelihood of quitting for females compared to males.

Strengths and limitations of this study

- A representative prospective cohort study assessed at two time points, which straddle the start of a severe economic crisis.

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- Due to the low number of individuals that change their smoking behaviours in a short period, we were unable to assess the effects of an unemployment change on smoking habits.

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Introduction

The Icelandic economy was severely affected by the global economic collapse of 2008. After a decade-long period of financial prosperity the nation was plunged into a recession of such severity that similar contractions had only been seen a handful of times before.[1 2]

Previous research on the health consequences of the Icelandic economic collapse has suggested adverse impacts on cardiovascular and mental health among women.[3 4] In the broader literature on economic crises and population health, however, it has been debated whether health moves in a pro-cyclical or counter-cyclical direction to macro-economic conditions. The work of Brenner beginning in the 1970s suggested that mortality is counter-cyclical, i.e. when the economy is down, mortality rates – in particular, suicides – rise.[5] However, in more recent years, a series of econometric studies have suggested that mortality is pro-cyclical, i.e. during economic contractions death rates decline.[6 7 8 9] There are plausible reasons for this unexpected finding – for instance, during the 1998 Korean financial crisis, economic activity was so depressed that there was a detectable decline in traffic-related mortality.[10] Others have speculated – without direct evidence – that people are more likely to be over-worked and "stressed" during economic booms than during busts, having less time flexibility to engage in health promoting behaviours.[11 12]

Few studies, however, have used individual-level data to test the association between recession and health. Most of the evidence to date has been at the ecological level. Using U.S. data, Ruhm previously reported that economic recession was associated with a decline in the prevalence of cigarette smoking.[12] In the present study, we took advantage of the natural experiment afforded by the Icelandic crisis to examine the relationship between changes in economic conditions and smoking behaviour. Utilizing a prospective cohort of Icelandic adults assessed before (in 2007) and after the start of the collapse (in 2009), we sought to examine the risk of relapse among pre-collapse former smokers, as well as quitting behaviour among current smokers.

Methods

Design and Samples

Cohort

Our cohort is based on the *Health and Wellbeing in Iceland* health survey. Data was collected by a questionnaire in two waves: (1) from October to December of 2007 (10-12 months pre-collapse), then again (2) between November and December of 2009 (13-14 months post-collapse). The cohort was based on a stratified random sample of the Icelandic population (n=9807), which was selected from 12 strata: consisting of two geographic regions further stratified by six age groups. Of the initial 9807, a total of 5918 responded to the initial 2007

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assessment (response rate of 60.3%), with 4092 responding again to the modified version of the survey in 2007 (response rate of 82.8% of those who responded to the pre-collapse baseline survey). Because of the importance of stress as a potential predictor of smoking behaviour, we excluded individuals who did not have complete responses to the *Perceived Stress Scale* in both 2007 and 2009. This left a final analytical sample of n=3755. Figure 1 shows the cohort attrition over questionnaire waves.

Measures

Smoking status and behaviour

In the questionnaire, we inquired about smoking status, i.e. whether respondents were current smokers, had quit smoking, or had never smoked. In order to examine the likelihood of relapsing or quitting following an economic collapse, respondents were stratified according to their smoking status: non-smoker, relapsed, and quit smoking.

Non-smoker: An individual was classified as a non-smoker if they responded that they did not currently smoke on both the 2007 and 2009 assessments.

Relapsed smoker: An individual was identified as relapsed if they indicated that they (a) were a former smoker on the 2007 questionnaire, but indicated they had (b) smoked in any frequency in 2009. In our analyses estimating the odds ratios of relapse, the base population was restricted to individuals who were former smokers at baseline.

Quit smoking: A respondent that had quit smoking must have indicated that they were (a) currently smoking in 2007, yet had (b) quit smoking by 2009. In our analyses estimating the odds ratios of quitting, our base population was restricted to individuals who were current smokers at baseline.

Change in economic status

Additional socio-economic questions pertained to employment and income status. Employment status was categorized into either (1) employed or (2) unemployed. Household income was classified into income ranges of (in terms of Icelandic currency; *ISK*) (1) low ($\leq$ 3.4 million ISK), (2) middle (3.5-9.4 million ISK), and (3) high ($\geq$ 9.5 million ISK); corresponding approximately to (1) $\leq$ 28,000 USD, (2) 28,000-77,000 USD, and (3) $\geq$ 77,000 USD. For analysis of income change, household income was further dichotomized into either high or "low" (which combined the middle & low income categories). We examined two types of income change: a) drop in income between 2007 and 2009 from high to low; and b) a rise in income between 2007 and 2009 from low to high.

Change in perceived stress

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Psychological stress was measured in both 2007 and 2009 using the four-item Perceived Stress Scale (PSS-4).[13] The PSS-4 is a shortened, validated, and acceptable substitute for the original scale,[14] with scores ranging from 0-16; the higher the score, the higher the perceived stress. An increase in stress was classified as any increase from baseline to follow-up; conversely, a decrease was classified as any decrease from baseline to follow-up. For example, an individual with a score of 5 in 2007 and a score of 10 in 2009, would be classified as having an increase in stress.

Explanatory variables and demographics

Our regression models controlled for the following socio-demographic covariates: age, sex, marital status, and education. Education was categorized as (1) basic (completed primary school or less), (2) middle (completed high school or equivalent), and (3) university (a completed university degree).

Statistical analyses

Table 1 presents the distribution of socio-demographic characteristics according to change in smoking status between 2007 and 2009.

Binary logistic regression was used to estimate ratio of odds (corresponding 95% confidence intervals) of relapse in 2009 (table 2), and the odds of quitting smoking in 2009 (table 3) by background characteristics, change in income and stress levels. Analyses were also stratified by gender. Models were adjusted for age, sex, marital status, and educational level; models for household income-specific odds were additionally adjusted for the number of adults in the household. As previous research supports the role of stress as a mediator of an individual's propensity to relapse,[17 18 19] we also ran models of relapse with and without the inclusion of change in stress levels between 2007 and 2009.

Repeated measures ANOVA (p-values, F statistic) was used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009 (table 4). Statistical analyses were conducted with IBM SPSS Statistics version 19.0 (SPSS Inc, Chicago, Illinois). Statistical significance was set at the 0.05 level, and all tests were 2-tailed.

Results

Baseline characteristics

Table 1 describes the baseline characteristics of the cohort in 2007 (n=3755), which was 53.0% female, 76.7% married/cohabiting, and with a mean (SD) age of 52.3 (16.0). Table 1 also describes the characteristics of those that had relapsed and quit: 72.2% (n=2711) of the cohort were non-smokers, 4.0% (n=56) of the former smokers at baseline had relapsed in 2009, and

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22.2% (n=149) of smokers at baseline had quit smoking in 2009. A significant reduction ($p<0.01$) in the prevalence of smokers was observed from 2007 to 2009 in both males (17.4% to 14.8%) and females (20.0% to 17.5%).

Relapse smoking

Among individuals who were former smokers at baseline (table 2), an increased risk of relapsing in 2009 (after the collapse) was observed in the younger age groups (compared to those aged 50-59), specifically among females aged 18-29 (3.70; 1.21, 11.27) and males aged 30-39 (2.89; 1.07, 7.82). Further age-stratification found that men over 70 years of age were significantly less likely to relapse (0.14; 0.03, 0.62).

While an individual's change in employment status from 2007 to 2009 was not involved in risk of relapsing, males receiving disability pension (compared to the employed) were less likely to relapse (0.13; 0.03, 0.62), while retired females showed significant increased risk of relapsing (5.30; 2.01, 13.98), compared to the employed.

Among men in the lower income groups at baseline (i.e. low, middle), those who moved into the high income group in 2009 experienced an increased risk of relapse (6.53; 1.58, 26.95)—while among those in the high income group at baseline, those whose incomes dropped had a decreased risk of relapsing (2.82; 1.17, 6.83). Further adjustments for a change in stress levels from 2007 to 2009, showed some attenuation in the coefficients, suggesting some mediation by perceived stress – i.e. former smokers whose incomes increased between 2007 and 2009 may have relapsed in part because of an increase in stress.

Smoking cessation

Women were less likely to quit smoking in 2009 (0.67; 0.52, 0.87), compared to males. An increased likelihood of quitting in 2009 was observed among the following female groups: those with middle (2.16) or university-level (2.50) education compared to a basic, and the disabled (4.73) compared to the employed. Additionally, compared to aged 50-59, females in the youngest (3.83; 1.51, 9.72) and oldest groups (4.72; 1.47, 15.12) were considerably more likely to quit.

Stress and smoking

With regard to the potential role of stress on an individual's likelihood of relapsing or quitting, males showed an association between an increase in stress from 2007 to 2009 and odds of relapse (2.82; 1.17, 3.30). Additional adjustments for a change in stress among the risk of relapse did not significantly alter the effect sizes.

Though stress change did not predict a relapse in females, further examination of changes in stress levels among smoking status, displayed a significant change in mean stress levels (SD)

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among females that had relapsed, with a significant increase in stress scores from 3.96 (2.52) in 2007 to 5.24 (3.46) (P 0.01; F = 7.67).

Discussion

In response to the severe economic collapse in Iceland, we found that the prevalence of smoking continued to decrease for both genders in the short period after. This drop in smoking may be attributed to background secular trends,[15] while other factors, such as changes in the price of cigarettes, change of priorities in the favour of more health promoting behaviours or anti-smoking campaigns, may also play a role. The strength of our study is that we were able to document changes in individual economic status – as well as perceived stress – straddling the economic downturn and link these exposures to individual changes in smoking habits. Additionally, in comparison to national smoking rates (2007: 23.0% of population; 2009: 19.0%) the prevalence rates from 2007 to 2009 of this sample are relatively analogous – offering support for the generalizability of the sample.

Our findings partially corroborate previous research on the pro-cyclical nature of the association between economic downturns and smoking habit, i.e. during recessions, smoking habits may be dampened. Among male former smokers, those who experienced a decline in income during the economic recession had a significantly lower risk of relapse two years later. Conversely, among men whose incomes or stress levels increased during the period of recession, their risk of relapse was considerably higher compared to those whose incomes stayed the same. Although the direction of associations was similar among women, none of the estimates were statistically significant.

Taken together, the main significant finding of our analyses is that male former smokers whose incomes fell during the period of the economic collapse experienced a reduced risk of relapse. Ruhm hypothesized that this risk reduction is possibly driven by a tendency to adopt healthier behaviours during periods of reduced income – driven by an increase in positive health behaviours (i.e. exercise) that accompanies newly acquired increased leisure time during economic contractions.[16] It could also be argued their behaviour change in a recession can be either intentional or inadvertent. When facing enforced economic inactivity – individuals may choose to fill their time by actively investing in positive personal health changes, which include stopping smoking or joining a fitness club. It is equally plausible that a drop in income involuntarily forces smokers to give up their habit. However, our results did not indicate an increased risk of quitting among those whose incomes fell, which is not consistent with the latter hypothesis.

Foremost, our findings support Ruhm's theory of the positive effects of recessions on a population's health behaviours.[Error! Bookmark not defined.] Ruhm revealed an association between markers (e.g. unemployment) of economic downturns and reductions in smoking, with an

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increase being seen during economic expansion. Though tobacco products are likely to be procyclical goods, as Ruhm further points out, offering some explanation of the decrease we observed, it does not explain all of the mechanisms involved.

We caution that our findings regarding recession, income change, and smoking habits cannot be generalized to other health outcomes. For example, observational reports found a spike in female cardiac emergency visits during the week corresponding to the economic collapse in October of 2008.[3] In accordance with this, our previous analysis on changes in mental health revealed significant increases in stress for mainly women.[4] This increase in stress for women, however threatening of related health outcomes, did not prove to be associated with an increased likelihood of relapsing.

Our findings are also congruent with multiple models explaining the link between stress levels and smoking behaviour. Though much research shows stress as a cause of smoking,[17 18] additional research actually points to cigarette smoking as a cause of stress and, furthermore, smoking cessation as leading to a reduction in stress.[19] This is in line with our findings, as both male and female relapsed smokers had the lowest levels of stress before the collapse when they considered themselves as having quit smoking in 2007 (table 4), yet experienced an increase in stress post-collapse—significantly for women. This may also point to a vulnerability of this group to use smoking as a means of alleviating stress—explaining their relapse in smoking after the collapse.[20] This vulnerability has been discussed and supported by previous research showing economic stress as a cause of adverse mental health.[21] This increased stress may have also been amplified by a return to smoking, as Cohen & Lichtenstein have found.[22] Caution is warranted in interpreting the findings on stress, however, since smokers may be citing an increase in perceived stress to justify their relapse or failure to quit.

Study limitations

Some limitations of our study should be noted. Relapsed smokers and quitters represent a small proportion of the population, and hence our odds ratios were estimated with imprecision. Similarly, we lacked statistical power to directly examine the effects of a change in employment status on change in smoking habits. In other words, though we were able to examine the effects of income change, we were not able to directly estimate the effects of unemployment as there were too few individuals in the sample who lost their jobs between 2007 and 2009. Finally, smoking status was based on self-report only, and not validated by biomarkers such as cotinine. This may have produced misclassification of the outcome, though it is not clear whether this misclassification was differential by exposure status (e.g. income changes).

Conclusions

Our large population-based cohort with assessment points straddling the 2008 economic crisis in Iceland revealed a reduction in smoking rates from the short periods before and after the start of the crisis - though our study could not disentangle the direct effects of the crisis with other

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mechanisms, e.g. secular trends, changing cigarette prices. Chiefly, this examination revealed a decisive role of income change and perceived stress on the risk relapsing after the collapse among former male smokers.

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Notes

Contributors: CM and IK (study guarantor) were responsible for the design of the study and preparation of the manuscript. CM conducted data analyses. AH and UV obtained funding. All contributors interpreted the data, contributed to the writing of the paper and approved the final version of the manuscript.

Funding: The project was funded in part by the Icelandic Centre for Research (RANNÍS). The authors are responsible for the manuscript's content, not the funding bodies.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare:, no other authors had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years.

Ethical approval: The study was approved by the Ethics Review Board of Iceland (09-094) and the Data Protection Authority of Iceland (S4455).

Data sharing: No additional data available.

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Figures and Tables

Figure 1- The cohort of the "Health and well-being"-study.

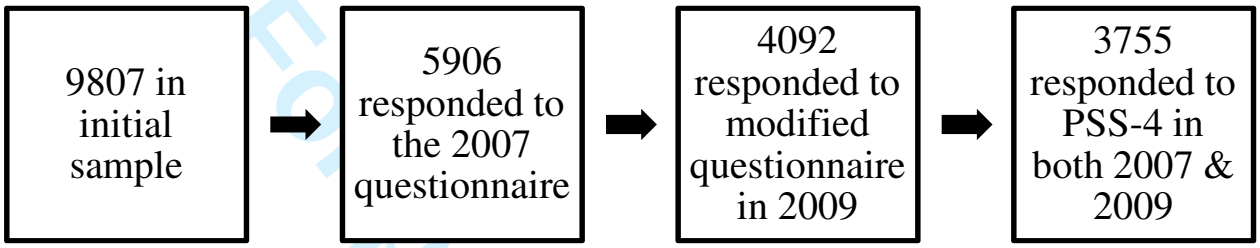

Table 1 – Baseline characteristics (in 2007) of the cohort and among differential smoking status

	Cohort	Relapsed in 2009	Quit Smoking in 2009
n	3755	56	160
Age Mean ± SD	52.3 ± 16.0	45.7 ± 14.2	47.4 ± 15.5
Sex		**n (%)**	
Male	1763 (47.0)	31 (55.4)	82 (51.3)
Female	1992 (53.0)	25 (44.6)	78 (48.8)
Marital status			
Single/Divorced	556 (14.9)	7 (12.5)	31 (19.4)
Committed, not cohabiting	131 (3.5)	2 (3.6)	9 (5.6)
Married, cohabiting	2871 (76.7)	45 (80.4)	116 (72.5)
Education			
Basic	1688 (47.1)	22 (40.7)	65 (42.5)
Middle	971 (27.1)	15 (27.8)	51 (33.3)
University	928 (25.9)	17 (31.5)	37 (24.2)
Employment status			
Employed	2019 (58.4)	37 (71.2)	98 (64.5)
Unemployed	169 (4.9)	3 (5.8)	10 (6.6)
Student	122 (3.5)	1 (1.9)	5 (3.3)
Homemaker/Paternal Leave	159 (4.6)	2 (3.8)	9 (5.9)
Retired	872 (25.2)	4 (7.7)	24 (15.8)
Disabled	119 (3.4)	5 (9.6)	6 (3.9)
Household income			
Low	621 (20.6)	8 (17.0)	22 (16.5)

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Middle	1855 (61.4)	25 (53.2)	80 (60.2)
High	543 (18.0)	14 (29.8)	31 (23.3)

Table 2 – The ratio of odds of relapsing in 2009 among those who had quit smoking at the baseline (2007)

		OR (95% CI) a			OR (95% CI) c		
			Male	Female		Male	Female
	Overall		Ref	0.64 (0.36, 1.15)	Overall	Ref	0.62 (0.35, 1.12)
Age	**n**						
18-29	9	3.79 (1.47, 9.76)	1.64 (0.18, 14.85)	3.70 (1.21, 11.27)	3.51 (1.34, 9.19)	1.41 (0.15, 13.33)	3.58 (1.16, 11.02)
30-39	13	1.62 (0.75, 3.53)	2.89 (1.07, 7.82)	0.75 (0.22, 2.61)	1.61 (0.74, 3.51)	3.07 (1.12, 8.43)	0.75 (0.21, 2.60)
40-49	8	0.71 (0.30, 1.69)	1.23 (0.43, 3.52)	0.28 (0.06, 1.37)	0.71 (0.30, 1.69)	1.20 (0.41, 3.46)	0.29 (0.06, 1.40)
50-59	18	Ref	Ref	Ref	Ref	Ref	Ref
60-69	6	0.30 (0.12, 0.76)	0.33 (0.10, 1.09)	0.26 (0.05, 1.28)	0.31 (0.12, 0.79)	0.35 (0.10, 1.14)	0.27 (0.06, 1.34)
>70	2	0.14 (0.03, 0.62)	0.11 (0.14, 0.32)	0.24 (0.03, 2.02)	0.15 (0.03, 0.64)	0.11 (0.01, 0.87)	0.25 (0.03, 2.10)
Marital Status							
Single/Divorced	8	1.03 (0.41, 2.56)	0.80 (0.18, 3.60)	1.28 (0.40, 4.07)	0.99 (0.39, 2.49)	0.70 (0.15, 3.37)	1.26 (0.39, 4.05)
Committed, not cohabiting	2	0.99 (0.21, 4.61)	0.84 (0.09, 7.74)	1.14 (0.14, 9.57)	0.94 (0.20, 4.39)	0.86 (0.09, 7.68)	1.04 (0.12, 8.98)
Married/Cohabiting	44	Ref	Ref	Ref	Ref	Ref	Ref
Education							
Basic	22	Ref	Ref	Ref	Ref	Ref	Ref
Middle	15	0.81 (0.48, 1.37)	0.89 (0.47, 1.71)	0.68 (0.28, 1.68)	0.95 (0.47, 1.90)	0.87 (0.35, 2.17)	1.10 (0.37, 3.28)
University	17	1.11 (0.70, 1.76)	1.03 (0.55, 1.95)	1.22 (0.66, 2.39)	1.09 (0.56, 2.15)	0.98 (0.38, 2.52)	1.21 (0.45, 3.26)
Employment status in 2009							
Employed	37	Ref	Ref	Ref	Ref	Ref	Ref
Unemployed	3	1.32 (0.54, 3.20)	1.50 (0.48, 4.70)	1.06 (0.23, 4.83)	1.05 (0.29, 3.86)	1.51 (0.29, 7.98)	0.69 (0.08, 6.39)
Student	1	0.64 (0.15, 2.73)	^	1.92 (0.41, 9.01)	0.65 (0.08, 5.09)	^	1.74 (0.20, 15.36)
Homemaker/Parental Leave	2	1.01 (0.35, 2.90)	0.67 (0.15, 2.94)	2.20 (0.47, 10.26)	0.86 (0.19, 3.89)	0.58 (0.07, 4.80)	1.74 (0.20, 15.45)
Disabled	4	0.47 (0.20, 1.13)	0.13 (0.03, 0.62)	2.73 (0.72, 10.26)	0.48 (0.14, 1.65)	0.14 (0.02, 1.24)	2.49 (0.39, 15.80)
Retired	5	2.74 (1.26, 5.96)	0.86 (0.18, 4.06)	5.30 (2.01, 13.98)	2.91 (0.97, 8.74)	0.87 (0.10, 7.89)	6.03 (1.55, 23.41)
Household income in 2009 b							
Low	8	0.69 (0.36, 1.32)	1.02 (0.37, 2.81)	0.54 (0.23, 1.29)	0.69 (0.28, 1.70)	1.29 (0.27, 6.04)	0.40 (0.12, 1.35)
Middle	25	1.36 (0.65, 2.83)	3.26 (1.11, 9.61)	0.39 (0.11, 1.35)	1.43 (0.52, 3.93)	3.41 (0.68, 17.19)	0.66 (0.14, 3.25)

High	14	Ref	Ref	Ref	Ref	Ref	Ref
Household income in 2009 (among high income at baseline)b							
High income in 2009	28	Ref	Ref	Ref	Ref	Ref	Ref
Lower income in 2009	16	0.41 (0.20, 0.86)	0.23 (0.08, 0.62)	0.85 (0.24, 2.96)	0.52 (0.25, 1.05)	0.36 (0.14, 0.91)	0.76 (0.21, 2.76)
Household income in 2009 (among low income at baseline)b							
High income in 2009	23	3.80 (1.43, 10.12)	6.53 (1.58, 26.95)	2.71 (0.64, 11.48)	3.44 (1.30, 9.12)	4.73 (1.16, 19.24)	3.22 (0.69, 15.06)
Lower income in 2009	7	Ref	Ref	Ref	Ref	Ref	Ref
Change in stress from 2007 to 2009							
Same	7	Ref	Ref	Ref			
Decreased	15	0.95 (0.47, 1.90)	1.51 (0.58, 3.92)	0.67 (0.24, 1.90)			
Increased	34	2.08 (1.32, 3.30)	2.82 (1.17, 6.83)	1.65 (0.67, 4.08)			

^ Estimates not possible

a OR adjusted for statuses in 2009: age, sex, education, marital status

b OR adjusted for statuses in 2009: age, sex, education, marital status, adults in household

c OR additionally adjusted for change in stress from 2007 to 2009.

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Table 3 - The ratio of odds of smoking cessation in 2009 among those who were smokers at the baseline (2007)

		OR (95% CI)a		
		Overall	Male	Female
			Ref	0.67 (0.52, 0.87)
Age	**n**			
18-29	24	2.58 (1.31, 5.09)	1.37 (0.43, 4.33)	3.83 (1.51, 9.72)
30-39	32	1.80 (0.98, 3.30)	1.35 (0.59, 3.09)	2.28 (0.90, 5.76)
40-49	34	1.49 (0.83, 2.67)	1.17 (0.54, 2.56)	2.00 (0.81, 4.94)
50-59	28	Ref	Ref	Ref
60-69	24	1.63 (0.85, 3.13)	1.17 (0.48, 2.86)	2.75 (1.02, 7.46)
>70	18	2.60 (1.26, 5.38)	1.87 (0.73, 4.79)	4.72 (1.47, 15.12)
Marital status				
Single/Divorced	31	0.72 (0.46, 1.15)	0.88 (0.46, 1.69)	0.57 (0.29, 1.12)
Committed, not cohabiting	9	1.02 (0.45, 2.31)	2.77 (0.73, 10.55)	0.49 (0.15, 1.16)
Married/Cohabiting	116	Ref	Ref	Ref
Education				
Basic	65	Ref	Ref	Ref
Middle	51	1.25 (0.91, 1.72)	0.73 (0.45, 1.17)	2.16 (1.38, 3.39)
University	37	1.44 (1.03, 2.01)	0.79 (0.48, 1.31)	2.50 (1.55, 4.01)
Employment status in 2009				
Employed	98	Ref	Ref	Ref
Unemployed	10	0.79 (0.45, 1.38)	0.56 (0.27, 1.18)	1.41 (0.59, 3.36)
Student	5	1.06 (0.51, 2.23)	^	1.49 (0.67, 3.30)
Homemaker/Parental Leave	9	0.66 (0.37, 1.17)	0.99 (0.41, 2.40)	0.58 (0.26, 1.28)
Disabled	24	1.84 (1.10, 3.09)	0.88 (0.42, 1.84)	4.73 (2.20, 10.14)
Retired	6	0.97 (0.48, 1.97)	2.47 (0.76, 8.03)	0.54 (0.21, 1.42)
Household income in 2009**				
Low	22	1.16 (0.75, 1.80)	1.17 (0.59, 2.32)	1.09 (0.61, 1.94)
Middle	80	1.50 (0.87, 2.57)	1.59 (0.70, 3.60)	1.36 (0.65, 2.86)
High	31	Ref	Ref	Ref
Household income in 2009 (among high income at baseline)b				
High income in 2009	96	Ref	Ref	Ref
Low income in 2009	32	0.87 (0.50, 1.49)	0.71 (0.33, 1.53)	1.09 (0.49, 2.42)
Household income in 2009 (among low income at baseline)b				
High income in 2009	89	0.61 (0.26, 1.46)	0.75 (0.22, 2.51)	0.44 (0.12, 1.60)
Low income in 2009	8	Ref	Ref	Ref
Change in stress from 2007 to 2009				
Same	22	Ref	Ref	Ref
Decreased	62	0.86 (0.57, 1.28)	1.34 (0.77, 2.33)	1.05 (0.57, 1.93)

Increased	76	1.04 (0.78, 1.38)	0.83 (0.47, 1.45)	1.52 (0.85, 2.71)

^ Estimates not possible
a OR adjusted for statuses in 2009: age, sex, education, marital status
b OR adjusted for statuses in 2009: age, sex, education, marital status, adults in household

Table 4 – Average stress levels according to smoking status – among waves (2007 & 2009)

	2007	2009	
	Stress Mean (SD)	**Stress Mean (SD)**	**p-value (F) ±**
Never smoker			
Male	3.70 (2.75)	3.83 (2.69)	0.31 (1.02)
Female	4.18 (2.70)	4.40 (2.90)	0.44 (0.60)
Relapsed			
Male	3.52 (2.28)	4.94 (2.80)	0.28 (1.20)
Female	3.96 (2.52)	5.24 (3.46)	0.01 (7.67)
Quit smoking			
Male	4.21 (2.71)	4.16 (2.78)	0.91 (0.01)
Female	4.38 (3.49)	5.03 (3.35)	0.13 (2.31)

* Prevalence rates compared using chi-squared tests
± Repeated measures ANOVA (p-values, F statistic) used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009; adjusted for age in 2009

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For peer review only

Economic crisis and smoking behaviour: Prospective cohort study in Iceland

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2012-001386.R1
Article Type:	Research
Date Submitted by the Author:	12-Jul-2012
Complete List of Authors:	McClure, Christopher; Centre of Public Health Sciences, University of Iceland, Department of Medicine Valdimarsdttir, Unnur; Centre of Public Health Sciences, University of Iceland, Department of Medicine Hauksdóttir, Arna; Centre of Public Health Sciences, University of Iceland, Department of Medicine Kawachi, Ichiro; Harvard School of Public Health, Department of Society Human Development and
Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Public health, Epidemiology, Mental health, Health economics, Addiction
Keywords:	PUBLIC HEALTH, Adult psychiatry < PSYCHIATRY, EPIDEMIOLOGY, MENTAL HEALTH, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

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Abstract

Objective To determine whether the strains of a national economic collapse affect smoking ~~sessation~~ cessation and risk of smoking relapse in the population.

Design A population-based, prospective cohort study based on a mail survey (*Health and Wellbeing in Iceland*) assessed in 2007 and 2009.

Setting National mail survey

Participants Representative cohort (n=3755) of Icelandic adults.

Main outcome measure Smoking status.

Results A significant reduction in the prevalence of smoking was observed from 2007 (pre-economic collapse) to 2009 (post-collapse) in both males (17.4% to 14.8%; P 0.01) and females (20.0% to 17.5%; P 0.01) in the cohort (n= 3755). An ~~increase in perceived stress levels from pre- to post-collapse was associated with the risk of smoking relapse (odds ratio 2.08; 95% confidence interval 1.32, 3.30), as was an~~ increase in income from pre- to post-collapse among males (~~O~~odds ratio~~R 6.53~~4.02; 95% ~~CI~~ confidence interval ~~1.58, 26.95~~1.15, 14.00) was strongly associated with an increased risk of relapse. Conversely, male former smokers experiencing a reduction in income were less likely to relapse (OR 0.~~23~~37; 95% CI 0.~~08, 0.62~~16, 0.85). Regarding the propensity of pre-collapse smokers to quit in the period after the collapse, female smokers were less likely to quit compared to males (OR 0.~~67~~65; 95% CI 0.~~52~~45, 0.~~87~~93).

Conclusions In line with on-going secular trend, the overall prevalence of smoking continued to decrease following the 2008 economic crisis in Iceland. ~~Increase in psychological stress and income~~Income increase during the period 2007-2009 ~~were~~ was strongly associated with having relapsed in 2009, particularly among men~~.~~ offering support for a pro-cyclical association between smoking and income.

Article Summary

Article Focus

- An examination on the association between economic crises and smoking behaviours, i.e. is a change in income related to a change in smoking status?
- What is the role of stress change on an individual's propensity to relapse or quit smoking?

Key Messages

- Evidence for the association between increased income and increased risk of smoking relapse following an economic collapse.
- Evidence for an association between decreased income and decreased risk of relapse.
- Gender differences in smoking—represented by higher female prevalence rates and decreased likelihood of quitting for females compared to males.

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Strengths and limitations of this study

- A representative prospective cohort study assessed at two time points, which straddle the start of a severe economic crisis.
- Due to the low number of individuals that change their smoking behaviours in a short period, we were unable to assess the effects of an unemployment change on smoking habits.

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Introduction

The Icelandic economy was severely affected by the global economic collapse of 2008. After a decade-long period of financial prosperity the nation was plunged into a recession of such severity that similar contractions had only been seen a handful of times before.[1 2]

Previous research on the health consequences of the Icelandic economic collapse has suggested adverse impacts on cardiovascular and mental health among women.[3 4] In the broader literature on economic crises and population health, however, it has been debated whether health moves in a pro-cyclical or counter-cyclical direction to macro-economic conditions. The work of Brenner beginning in the 1970s suggested that mortality is counter-cyclical, i.e. when the economy is down, mortality rates – in particular, suicides – rise.[5] However, in more recent years, a series of econometric studies have suggested that mortality is pro-cyclical, i.e. during economic contractions death rates decline.[6 7 8 9] There are plausible reasons for this unexpected finding – for instance, during the 1998 Korean financial crisis, economic activity was so depressed that there was a detectable decline in traffic-related mortality.[10] Others have speculated – without direct evidence – that people are more likely to be over-worked and "stressed" during economic booms than during busts, having less time flexibility to engage in health promoting behaviours.[11 12]

Few studies, however, have used individual-level data to test the association between recession and health, especially smoking. Most of the evidence to date has been at the ecological level, though not all.[13] For instance, Shaw et al. found a direct association between economic hardship and a propensity to smoke.[14] Using U.S. data, Ruhm previously reported that economic recession was associated with a decline in the prevalence of cigarette smoking.[12] A recent report from Gallus et al. found that the recent economic contraction in Italy has given rise to an increase in the percentage of current smokers – primarily for females.[15] In the present study, we took advantage of the natural experiment afforded by the Icelandic crisis to examine the relationship between changes in economic conditions and smoking behaviour. Utilizing a prospective cohort of Icelandic adults assessed before (in 2007) and after the start of the collapse (in 2009), we sought to examine the risk of relapse among pre-collapse former smokers, as well as quitting behaviour among current smokers in terms of economic changes. Furthermore, because of the important role of perceived stress on smoking status, we sought to examine the potential influence of stress on the studied associations~~this role~~.[16 17]

Methods

Design and Samples

Cohort

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Our cohort is based on the *Health and Wellbeing in Iceland* health survey. Data was collected by a questionnaire in two waves: (1) from October to December of 2007 (10-12 months pre-collapse), then again (2) between November and December of 2009 (13-14 months post-collapse). The cohort was based on a stratified random sample of the Icelandic population (n=9807), which was selected from 12 strata: consisting of two geographic regions further stratified by six age groups. Of the initial 9807, a total of 5918 responded to the initial 2007 assessment (response rate of 60.3%), with 4092 responding again to the modified version of the survey in 2007 (response rate of 82.8% of those who responded to the pre-collapse baseline survey). Because of the importance of stress as a potential predictor of smoking behaviour, we excluded individuals who did not have complete responses to the *Perceived Stress Scale* in both 2007 and 2009. This left a final analytical sample of n=3755. Figure 1 shows the cohort attrition over questionnaire waves.

Measures

Smoking status and behaviour

In the questionnaire, we inquired about smoking status, i.e. whether respondents were current smokers, had quit smoking, or had never smoked. In order to examine the likelihood of relapsing or quitting following an economic collapse, respondents were stratified according to their smoking status: non-smoker, relapsed, and quit smoking.

Non-smoker: An individual was classified as a non-smoker if they responded that they did not currently smoke on both the 2007 and 2009 assessments.

Relapsed smoker: An individual was identified as relapsed if they indicated that they (a) were a former smoker on the 2007 questionnaire, but indicated they had (b) smoked in any frequency in 2009. In our analyses estimating the odds ratios of relapse, the base population was restricted to individuals who were former smokers at baseline.

Quit smoking: A respondent that had quit smoking must have indicated that they were (a) currently smoking in 2007, yet had (b) quit smoking by 2009. In our analyses estimating the odds ratios of quitting, our base population was restricted to individuals who were current smokers at baseline.

Change in economic status

Additional socio-economic questions pertained to employment and income status. ~~Employment status was categorized into either (1) employed or (2) unemployed.~~ Household income was classified into income ranges of (in terms of Icelandic currency; *ISK*) (1) low (≤ 3.4 million ISK), (2) middle (3.5-9.4 million ISK), and (3) high (≥ 9.5 million ISK); corresponding approximately to (1) ≤ 28,000 USD, (2) 28,000-77,000 USD, and (3) ≥ 77,000 USD. For analysis of income change, household income was further dichotomized into either high or "low"

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(which combined the middle & low income categories). We examined two types of income change: a) drop in income between 2007 and 2009 from high to low; and b) a rise in income between 2007 and 2009 from low to high.

Change in perceived stress

Psychological stress was measured in both 2007 and 2009 using the four-item Perceived Stress Scale (PSS-4).[18] The PSS-4 is a shortened, validated, and acceptable substitute for the original scale,[19] with scores ranging from 0-16; the higher the score, the higher the perceived stress. An increase in stress was classified as any increase from baseline to follow-up; conversely, a decrease was classified as any decrease from baseline to follow-up. For example, an individual with a score of 5 in 2007 and a score of 10 in 2009~~,~~ would be classified as having an increase in stress.

Explanatory variables and demographics

Our regression models controlled for the following socio-demographic covariates: age, sex, marital status, and education. Education was categorized as (1) basic (completed primary school or less), (2) middle (completed high school or equivalent), and (3) university (a completed university degree).

Statistical analyses

Table 1 presents the distribution of socio-demographic characteristics according to change in smoking status between 2007 and 2009.

Binary logistic regression was used to estimate ~~ratio of odds~~odds ratio (corresponding 95% confidence intervals) of relapse in 2009 (table 2), and the odds of quitting smoking in 2009 (table 3) by background characteristics, change in income and stress levels. Analyses were also stratified by gender. Models were adjusted for age~~, sex, marital status, and educational level~~ and sex; models for household income and income change ~~odds~~ were additionally adjusted for ~~the number of adults in the household~~baseline income levels. As previous research supports the role of stress as a mediator of an individual's propensity to ~~relapse~~change smoking status,[16 17 23] we also ran models of relapse and cessation with and without the inclusion of (1) changes in stress levels between 2007 and 2009 and (2) baseline stress levels.~~.~~

Repeated measures ANOVA (p-values, F statistic) was used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009 (table 4). Statistical analyses were conducted with IBM SPSS Statistics version 19.0 (SPSS Inc, Chicago, Illinois). Statistical significance was set at the 0.05 level, and all tests were 2-tailed.

Results

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Baseline characteristics

Table 1 describes the baseline characteristics of the cohort in 2007 (n=3755), which was 53.0% female, 76.7% married/cohabiting, and with a mean (SD) age of 52.3 (16.0). Table 1 also describes the characteristics of those that had relapsed and quit: 72.2% (n=2711) of the cohort were non-smokers, 4.0% (n=56) of the former smokers at baseline had relapsed in 2009, and 22.2% (n=149) of smokers at baseline had quit smoking in 2009. A significant reduction ($p<0.01$) in the prevalence of smokers was observed from 2007 to 2009 in both males (17.4% to 14.8%) and females (20.0% to 17.5%).

Relapse smoking

Among individuals who were former smokers at baseline (table 2), ~~a~~decreased ~~n increased risk~~ odds of relapsing in 2009 (after the collapse) ~~was~~ were observed in the ~~younger~~ older age groups (compared to those aged ~~50-59~~18-39), ~~specifically among females aged 18-29 (3.70; 1.21, 11.27) and males aged 30-39 (2.89; 1.07, 7.82)~~regardless of gender (age of 40-59: odds ratio 0.38; 95% confidence interval 0.21, 0.69 | age ≥ 60: 0.10; 0.04, 0.23). ~~Further age-stratification found that men over 70 years of age were significantly less likely to relapse (0.14; 0.03, 0.62).~~

While an individual's ~~change in~~ employment status ~~from 2007 to 2009~~ was not involved in their risk of relapsing, ~~males receiving disability pension (compared to the employed) were less likely to relapse (0.13; 0.03, 0.62), while~~ retired females showed a significant increased risk of relapsing (~~5.30; 2.01, 13.98~~4.12; 1.11, 15.29), compared to the employed.

Among men in the lower income groups at baseline (i.e. low, middle), those who moved into the high income group in 2009 experienced an increased risk of relapse (~~6.53; 1.58, 26.95~~4.02; 1.15, 14.00)—while among those in the high income group at baseline, those whose incomes dropped had a decreased risk of relapsing (~~2.82; 1.17, 6.83~~0.37; 0.16, 0.85). Further adjustments for a change in stress levels from 2007 to 2009, showed ~~some~~ limited attenuation in the coefficients, suggesting some mediation by perceived stress – i.e. former smokers whose incomes increased between 2007 and 2009 may have relapsed in part because of an increase in stress.

Smoking cessation

~~Women~~ Females were less likely to quit smoking in 2009 (0.~~67~~65; 0.~~52~~45, 0.~~87~~93), compared to males. An increased likelihood of quitting in 2009 was observed among the following female groups: those with middle (2.78; 1.48, 5.21~~2.16~~) or university-level (2.73; 1.38, 5.40~~2.50~~) education compared to a basic, and the disabled (3.42; 1.23, 9.52~~4.73~~) compared to the employed. Compared to females aged 18-29~~aged 50-59, females~~ those in the middle-aged group~~youngest~~ (~~3.83; 1.51, 9.72~~0.46; 0.26, 0.83) ~~and oldest groups (4.72; 1.47, 15.12)~~ were ~~considerably more~~less likely to quit. Additional adjustments for a change in stress levels from baseline to follow-up in the cessation models revealed no diminished significance in effect sizes.

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Stress and smoking

~~With regard to the potential role of stress on an individual's likelihood of relapsing or quitting, males showed an association between an increase in stress from 2007 to 2009 and odds of relapse (2.82; 1.17, 3.30). Additional adjustments for a change in stress among the risk of relapse did not significantly alter the effect sizes.~~

Though stress change did not predict a relapse in females, further examination of changes in stress levels among smoking status, displayed a significant change in mean stress levels (SD) among females that had relapsed, with a significant increase in stress scores from 3.96 (2.52) in 2007 to 5.24 (3.46) (P 0.01; F = 7.67).

Discussion

In response to the severe economic collapse in Iceland, we found that the prevalence of smoking continued to decrease for both genders in the short period after. This drop in smoking may be attributed to background secular trends,[20] while other factors, such as changes in the price of cigarettes, change of priorities in the favour of more health promoting behaviours or anti-smoking campaigns, may also play a role. The strength of our study is that we were able to document changes in individual economic status ~~– as well as perceived stress –~~ straddling the economic downturn and link these exposures to individual changes in smoking habits. Additionally, in comparison to national smoking rates (2007: 23.0% of population; 2009: 19.0%) the prevalence rates from 2007 to 2009 of this sample are relatively analogous – offering support for the generalizability of the sample.

Our findings partially corroborate previous research on the pro-cyclical nature of the association between economic downturns and smoking habit, i.e. during recessions, smoking habits may be dampened. Among male former smokers, those who experienced a decline in income during the economic recession had a significantly lower risk of relapse two years later. Conversely, among men whose incomes ~~or stress levels~~ increased during the period of recession, their risk of relapse was considerably higher compared to those whose incomes stayed the same. Although the direction of associations was similar among women, none of the estimates were statistically significant.

Taken together, the main significant finding of our analyses is that male former smokers whose incomes fell during the period of the economic collapse experienced a reduced risk of relapse. Ruhm hypothesized that this risk reduction is possibly driven by a tendency to adopt healthier behaviours during periods of reduced income – driven by an increase in positive health behaviours (i.e. exercise) that accompanies newly acquired increased leisure time during economic contractions.[21] It could also be argued their behaviour change in a recession can be either intentional or inadvertent. When facing enforced economic inactivity – individuals may

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choose to fill their time by actively investing in positive personal health changes, which include stopping smoking or joining a fitness club. It is equally plausible that a drop in income involuntarily forces smokers to give up their habit. However, our results did not indicate an increased risk of quitting among those whose incomes fell~~,~~ – which is ~~not~~ inconsistent with the latter hypothesis, as well as previous research by Siahpush & Carlin.[22]

Foremost, our findings support Ruhm's theory of the positive effects of recessions on a population's health behaviours.[12] Ruhm revealed an association between markers (e.g. unemployment) of economic downturns and reductions in smoking, with an increase being seen during economic expansion. Though tobacco products are likely to be procyclical goods, as Ruhm further points out, offering some explanation of the decrease we observed, it does not explain all of the mechanisms involved.

We caution that our findings regarding recession, income change, and smoking habits cannot be generalized to other health outcomes. For example, observational reports found a spike in female cardiac emergency visits during the week corresponding to the economic collapse in October of 2008.3 In accordance with this, our previous analysis on changes in mental health revealed significant increases in stress for mainly women.4 This increase in stress for women, however threatening ~~of~~ to related health outcomes, did not prove to be associated with an increased likelihood of relapsing.

Our findings are also congruent with multiple models explaining the link between stress levels and smoking behaviour. Though much research shows stress as a cause of smoking,[16 17] additional research actually points to cigarette smoking as a cause of stress and, furthermore, smoking cessation as leading to a reduction in stress.[23] This is in line with our findings, as both male and female relapsed smokers had the lowest levels of stress before the collapse when they considered themselves as having quit smoking in 2007 (table 4), yet experienced an increase in stress post-collapse—significantly for women. This may also point to a vulnerability of this group to use smoking as a means of alleviating stress—explaining their relapse in smoking after the collapse.[24] This vulnerability has been discussed and supported by previous research showing economic stress as a cause of adverse mental health.[25] This increased stress may have also been amplified by a return to smoking, as Cohen & Lichtenstein have found.[26] Caution is warranted in interpreting the findings on stress, however, since smokers may be citing an increase in perceived stress to justify their relapse or failure to quit.

Study limitations

Some limitations of our study should be noted. Relapsed smokers and quitters represent a small proportion of the population, and hence our odds ratios were estimated with imprecision. Similarly, we lacked statistical power to directly examine the effects of a change in employment status on change in smoking habits. In other words, though we were able to examine the effects of income change, we were not able to directly estimate the effects of unemployment as there

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were too few individuals in the sample who lost their jobs between 2007 and 2009. Finally, smoking status was based on self-report only, and not validated by biomarkers such as cotinine. This may have produced misclassification of the outcome, though it is not clear whether this misclassification was differential by exposure status (e.g. income changes).

Conclusions

Our large population-based cohort with assessment points straddling the 2008 economic crisis in Iceland revealed a reduction in smoking rates from the short periods before and after the start of the crisis - though our study could not disentangle the direct effects of the crisis with other mechanisms, e.g. secular trends, changing cigarette prices. Chiefly, this examination revealed a decisive role of income change ~~and perceived stress~~ on the risk of relapsing after the collapse among former male smokers.

Notes

Contributors: CM and IK (study guarantor) were responsible for the design of the study and preparation of the manuscript. CM conducted data analyses. AH and UV obtained funding. All contributors interpreted the data, contributed to the writing of the paper and approved the final version of the manuscript.

Funding: The project was funded in part by the Icelandic Centre for Research (RANNÍS). The authors are responsible for the manuscript's content, not the funding bodies.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no other authors had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years.

Ethical approval: The study was approved by the Ethics Review Board of Iceland (09-094) and the Data Protection Authority of Iceland (S4455).

Data sharing: No additional data available.

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Figures and Tables

Figure 1- The cohort of the "Health and well-being"-study.

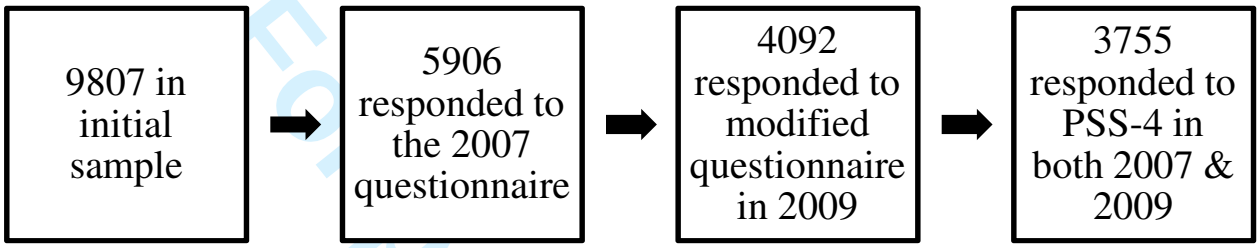

Table 1 – Baseline characteristics (in 2007) of the cohort and among differential smoking status

	Cohort	Relapsed in 2009	Quit Smoking in 2009
n	3755	56	160
Age Mean ± SD	52.3 ± 16.0	45.7 ± 14.2	47.4 ± 15.5
Sex		**n (% of category)**	
Male	1763 (47.0)	31 (55.4)	82 (51.3)
Female	1992 (53.0)	25 (44.6)	78 (48.8)
Marital status			
Single/Divorced	556 (14.9)	7 (~~12.5~~13.0)	31 (19.~~4~~9)
Committed, not cohabiting	131 (3.5)	2 (3.~~6~~7)	9 (5.~~6~~8)
Married, cohabiting	2871 (76.7)	45 (~~80.4~~83.3)	116 (~~72.5~~74.4)
Education			
Basic	1688 (47.1)	22 (40.7)	65 (42.5)
Middle	971 (27.1)	15 (27.8)	51 (33.3)
University	928 (25.9)	17 (31.5)	37 (24.2)
Employment status			
Employed	2019 (58.4)	37 (71.2)	98 (64.5)
Unemployed	169 (4.9)	3 (5.8)	10 (6.6)
Student	122 (3.5)	1 (1.9)	5 (3.3)
Homemaker/Paternal Leave	159 (4.6)	2 (3.8)	9 (5.9)
Retired	872 (25.2)	4 (7.7)	24 (15.8)
Disabled	119 (3.4)	5 (9.6)	6 (3.9)
Household income			

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Low	621 (20.6)	8 (17.0)	22 (16.5)
Middle	1855 (61.4)	25 (53.2)	80 (60.2)
High	543 (18.0)	14 (29.8)	31 (23.3)

Table 2 – The ~~ratio of odds~~odds ratio of relapsing in 2009 among those who had quit smoking at the baseline (2007)

		OR (95% CI) a		
		Overall	Male	Female
2009 Status			Ref	0.67 (0.38, 1.18)
~~Age~~	~~n~~	-	-	-
~~18-39~~	~~22~~	~~Ref~~	~~Ref~~	~~Ref~~
~~40-59~~	~~26~~	~~0.38 (0.21, 0.69)~~	~~0.37 (0.16, 0.85)~~	~~0.39 (0.16, 0.92)~~
~~≥60~~	~~8~~	~~0.10 (0.04, 0.23)~~	~~0.08 (0.03, 0.24)~~	~~0.14 (0.04, 0.50)~~
~~Marital Status~~		-	-	-
~~Single~~	~~8~~	~~1.11 (0.48, 2.59)~~	~~0.69 (0.16, 3.11)~~	~~1.51 (0.53, 4.35)~~
~~Married/Cohabiting~~	~~46~~	~~Ref~~	~~Ref~~	~~Ref~~
~~Education~~		-	-	-
~~Basic~~	~~22~~	~~Ref~~	~~Ref~~	~~Ref~~
~~Middle~~	~~15~~	~~0.89 (0.45, 1.77)~~	~~0.82 (0.33, 1.99)~~	~~1.01 (0.35, 2.96)~~
~~University~~	~~17~~	~~1.02 (0.52, 1.99)~~	~~0.99 (0.39, 2.48)~~	~~1.09 (0.41, 2.90)~~
~~Employment status in 2009~~		-	-	-
~~Employed~~	~~37~~	~~Ref~~	~~Ref~~	~~Ref~~
~~Unemployed~~	~~3~~	~~1.37 (0.40, 4.68)~~	~~1.81 (0.38, 8.65)~~	~~0.97 (0.12, 7.95)~~
~~Disabled~~	~~4~~	~~0.56 (0.16, 1.89)~~	~~0.17 (0.02, 1.44)~~	~~2.69 (0.46, 15.64)~~
~~Retired~~	~~5~~	~~2.49 (0.85, 7.33)~~	~~0.90 (0.10, 7.97)~~	~~4.12 (1.11, 15.29)~~
Household income in 2009 b				
Low	8	0.66 (0.26, 1.70)	1.13 (0.24, 5.36)	0.56 (0.15, 2.08)
Middle	25	1.57 (0.48, 5.17)	2.28 (0.38, 13.55)	1.31 (0.21, 8.32)
High	14	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	28	Ref	Ref	Ref
Lower income in 2009	16	0.53 (0.28, 1.01)	0.37 (0.16, 0.85)	0.92 (0.29, 2.88)
Household income in 2009 (among low income at baseline) b				
High income in 2009	23	3.14 (1.27, 7.72)	4.02 (1.15, 14.00)	2.43 (0.64, 9.19)

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Lower income in 2009	7	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	7	Ref~~Ref~~	Ref~~Ref~~	Ref~~Ref~~
Decreased	15	0.91 (0.35, 2.36)~~0.95 (0.47, 1.90)~~	0.83 (0.23, 2.99)~~1.51 (0.58, 3.92)~~	1.03 (0.25, 4.28)~~0.67 (0.24, 1.90)~~
Increased	34	1.71 (0.86, 3.37)~~2.08 (1.32, 3.30)~~	1.75 (0.68, 4.53)~~2.82 (1.17, 6.83)~~	1.64 (0.61, 4.39)~~1.65 (0.67, 4.08)~~

~~^ Estimates not possible~~

a OR adjusted for statuses in 2009: age, sex

b OR adjusted for statuses in 2009: age, sex, baseline income in 2007

c OR additionally adjusted for baseline stress (2007)

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Table 3 - The ~~ratio of odds~~odds ratio of smoking cessation in 2009 among those who were smokers at the baseline (2007)

		OR (95% CI) a	
	Overall	Male	Female
~~2009 Status~~		Ref	0.65 (0.45, 0.93)
~~Age~~	~~n~~	-	-
~~18-39~~	~~24~~	~~Ref~~	~~Ref~~
~~40-59~~	~~32~~	~~0.60 (0.40, 0.92)~~	~~0.81 (0.44, 1.51)~~
~~≥60~~	~~34~~	~~0.84 (0.52, 1.35)~~	~~0.98 (0.48, 1.97)~~
~~Marital status~~	-	-	-
~~Single~~	~~31~~	~~0.70 (0.45, 1.10)~~	~~0.73 (0.39, 1.38)~~
~~Married/Cohabiting~~	~~116~~	~~Ref~~	~~Ref~~
~~Education~~	-	-	-
~~Basic~~	~~65~~	~~Ref~~	~~Ref~~
~~Middle~~	~~51~~	~~1.49 (0.97, 2.29)~~	~~0.81 (0.44, 1.48)~~
~~University~~	~~37~~	~~1.58 (0.97, 2.55)~~	~~0.84 (0.41, 1.73)~~
~~Employment status in 2009~~	-	-	-
~~Employed~~	~~98~~	~~Ref~~	~~Ref~~
~~Unemployed~~	~~10~~	~~0.80 (0.38, 1.68)~~	~~0.54 (0.19, 1.52)~~
~~Student~~	~~5~~	~~1.06 (0.51, 2.23)~~	~~^~~
~~Homemaker/Parental Leave~~	~~9~~	~~0.66 (0.37, 1.17)~~	~~0.99 (0.41, 2.40)~~
~~Disabled~~	~~24~~	~~1.61 (0.79, 3.26)~~	~~0.76 (0.28, 2.07)~~
~~Retired~~	~~6~~	~~0.90 (0.34, 2.42)~~	~~2.53 (0.48, 13.33)~~
Household income in 2009~~~~ b**			
Low	22	0.89 (0.49, 1.60)	0.75 (0.33, 1.74)	1.01 (0.43, 2.36)
Middle	80	0.98 (0.45, 2.13)	0.80 (0.27, 2.38)	1.12 (0.36, 3.46)
High	31	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b			
High income in 2009	96	Ref	Ref	Ref
Low income in 2009	32	0.75 (0.46, 1.22)	0.82 (0.41, 1.62)	0.68 (0.34, 1.37)
Household income in 2009 (among low income at baseline) b			
High income in 2009	89	0.68 (0.30, 1.55)	0.61 (0.19, 1.97)	0.77 (0.24, 2.41)
Low income in 2009	8	Ref	Ref	Ref
Change in stress from 2007 to 2009 c			
Same	22	Ref	Ref	Ref

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Decreased	62	0.84 (0.47, 1.48)	0.73 (0.34, 1.56)	0.98 (0.41, 2.31)
Increased	76	0.98 (0.64, 1.51)	0.66 (0.36, 1.22)	1.38 (0.74, 2.58)

a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)
~~a OR adjusted for statuses in 2009: age, sex, education, marital status~~
~~b OR adjusted for statuses in 2009: age, sex, education, marital status, adults in household~~

Table 4 – Average stress levels according to smoking status – among waves (2007 & 2009)

	2007	2009	
	Stress Mean (SD)	**Stress Mean (SD)**	**p-value (F) ±**
Never smoker			
Male	3.70 (2.75)	3.83 (2.69)	0.31 (1.02)
Female	4.18 (2.70)	4.40 (2.90)	0.44 (0.60)
Relapsed			
Male	3.52 (2.28)	4.94 (2.80)	0.28 (1.20)
Female	3.96 (2.52)	5.24 (3.46)	0.01 (7.67)
Quit smoking			
Male	4.21 (2.71)	4.16 (2.78)	0.91 (0.01)
Female	4.38 (3.49)	5.03 (3.35)	0.13 (2.31)

~~* Prevalence rates compared using chi-squared tests~~
± Repeated measures ANOVA (p-values, F statistic) used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009; adjusted for age in 2009

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2012-001386.R2
Article Type:	Research
Date Submitted by the Author:	09-Aug-2012
Complete List of Authors:	McClure, Christopher; Centre of Public Health Sciences, University of Iceland, Department of Medicine Valdimarsdttir, Unnur; Centre of Public Health Sciences, University of Iceland, Department of Medicine Hauksdóttir, Arna; Centre of Public Health Sciences, University of Iceland, Department of Medicine Kawachi, Ichiro; Harvard School of Public Health, Department of Society Human Development and
Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Public health, Epidemiology, Mental health, Health economics, Addiction
Keywords:	PUBLIC HEALTH, Adult psychiatry < PSYCHIATRY, EPIDEMIOLOGY, MENTAL HEALTH, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

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Abstract

Objective To determine whether the strains of a national economic collapse affect smoking cessation and risk of smoking relapse in the population.

Design A population-based, prospective cohort study based on a mail survey (*Health and Wellbeing in Iceland*) assessed in 2007 and 2009.

Setting National mail survey

Participants Representative cohort (n=3755) of Icelandic adults.

Main outcome measure Smoking status.

Results A significant reduction in the prevalence of smoking was observed from 2007 (pre-economic collapse) to 2009 (post-collapse) in both males (17.4% to 14.8%; P 0.01) and females (20.0% to 17.5%; P 0.01) in the cohort (n= 3755). An increase in income from pre- to post-collapse among males (odds ratio 4.02; 95% confidence interval 1.15, 14.00) was strongly associated with an increased risk of relapse. Conversely, male former smokers experiencing a reduction in income were less likely to relapse (OR 0.37; 95% CI 0.16, 0.85). Regarding the propensity of pre-collapse smokers to quit in the period after the collapse, female smokers were less likely to quit compared to males (OR 0.65; 95% CI 0.45, 0.93).

Conclusions In line with on-going secular trend, the overall prevalence of smoking continued to decrease following the 2008 economic crisis in Iceland. Income increase during the period 2007-2009 was strongly associated with having relapsed in 2009, particularly among men, offering support for a pro-cyclical association between smoking and income. Yet the findings must be taken with caution, as they are based on a low number of subjects.

Article Summary

Article Focus

- An examination on the association between economic crises and smoking behaviours, i.e. is a change in income related to a change in smoking status?

Key Messages

- Evidence for the association between increased income and increased risk of smoking relapse following an economic collapse.
- Evidence for an association between decreased income and decreased risk of relapse.
- Gender differences in smoking—represented by higher female prevalence rates and decreased likelihood of quitting for females compared to males.

Strengths and limitations of this study

- A representative prospective cohort study assessed at two time points, which straddle the start of a severe economic crisis.
- Due to the low number of individuals that change their smoking behaviours in a short period, we were unable to assess the effects of a change in employment on smoking

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habits.

- Findings are based on a low number of subjects and must be taken with caution.

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Introduction

The Icelandic economy was severely affected by the global economic collapse of 2008. After a decade-long period of financial prosperity the nation was plunged into a recession of such severity that similar contractions had only been seen a handful of times before.[1 2]

Previous research on the health consequences of the Icelandic economic collapse has suggested adverse impacts on cardiovascular and mental health among women.[3 4] In the broader literature on economic crises and population health, however, it has been debated whether health moves in a pro-cyclical or counter-cyclical direction to macro-economic conditions. The work of Brenner beginning in the 1970s suggested that mortality is counter-cyclical, i.e. when the economy is down, mortality rates – in particular, suicides – rise.[5] However, in more recent years, a series of econometric studies have suggested that mortality is pro-cyclical, i.e. during economic contractions death rates decline.[6 7 8 9] There are plausible reasons for this unexpected finding – for instance, during the 1998 Korean financial crisis, economic activity was so depressed that there was a detectable decline in traffic-related mortality.[10] Others have speculated – without direct evidence – that people are more likely to be over-worked and "stressed" during economic booms than during busts, having less time flexibility to engage in health promoting behaviours.[11 12]

Few studies, however, have used individual-level data to test the association between recession and health, especially smoking. Most of the evidence to date has been at the ecological level, though not all.[13] For instance, Shaw et al. found a direct association between economic hardship and a propensity to smoke.[14] Using U.S. data, Ruhm previously reported that economic recession was associated with a decline in the prevalence of cigarette smoking.[12~~12~~] A recent report from Gallus et al. found that the recent economic contraction in Italy has given rise to an increase in the percentage of current smokers – primarily for females.[15] In the present study, we took advantage of the natural experiment afforded by the Icelandic crisis to examine the relationship between changes in economic conditions and smoking behaviour. Utilizing a prospective cohort of Icelandic adults assessed before (in 2007) and after the start of the collapse (in 2009), we sought to examine the risk of relapse among pre-collapse former smokers, as well as quitting behaviour among current smokers in terms of economic changes. Furthermore, because of the important role of perceived stress on smoking status, we sought to examine the potential influence of stress on the studied associations.[16 17]

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Methods

Design and Samples

Cohort

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Our cohort is based on the *Health and Wellbeing in Iceland* health survey. Data was collected by a questionnaire in two waves: (1) from October to December of 2007 (10-12 months pre-collapse), then again (2) between November and December of 2009 (13-14 months post-collapse). The cohort was based on a stratified random sample of the Icelandic population (n=9807), which was selected from 12 strata: consisting of two geographic regions further stratified by six age groups. Of the initial 9807, a total of 5918 responded to the initial 2007 assessment (response rate of 60.3%), with 4092 responding again to the modified version of the survey in 2007 (response rate of 82.8% of those who responded to the pre-collapse baseline survey). Because of the importance of stress as a potential predictor of smoking behaviour, we excluded individuals who did not have complete responses to the *Perceived Stress Scale* in both 2007 and 2009. This left a final analytical sample of n=3755. Figure 1 shows the cohort attrition over questionnaire waves.

Measures

Smoking status and behaviour

In the questionnaire, we inquired about smoking status, i.e. whether respondents were current smokers, had quit smoking, or had never smoked. In order to examine the likelihood of relapsing or quitting following an economic collapse, respondents were stratified according to their smoking status: non-smoker, relapsed, and quit smoking.

Non-smoker: An individual was classified as a non-smoker if they responded that they did not currently smoke on both the 2007 and 2009 assessments.

Relapsed smoker: An individual was identified as relapsed if they indicated that they (a) were a former smoker on the 2007 questionnaire, but indicated they had (b) smoked in any frequency in 2009. In our analyses estimating the odds ratios of relapse, the base population was restricted to individuals who were former smokers at baseline.

Quit smoking: A respondent that had quit smoking must have indicated that they were (a) currently smoking in 2007, yet had (b) quit smoking by 2009. In our analyses estimating the odds ratios of quitting, our base population was restricted to individuals who were current smokers at baseline.

Change in economic status

Additional socio-economic questions pertained to employment and income status. Household income was classified into income ranges of (in terms of Icelandic currency; *ISK*) (1) low (≤ 3.4 million ISK), (2) middle (3.5-9.4 million ISK), and (3) high (≥ 9.5 million ISK); corresponding approximately to (1) ≤ 28,000 USD, (2) 28,000-77,000 USD, and (3) ≥ 77,000 USD. For analysis of income change, household income was further dichotomized into either high or "low" (which combined the middle & low income categories). We examined two types of income

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change: a) drop in income between 2007 and 2009 from high to low; and b) a rise in income between 2007 and 2009 from low to high.

Change in perceived stress

Psychological stress was measured in both 2007 and 2009 using the four-item Perceived Stress Scale (PSS-4).[18] The PSS-4 is a shortened, validated, and acceptable substitute for the original scale,[19] with scores ranging from 0-16; the higher the score, the higher the perceived stress. An increase in stress was classified as any increase from baseline to follow-up; conversely, a decrease was classified as any decrease from baseline to follow-up. For example, an individual with a score of 5 in 2007 and a score of 10 in 2009 would be classified as having an increase in stress.

Explanatory variables and demographics

Our regression models controlled for the following socio-demographic covariates: age, sex, marital status, and education. Education was categorized as (1) basic (completed primary school or less), (2) middle (completed high school or equivalent), and (3) university (a completed university degree). Employment status was categorized as (1) employed, (2) unemployed, (3) student (4) homemaker/paternal leave, (5) retired, and (6) disabled.

Statistical analyses

Table 1 presents the distribution of socio-demographic characteristics according to change in smoking status between 2007 and 2009.

Binary logistic regression was used to estimate odds ratio (corresponding 95% confidence intervals) of relapse in 2009 (table 2), and the odds of quitting smoking in 2009 (table 3) by background characteristics, change in income and stress levels. Analyses were also stratified by gender. Models were adjusted for age and sex; models for household income and income change were additionally adjusted for baseline income levels. As previous research supports the role of stress as a mediator of an individual's propensity to change smoking status, ~~1615~~ ~~1716~~ ~~2321~~ we also ran models of relapse and cessation with and without the inclusion of (1) changes in stress levels between 2007 and 2009 and (2) baseline stress levels.

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Repeated measures ANOVA (p-values, F statistic) was used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009 (table 4). Statistical analyses were conducted with IBM SPSS Statistics version 19.0 (SPSS Inc, Chicago, Illinois). Statistical significance was set at the 0.05 level, and all tests were 2-tailed.

Results

Baseline characteristics

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Table 1 describes the baseline characteristics of the cohort in 2007 (n=3755), which was 53.0% female, 76.7% married/cohabiting, and with a mean (SD) age of 52.3 (16.0). Table 1 also describes the characteristics of those that had relapsed and quit: 72.2% (n=2711) of the cohort were non-smokers, 4.0% (n=56) of the former smokers at baseline had relapsed in 2009, and 22.2% (n=149) of smokers at baseline had quit smoking in 2009. A significant reduction ($P < 0.01$) in the prevalence of smokers was observed from 2007 to 2009 in both males (17.4% to 14.8%) and females (20.0% to 17.5%).

Relapse smoking

Among individuals who were former smokers at baseline (table 2), decreased odds of relapsing in 2009 (after the collapse) were observed in the older age groups (compared to those aged 18-39), regardless of gender (age of 40-59: odds ratio 0.38; 95% confidence interval 0.21, 0.69 | age ≥ 60: 0.10; 0.04, 0.23).

While an individual's employment status was not involved in their risk of relapsing, retired females showed a significant increased risk of relapsing (4.12; 1.11, 15.29), compared to the employed.

Among men in the lower income groups at baseline (i.e. low, middle), those who moved into the high income group in 2009 experienced an increased risk of relapse (4.02; 1.15, 14.00)—while among those in the high income group at baseline, those whose incomes dropped had a decreased risk of relapsing (0.37; 0.16, 0.85). Further adjustments for a change in stress levels from 2007 to 2009, showed limited attenuation in the coefficients, suggesting some mediation by perceived stress – i.e. former smokers whose incomes increased between 2007 and 2009 may have relapsed in part because of an increase in stress.

Smoking cessation

Females were less likely to quit smoking in 2009 (0.65; 0.45, 0.93), compared to males. An increased likelihood of quitting in 2009 was observed among the following female groups: those with middle (2.78; 1.48, 5.21) or university-level (2.73; 1.38, 5.40) education compared to a basic, and the disabled (3.42; 1.23, 9.52) compared to the employed. Compared to females aged 18-29, those in the middle-aged group (0.46; 0.26, 0.83) were less likely to quit. Additional adjustments for a change in stress levels from baseline to follow-up in the cessation models revealed no diminished significance in effect sizes.

Stress and smoking

Though stress change (increase vs. stable, decrease vs. stable) did not predict a relapse in females in aforementioned analyses, further examination of changes in stress levels among smoking status displayed a significant change in mean stress levels (SD) among females that had relapsed,

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with a significant increase in stress scores from 3.96 (2.52) in 2007 to 5.24 (3.46) (P 0.01; F = 7.67).

Discussion

In response to the severe economic collapse in Iceland, we found that the prevalence of smoking continued to decrease for both genders in the short period after. This drop in smoking may be attributed to background secular trends,[20] while other factors, such as changes in the price of cigarettes, change of priorities in the favour of more health promoting behaviours or anti-smoking campaigns, may also play a role. The strength of our study is that we were able to document changes in individual economic status straddling the economic downturn and link these exposures to individual changes in smoking habits. Additionally, in comparison to national smoking rates (2007: 23.0% of population; 2009: 19.0%) the prevalence rates from 2007 to 2009 of this sample are relatively analogous – offering support for the generalizability of the sample.

Our findings partially corroborate previous research on the pro-cyclical nature of the association between economic downturns and smoking habit, i.e. during recessions, smoking habits may be dampened. Among male former smokers, those who experienced a decline in income during the economic recession had a significantly lower risk of relapse two years later. Conversely, among men whose incomes increased during the period of recession, their risk of relapse was considerably higher compared to those whose incomes stayed the same. Although the direction of associations was similar among women, none of the estimates were statistically significant.

Taken together, the main significant finding of our analyses is that male former smokers whose incomes fell during the period of the economic collapse experienced a reduced risk of relapse. Ruhm hypothesized that this risk reduction is possibly driven by a tendency to adopt healthier behaviours during periods of reduced income – driven by an increase in positive health behaviours (i.e. exercise) that accompanies newly acquired increased leisure time during economic contractions.[21] It could also be argued their behaviour change in a recession can be either intentional or inadvertent. When facing enforced economic inactivity – individuals may choose to fill their time by actively investing in positive personal health changes, which include stopping smoking or joining a fitness club. It is equally plausible that a drop in income involuntarily forces smokers to give up their habit. However, our results did not indicate an increased risk of quitting among those whose incomes fell – which is inconsistent with the latter hypothesis, as well as previous research by Siahpush & Carlin.[22]

Foremost, our findings support Ruhm's theory of the positive effects of recessions on a population's health behaviours.[12~~12~~] Ruhm revealed an association between markers (e.g. unemployment) of economic downturns and reductions in smoking, with an increase being seen during economic expansion. Though tobacco products are likely to be procyclical goods, as

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Ruhm further points out, offering some explanation of the decrease we observed, it does not explain all of the mechanisms involved.

We caution that our findings regarding recession, income change, and smoking habits cannot be generalized to other health outcomes. For example, observational reports found a spike in female cardiac emergency visits during the week corresponding to the economic collapse in October of 2008.[3] In accordance with this, our previous analysis on changes in mental health revealed significant increases in stress for mainly women.[4] This increase in stress for women, however threatening to related health outcomes, did not prove to be associated with an increased likelihood of relapsing.

Our findings are also congruent with multiple models explaining the link between stress levels and smoking behaviour. Though much research shows stress as a cause of smoking, additional research actually points to cigarette smoking as a cause of stress and, furthermore, smoking cessation as leading to a reduction in stress.[23] This is in line with our findings, as both male and female relapsed smokers had the lowest levels of stress before the collapse when they considered themselves as having quit smoking in 2007 (table 4), yet experienced an increase in stress post-collapse—significantly for women. This may also point to a vulnerability of this group to use smoking as a means of alleviating stress—explaining their relapse in smoking after the collapse.[24] This vulnerability has been discussed and supported by previous research showing economic stress as a cause of adverse mental health.[25] This increased stress may have also been amplified by a return to smoking, as Cohen & Lichtenstein have found.[26] Caution is warranted in interpreting the findings on stress, however, since smokers may be citing an increase in perceived stress to justify their relapse or failure to quit. We cannot conclusively argue that stress did not play a mediating role in the association between income change and smoking behaviour because of measurement error.

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Study limitations

Some limitations of our study should be noted. Relapsed smokers and quitters represent a small proportion of the population, and hence our odds ratios were estimated with imprecision and must be interpreted with caution. Similarly, we lacked statistical power to directly examine the effects of a change in employment status on change in smoking habits. In other words, though we were able to examine the effects of income change, we were not able to directly estimate the effects of unemployment as there were too few individuals in the sample who lost their jobs between 2007 and 2009. While our findings are based on the potential effects of an economic crisis on a change in smoking status, it is not clear whether these similar findings would hold true in normal scenarios and, thus, caution is warranted when generalizing our findings to other normative scenarios. Finally, smoking status was based on self-report only, and not validated by biomarkers such as cotinine. This may have produced misclassification of the outcome, though it is not clear whether this misclassification was differential by exposure status (e.g. income changes).

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Conclusions

Our large population-based cohort with assessment points straddling the 2008 economic crisis in Iceland revealed a reduction in smoking rates from the short periods before and after the start of the crisis - though our study could not disentangle the direct effects of the crisis with other mechanisms, e.g. secular trends, changing cigarette prices. Chiefly, this examination revealed a decisive role of income change on the risk of relapsing after the collapse among former male smokers.

Notes

Contributors: CM and IK (study guarantor) were responsible for the design of the study and preparation of the manuscript. CM conducted data analyses. AH and UV obtained funding. All contributors interpreted the data, contributed to the writing of the paper and approved the final version of the manuscript.

Funding: The project was funded in part by the Icelandic Centre for Research (RANNÍS). The authors are responsible for the manuscript's content, not the funding bodies.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no other authors had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years.

Ethical approval: The study was approved by the Ethics Review Board of Iceland (09-094) and the Data Protection Authority of Iceland (S4455).

Data sharing: No additional data available.

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Figures and Tables

Figure 1- The cohort of the "Health and well-being"-study.

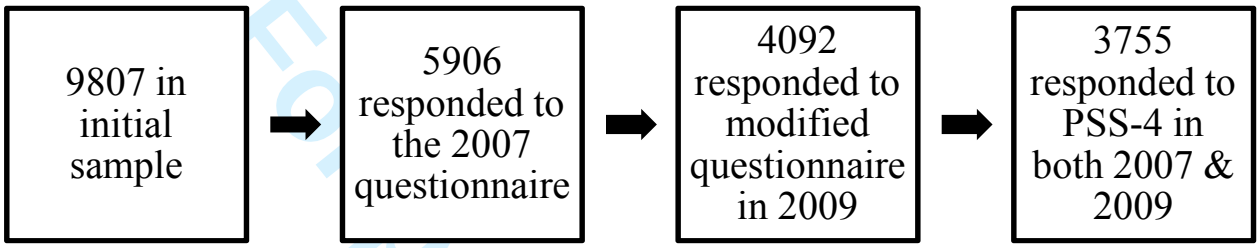

Table 1 – Baseline characteristics (in 2007) of the cohort and among differential smoking status

	Cohort	Relapsed in 2009	Quit Smoking in 2009
n	3755	56	160
Age Mean ± SD	52.3 ± 16.0	45.7 ± 14.2	47.4 ± 15.5
Sex		**n (% of category)**	
Male	1763 (47.0)	31 (55.4)	82 (51.3)
Female	1992 (53.0)	25 (44.6)	78 (48.8)
Marital status			
Single/Divorced	556 (14.9)	7 (13.0)	31 (19.9)
Committed, not cohabiting	131 (3.5)	2 (3.7)	9 (5.8)
Married, cohabiting	2871 (76.7)	45 (83.3)	116 (74.4)
Education			
Basic	1688 (47.1)	22 (40.7)	65 (42.5)
Middle	971 (27.1)	15 (27.8)	51 (33.3)
University	928 (25.9)	17 (31.5)	37 (24.2)
Employment status			
Employed	2019 (58.4)	37 (71.2)	98 (64.5)
Unemployed	169 (4.9)	3 (5.8)	10 (6.6)
Student	122 (3.5)	1 (1.9)	5 (3.3)
Homemaker/Paternal Leave	159 (4.6)	2 (3.8)	9 (5.9)
Retired	872 (25.2)	4 (7.7)	24 (15.8)
Disabled	119 (3.4)	5 (9.6)	6 (3.9)
Household income			

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Low	621 (20.6)	8 (17.0)	22 (16.5)
Middle	1855 (61.4)	25 (53.2)	80 (60.2)
High	543 (18.0)	14 (29.8)	31 (23.3)

Table 2 – The odds ratio of relapsing in 2009 among those who had quit smoking at the baseline (2007)

		OR (95% CI) a		
		Overall	Male	Female
2009 Status			Ref	0.67 (0.38, 1.18)
Household income in 2009 b	**n ***			
Low	8	0.66 (0.26, 1.70)	1.13 (0.24, 5.36)	0.56 (0.15, 2.08)
Middle	25	1.57 (0.48, 5.17)	2.28 (0.38, 13.55)	1.31 (0.21, 8.32)
High	17	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	5	Ref	Ref	Ref
Lower income in 2009	9	0.53 (0.28, 1.01)	0.37 (0.16, 0.85)	0.92 (0.29, 2.88)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	23	3.14 (1.27, 7.72)	4.02 (1.15, 14.00)	2.43 (0.64, 9.19)
Lower income in 2009	7	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	7	Ref	Ref	Ref
Decreased	15	0.91 (0.35, 2.36)	0.83 (0.23, 2.99)	1.03 (0.25, 4.28)
Increased	34	1.71 (0.86, 3.37)	1.75 (0.68, 4.53)	1.64 (0.61, 4.39)

* Totals do not include missing values from 2009
a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)

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Table 3 - The odds ratio of smoking cessation in 2009 among those who were smokers at the baseline (2007)

		OR (95% CI) a		
		Overall	Male	Female
2009 Status			Ref	0.65 (0.45, 0.93)
Household income in 2009 b	**n ***			
Low	22	0.89 (0.49, 1.60)	0.75 (0.33, 1.74)	1.01 (0.43, 2.36)
Middle	80	0.98 (0.45, 2.13)	0.80 (0.27, 2.38)	1.12 (0.36, 3.46)
High	31	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	19	Ref	Ref	Ref
Lower income in 2009	6	0.75 (0.46, 1.22)	0.82 (0.41, 1.62)	0.68 (0.34, 1.37)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	85	0.68 (0.30, 1.55)	0.61 (0.19, 1.97)	0.77 (0.24, 2.41)
Lower income in 2009	8	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	22	Ref	Ref	Ref
Decreased	62	0.84 (0.47, 1.48)	0.73 (0.34, 1.56)	0.98 (0.41, 2.31)
Increased	76	0.98 (0.64, 1.51)	0.66 (0.36, 1.22)	1.38 (0.74, 2.58)

* Totals do not include missing values from 2009
a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)

Table 4 – Average stress levels according to smoking status – among waves (2007 & 2009)

	2007	2009	
	Stress Mean (SD)	**Stress Mean (SD)**	**p-value (F) ±**
Never smoker			
Male	3.70 (2.75)	3.83 (2.69)	0.31 (1.02)
Female	4.18 (2.70)	4.40 (2.90)	0.44 (0.60)
Relapsed			
Male	3.52 (2.28)	4.94 (2.80)	0.28 (1.20)
Female	3.96 (2.52)	5.24 (3.46)	0.01 (7.67)
Quit smoking			

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Male	4.21 (2.71)	4.16 (2.78)	0.91 (0.01)
Female	4.38 (3.49)	5.03 (3.35)	0.13 (2.31)

± Repeated measures ANOVA (p-values, F statistic) used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009; adjusted for age in 2009

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

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Abstract

Objective To determine whether the strains of a national economic collapse affect smoking cessation and risk of smoking relapse in the population.

Design A population-based, prospective cohort study based on a mail survey (*Health and Wellbeing in Iceland*) assessed in 2007 and 2009.

Setting National mail survey

Participants Representative cohort (n=3755) of Icelandic adults.

Main outcome measure Smoking status.

Results A significant reduction in the prevalence of smoking was observed from 2007 (pre-economic collapse) to 2009 (post-collapse) in both males (17.4% to 14.8%; P 0.01) and females (20.0% to 17.5%; P 0.01) in the cohort (n= 3755). An increase in income from pre- to post-collapse among males (odds ratio 4.02; 95% confidence interval 1.15, 14.00) was strongly associated with an increased risk of relapse. Conversely, male former smokers experiencing a reduction in income were less likely to relapse (OR 0.37; 95% CI 0.16, 0.85). Regarding the propensity of pre-collapse smokers to quit in the period after the collapse, female smokers were less likely to quit compared to males (OR 0.65; 95% CI 0.45, 0.93).

Conclusions In line with on-going secular trend, the overall prevalence of smoking continued to decrease following the 2008 economic crisis in Iceland. Income increase during the period 2007-2009 was strongly associated with having relapsed in 2009, particularly among men, offering support for a pro-cyclical association between smoking and income. Yet the findings must be taken with caution, as they are based on a low number of subjects.

Article Summary

Article Focus

- An examination on the association between economic crises and smoking behaviours, i.e. is a change in income related to a change in smoking status?
- ~~What is the role of stress change on an individual's propensity to relapse or quit smoking?~~

Key Messages

- Evidence for the association between increased income and increased risk of smoking relapse following an economic collapse.
- Evidence for an association between decreased income and decreased risk of relapse.
- Gender differences in smoking—represented by higher female prevalence rates and decreased likelihood of quitting for females compared to males.

Strengths and limitations of this study

- A representative prospective cohort study assessed at two time points, which straddle the start of a severe economic crisis.

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- Due to the low number of individuals that change their smoking behaviours in a short period, we were unable to assess the effects of ~~an unemployment change~~a change in employment on smoking habits.
- Findings are based on a low number of subjects and must be taken with caution.

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Introduction

The Icelandic economy was severely affected by the global economic collapse of 2008. After a decade-long period of financial prosperity the nation was plunged into a recession of such severity that similar contractions had only been seen a handful of times before.[1 2]

Previous research on the health consequences of the Icelandic economic collapse has suggested adverse impacts on cardiovascular and mental health among women.[3 4] In the broader literature on economic crises and population health, however, it has been debated whether health moves in a pro-cyclical or counter-cyclical direction to macro-economic conditions. The work of Brenner beginning in the 1970s suggested that mortality is counter-cyclical, i.e. when the economy is down, mortality rates – in particular, suicides – rise.[5] However, in more recent years, a series of econometric studies have suggested that mortality is pro-cyclical, i.e. during economic contractions death rates decline.[6 7 8 9] There are plausible reasons for this unexpected finding – for instance, during the 1998 Korean financial crisis, economic activity was so depressed that there was a detectable decline in traffic-related mortality.[10] Others have speculated – without direct evidence – that people are more likely to be over-worked and "stressed" during economic booms than during busts, having less time flexibility to engage in health promoting behaviours.[11 12]

Few studies, however, have used individual-level data to test the association between recession and health, especially smoking. Most of the evidence to date has been at the ecological level, though not all.[13] For instance, Shaw et al. found a direct association between economic hardship and a propensity to smoke.[14] Using U.S. data, Ruhm previously reported that economic recession was associated with a decline in the prevalence of cigarette smoking.[12~~12~~] A recent report from Gallus et al. found that the recent economic contraction in Italy has given rise to an increase in the percentage of current smokers – primarily for females.[15] In the present study, we took advantage of the natural experiment afforded by the Icelandic crisis to examine the relationship between changes in economic conditions and smoking behaviour. Utilizing a prospective cohort of Icelandic adults assessed before (in 2007) and after the start of the collapse (in 2009), we sought to examine the risk of relapse among pre-collapse former smokers, as well as quitting behaviour among current smokers in terms of economic changes. Furthermore, because of the important role of perceived stress on smoking status, we sought to examine the potential influence of stress on the studied associations.[16 17]

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Methods

Design and Samples

Cohort

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Our cohort is based on the *Health and Wellbeing in Iceland* health survey. Data was collected by a questionnaire in two waves: (1) from October to December of 2007 (10-12 months pre-collapse), then again (2) between November and December of 2009 (13-14 months post-collapse). The cohort was based on a stratified random sample of the Icelandic population (n=9807), which was selected from 12 strata: consisting of two geographic regions further stratified by six age groups. Of the initial 9807, a total of 5918 responded to the initial 2007 assessment (response rate of 60.3%), with 4092 responding again to the modified version of the survey in 2007 (response rate of 82.8% of those who responded to the pre-collapse baseline survey). Because of the importance of stress as a potential predictor of smoking behaviour, we excluded individuals who did not have complete responses to the *Perceived Stress Scale* in both 2007 and 2009. This left a final analytical sample of n=3755. Figure 1 shows the cohort attrition over questionnaire waves.

Measures

Smoking status and behaviour

In the questionnaire, we inquired about smoking status, i.e. whether respondents were current smokers, had quit smoking, or had never smoked. In order to examine the likelihood of relapsing or quitting following an economic collapse, respondents were stratified according to their smoking status: non-smoker, relapsed, and quit smoking.

Non-smoker: An individual was classified as a non-smoker if they responded that they did not currently smoke on both the 2007 and 2009 assessments.

Relapsed smoker: An individual was identified as relapsed if they indicated that they (a) were a former smoker on the 2007 questionnaire, but indicated they had (b) smoked in any frequency in 2009. In our analyses estimating the odds ratios of relapse, the base population was restricted to individuals who were former smokers at baseline.

Quit smoking: A respondent that had quit smoking must have indicated that they were (a) currently smoking in 2007, yet had (b) quit smoking by 2009. In our analyses estimating the odds ratios of quitting, our base population was restricted to individuals who were current smokers at baseline.

Change in economic status

Additional socio-economic questions pertained to employment and income status. Household income was classified into income ranges of (in terms of Icelandic currency; *ISK*) (1) low (≤ 3.4 million ISK), (2) middle (3.5-9.4 million ISK), and (3) high (≥ 9.5 million ISK); corresponding approximately to (1) ≤ 28,000 USD, (2) 28,000-77,000 USD, and (3) ≥ 77,000 USD. For analysis of income change, household income was further dichotomized into either high or "low" (which combined the middle & low income categories). We examined two types of income

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change: a) drop in income between 2007 and 2009 from high to low; and b) a rise in income between 2007 and 2009 from low to high.

Change in perceived stress

Psychological stress was measured in both 2007 and 2009 using the four-item Perceived Stress Scale (PSS-4).[18] The PSS-4 is a shortened, validated, and acceptable substitute for the original scale,[19] with scores ranging from 0-16; the higher the score, the higher the perceived stress. An increase in stress was classified as any increase from baseline to follow-up; conversely, a decrease was classified as any decrease from baseline to follow-up. For example, an individual with a score of 5 in 2007 and a score of 10 in 2009 would be classified as having an increase in stress.

Explanatory variables and demographics

Our regression models controlled for the following socio-demographic covariates: age, sex, marital status, and education. Education was categorized as (1) basic (completed primary school or less), (2) middle (completed high school or equivalent), and (3) university (a completed university degree). Employment status was categorized as (1) employed, (2) unemployed, (3) student (4) homemaker/paternal leave, (5) retired, and (6) disabled.

Statistical analyses

Table 1 presents the distribution of socio-demographic characteristics according to change in smoking status between 2007 and 2009.

Binary logistic regression was used to estimate odds ratio (corresponding 95% confidence intervals) of relapse in 2009 (table 2), and the odds of quitting smoking in 2009 (table 3) by background characteristics, change in income and stress levels. Analyses were also stratified by gender. Models were adjusted for age and sex; models for household income and income change were additionally adjusted for baseline income levels. As previous research supports the role of stress as a mediator of an individual's propensity to change smoking status,[16~~15~~ 17~~16~~ 23~~21~~] we also ran models of relapse and cessation with and without the inclusion of (1) changes in stress levels between 2007 and 2009 and (2) baseline stress levels.

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Repeated measures ANOVA (p-values, F statistic) was used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009 (table 4). Statistical analyses were conducted with IBM SPSS Statistics version 19.0 (SPSS Inc, Chicago, Illinois). Statistical significance was set at the 0.05 level, and all tests were 2-tailed.

Results

Baseline characteristics

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Table 1 describes the baseline characteristics of the cohort in 2007 (n=3755), which was 53.0% female, 76.7% married/cohabiting, and with a mean (SD) age of 52.3 (16.0). Table 1 also describes the characteristics of those that had relapsed and quit: 72.2% (n=2711) of the cohort were non-smokers, 4.0% (n=56) of the former smokers at baseline had relapsed in 2009, and 22.2% (n=149) of smokers at baseline had quit smoking in 2009. A significant reduction ($P < 0.01$) in the prevalence of smokers was observed from 2007 to 2009 in both males (17.4% to 14.8%) and females (20.0% to 17.5%).

Relapse smoking

Among individuals who were former smokers at baseline (table 2), decreased odds of relapsing in 2009 (after the collapse) were observed in the older age groups (compared to those aged 18-39), regardless of gender (age of 40-59: odds ratio 0.38; 95% confidence interval 0.21, 0.69 | age ≥ 60: 0.10; 0.04, 0.23).

While an individual's employment status was not involved in their risk of relapsing, retired females showed a significant increased risk of relapsing (4.12; 1.11, 15.29), compared to the employed.

Among men in the lower income groups at baseline (i.e. low, middle), those who moved into the high income group in 2009 experienced an increased risk of relapse (4.02; 1.15, 14.00)—while among those in the high income group at baseline, those whose incomes dropped had a decreased risk of relapsing (0.37; 0.16, 0.85). Further adjustments for a change in stress levels from 2007 to 2009, showed limited attenuation in the coefficients, suggesting some mediation by perceived stress – i.e. former smokers whose incomes increased between 2007 and 2009 may have relapsed in part because of an increase in stress.

Smoking cessation

Females were less likely to quit smoking in 2009 (0.65; 0.45, 0.93), compared to males. An increased likelihood of quitting in 2009 was observed among the following female groups: those with middle (2.78; 1.48, 5.21) or university-level (2.73; 1.38, 5.40) education compared to a basic, and the disabled (3.42; 1.23, 9.52) compared to the employed. Compared to females aged 18-29, those in the middle-aged group (0.46; 0.26, 0.83) were less likely to quit. Additional adjustments for a change in stress levels from baseline to follow-up in the cessation models revealed no diminished significance in effect sizes.

Stress and smoking

Though stress change (increase vs. stable, decrease vs. stable) did not predict a relapse in females in aforementioned analyses, further examination of changes in stress levels among smoking status, displayed a significant change in mean stress levels (SD) among females that had

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relapsed, with a significant increase in stress scores from 3.96 (2.52) in 2007 to 5.24 (3.46) (P 0.01; F = 7.67).

Discussion

In response to the severe economic collapse in Iceland, we found that the prevalence of smoking continued to decrease for both genders in the short period after. This drop in smoking may be attributed to background secular trends,[20] while other factors, such as changes in the price of cigarettes, change of priorities in the favour of more health promoting behaviours or anti-smoking campaigns, may also play a role. The strength of our study is that we were able to document changes in individual economic status straddling the economic downturn and link these exposures to individual changes in smoking habits. Additionally, in comparison to national smoking rates (2007: 23.0% of population; 2009: 19.0%) the prevalence rates from 2007 to 2009 of this sample are relatively analogous – offering support for the generalizability of the sample.

Our findings partially corroborate previous research on the pro-cyclical nature of the association between economic downturns and smoking habit, i.e. during recessions, smoking habits may be dampened. Among male former smokers, those who experienced a decline in income during the economic recession had a significantly lower risk of relapse two years later. Conversely, among men whose incomes increased during the period of recession, their risk of relapse was considerably higher compared to those whose incomes stayed the same. Although the direction of associations was similar among women, none of the estimates were statistically significant.

Taken together, the main significant finding of our analyses is that male former smokers whose incomes fell during the period of the economic collapse experienced a reduced risk of relapse. Ruhm hypothesized that this risk reduction is possibly driven by a tendency to adopt healthier behaviours during periods of reduced income – driven by an increase in positive health behaviours (i.e. exercise) that accompanies newly acquired increased leisure time during economic contractions.[21] It could also be argued their behaviour change in a recession can be either intentional or inadvertent. When facing enforced economic inactivity – individuals may choose to fill their time by actively investing in positive personal health changes, which include stopping smoking or joining a fitness club. It is equally plausible that a drop in income involuntarily forces smokers to give up their habit. However, our results did not indicate an increased risk of quitting among those whose incomes fell – which is inconsistent with the latter hypothesis, as well as previous research by Siahpush & Carlin.[22]

Foremost, our findings support Ruhm's theory of the positive effects of recessions on a population's health behaviours.[12,13] Ruhm revealed an association between markers (e.g. unemployment) of economic downturns and reductions in smoking, with an increase being seen during economic expansion. Though tobacco products are likely to be procyclical goods, as

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Ruhm further points out, offering some explanation of the decrease we observed, it does not explain all of the mechanisms involved.

We caution that our findings regarding recession, income change, and smoking habits cannot be generalized to other health outcomes. For example, observational reports found a spike in female cardiac emergency visits during the week corresponding to the economic collapse in October of 2008.[3] In accordance with this, our previous analysis on changes in mental health revealed significant increases in stress for mainly women.[4] This increase in stress for women, however threatening to related health outcomes, did not prove to be associated with an increased likelihood of relapsing.

Our findings are also congruent with multiple models explaining the link between stress levels and smoking behaviour. Though much research shows stress as a cause of smoking,[16~~15~~ 17~~16~~] additional research actually points to cigarette smoking as a cause of stress and, furthermore, smoking cessation as leading to a reduction in stress.[23] This is in line with our findings, as both male and female relapsed smokers had the lowest levels of stress before the collapse when they considered themselves as having quit smoking in 2007 (table 4), yet experienced an increase in stress post-collapse—significantly for women. This may also point to a vulnerability of this group to use smoking as a means of alleviating stress—explaining their relapse in smoking after the collapse.[24] This vulnerability has been discussed and supported by previous research showing economic stress as a cause of adverse mental health.[25] This increased stress may have also been amplified by a return to smoking, as Cohen & Lichtenstein have found.[26] Caution is warranted in interpreting the findings on stress, however, since smokers may be citing an increase in perceived stress to justify their relapse or failure to quit. We cannot conclusively argue that stress did not play a mediating role in the association between income change and smoking behaviour because of measurement error.

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Study limitations

Some limitations of our study should be noted. Relapsed smokers and quitters represent a small proportion of the population, and hence our odds ratios were estimated with imprecision and must be interpreted with caution. Similarly, we lacked statistical power to directly examine the effects of a change in employment status on change in smoking habits. In other words, though we were able to examine the effects of income change, we were not able to directly estimate the effects of unemployment as there were too few individuals in the sample who lost their jobs between 2007 and 2009. While our findings are based on the potential effects of an economic crisis on a change in smoking status, it is not clear whether these similar findings would hold true in normal scenarios and, thus, caution is warranted when generalizing our findings to other normative scenarios. Finally, smoking status was based on self-report only, and not validated by biomarkers such as cotinine. This may have produced misclassification of the outcome, though it is not clear whether this misclassification was differential by exposure status (e.g. income changes).

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Conclusions

Our large population-based cohort with assessment points straddling the 2008 economic crisis in Iceland revealed a reduction in smoking rates from the short periods before and after the start of the crisis - though our study could not disentangle the direct effects of the crisis with other mechanisms, e.g. secular trends, changing cigarette prices. Chiefly, this examination revealed a decisive role of income change on the risk of relapsing after the collapse among former male smokers.

Notes

Contributors: CM and IK (study guarantor) were responsible for the design of the study and preparation of the manuscript. CM conducted data analyses. AH and UV obtained funding. All contributors interpreted the data, contributed to the writing of the paper and approved the final version of the manuscript.

Funding: The project was funded in part by the Icelandic Centre for Research (RANNÍS). The authors are responsible for the manuscript's content, not the funding bodies.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no other authors had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years.

Ethical approval: The study was approved by the Ethics Review Board of Iceland (09-094) and the Data Protection Authority of Iceland (S4455).

Data sharing: No additional data available.

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Figures and Tables

Figure 1- The cohort of the "Health and well-being"-study.

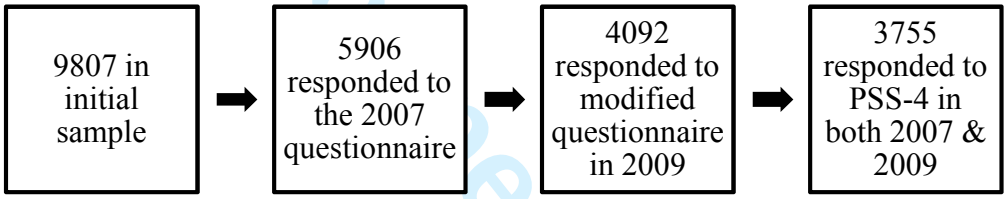

Table 1 – Baseline characteristics (in 2007) of the cohort and among differential smoking status

	Cohort	Relapsed in 2009	Quit Smoking in 2009
n	3755	56	160
Age Mean ± SD	52.3 ± 16.0	45.7 ± 14.2	47.4 ± 15.5
Sex	**n (% of category)**		
Male	1763 (47.0)	31 (55.4)	82 (51.3)
Female	1992 (53.0)	25 (44.6)	78 (48.8)
Marital status			
Single/Divorced	556 (14.9)	7 (13.0)	31 (19.9)
Committed, not cohabiting	131 (3.5)	2 (3.7)	9 (5.8)
Married, cohabiting	2871 (76.7)	45 (83.3)	116 (74.4)
Education			
Basic	1688 (47.1)	22 (40.7)	65 (42.5)
Middle	971 (27.1)	15 (27.8)	51 (33.3)
University	928 (25.9)	17 (31.5)	37 (24.2)
Employment status			
Employed	2019 (58.4)	37 (71.2)	98 (64.5)
Unemployed	169 (4.9)	3 (5.8)	10 (6.6)
Student	122 (3.5)	1 (1.9)	5 (3.3)
Homemaker/Paternal Leave	159 (4.6)	2 (3.8)	9 (5.9)
Retired	872 (25.2)	4 (7.7)	24 (15.8)
Disabled	119 (3.4)	5 (9.6)	6 (3.9)
Household income			

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Low	621 (20.6)	8 (17.0)	22 (16.5)
Middle	1855 (61.4)	25 (53.2)	80 (60.2)
High	543 (18.0)	14 (29.8)	31 (23.3)

Table 2 – The odds ratio of relapsing in 2009 among those who had quit smoking at the baseline (2007)

		OR (95% CI) a		
	Overall		Male	Female
2009 Status			Ref	0.67 (0.38, 1.18)
Household income in 2009 b	n *			
Low	8	0.66 (0.26, 1.70)	1.13 (0.24, 5.36)	0.56 (0.15, 2.08)
Middle	25	1.57 (0.48, 5.17)	2.28 (0.38, 13.55)	1.31 (0.21, 8.32)
High	17	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	~~28~~5	Ref	Ref	Ref
Lower income in 2009	~~16~~9	0.53 (0.28, 1.01)	0.37 (0.16, 0.85)	0.92 (0.29, 2.88)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	23	3.14 (1.27, 7.72)	4.02 (1.15, 14.00)	2.43 (0.64, 9.19)
Lower income in 2009	7	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	7	Ref	Ref	Ref
Decreased	15	0.91 (0.35, 2.36)	0.83 (0.23, 2.99)	1.03 (0.25, 4.28)
Increased	34	1.71 (0.86, 3.37)	1.75 (0.68, 4.53)	1.64 (0.61, 4.39)

* Totals do not include missing values from 2009

a OR adjusted for statuses in 2009: age, sex

b OR adjusted for statuses in 2009: age, sex, baseline income in 2007

c OR additionally adjusted for baseline stress (2007)

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Table 3 - The odds ratio of smoking cessation in 2009 among those who were smokers at the baseline (2007)

		OR (95% CI) a		
	Overall		Male	Female
2009 Status			Ref	0.65 (0.45, 0.93)
Household income in 2009 b	n *			
Low	22	0.89 (0.49, 1.60)	0.75 (0.33, 1.74)	1.01 (0.43, 2.36)
Middle	80	0.98 (0.45, 2.13)	0.80 (0.27, 2.38)	1.12 (0.36, 3.46)
High	31	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	961 9	Ref	Ref	Ref
Lower income in 2009	326	0.75 (0.46, 1.22)	0.82 (0.41, 1.62)	0.68 (0.34, 1.37)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	898 5	0.68 (0.30, 1.55)	0.61 (0.19, 1.97)	0.77 (0.24, 2.41)
Lower income in 2009	8	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	22	Ref	Ref	Ref
Decreased	62	0.84 (0.47, 1.48)	0.73 (0.34, 1.56)	0.98 (0.41, 2.31)
Increased	76	0.98 (0.64, 1.51)	0.66 (0.36, 1.22)	1.38 (0.74, 2.58)

* Totals do not include missing values from 2009

a OR adjusted for statuses in 2009: age, sex

b OR adjusted for statuses in 2009: age, sex, baseline income in 2007

c OR additionally adjusted for baseline stress (2007)

Table 4 – Average stress levels according to smoking status – among waves (2007 & 2009)

	2007	2009	
	Stress Mean (SD)	**Stress Mean (SD)**	**p-value (F) ±**
Never smoker			
Male	3.70 (2.75)	3.83 (2.69)	0.31 (1.02)
Female	4.18 (2.70)	4.40 (2.90)	0.44 (0.60)
Relapsed			
Male	3.52 (2.28)	4.94 (2.80)	0.28 (1.20)
Female	3.96 (2.52)	5.24 (3.46)	0.01 (7.67)

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Quit smoking			
Male	4.21 (2.71)	4.16 (2.78)	0.91 (0.01)
Female	4.38 (3.49)	5.03 (3.35)	0.13 (2.31)

± Repeated measures ANOVA (p-values, F statistic) used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009; adjusted for age in 2009

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2012-001386.R3
Article Type:	Research
Date Submitted by the Author:	04-Sep-2012
Complete List of Authors:	McClure, Christopher; Centre of Public Health Sciences, University of Iceland, Department of Medicine Valdimarsdttir, Unnur; Centre of Public Health Sciences, University of Iceland, Department of Medicine Hauksdóttir, Arna; Centre of Public Health Sciences, University of Iceland, Department of Medicine Kawachi, Ichiro; Harvard School of Public Health, Department of Society Human Development and
Primary Subject Heading:	Smoking and tobacco
Secondary Subject Heading:	Public health, Epidemiology, Mental health, Health economics, Addiction
Keywords:	PUBLIC HEALTH, Adult psychiatry < PSYCHIATRY, EPIDEMIOLOGY, MENTAL HEALTH, Health economics < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

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Abstract

Objective To examine the associations between the 2008 economic collapse in Iceland and smoking behaviour at the national and individual levels.

Design A population-based, prospective cohort study based on a mail survey (*Health and Wellbeing in Iceland*) assessed in 2007 and 2009.

Setting National mail survey

Participants Representative cohort (n=3755) of Icelandic adults.

Main outcome measure Smoking status.

Results A significant reduction in the prevalence of smoking was observed from 2007 (pre-economic collapse) to 2009 (post-collapse) in both males (17.4% to 14.8%; P 0.01) and females (20.0% to 17.5%; P 0.01) in the cohort (n= 3755). At the individual level of analysis, male former smokers experiencing a reduction in income during the same period were less likely to relapse (OR 0.37; 95% CI 0.16, 0.85). Female smokers were less likely to quit over time compared to males (OR 0.65; 95% CI 0.45, 0.93). Among male former smokers who experienced an increase in income between 2007 and 2009, we observed an elevated risk of smoking relapse (OR 4.02; 95% CI 1.15, 14.00).

Conclusions The national prevalence of smoking in Iceland declined following the 2008 economic crisis. This could be due to the pro-cyclical relationship between macro-economic conditions and smoking behaviour (i.e. hard times lead to less smoking because of lower affordability), or it may simply reflect a continuation of trends already in place prior to the crisis. In individual-level analysis, we find that former smokers who experienced a decline in income were less likely to relapse; and conversely, an increase in income raises the risk. However, caution is warranted since these findings are based on small numbers.

Article Summary

Article Focus

- An examination on the association between economic crises and smoking behaviours, i.e. is change in income (at both the national and individual levels) related to a change in smoking status?

Key Messages

- National smoking prevalence declined in Iceland following the 2008 economic crisis.
- In individual-level analysis, male former smokers whose incomes declined experienced a reduced risk of smoking relapse.
- Conversely, an increase in income from 2007-2009 was associated with increased risk of relapse.

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- Our findings are consistent with the hypothesis that economic downturns may result in decreased tobacco use (procyclical effect).

Strengths and limitations of this study

- A representative prospective cohort study assessed at two time points, which straddle the start of a severe economic crisis.
- Due to the low number of individuals that change their smoking behaviours in a short period, we were unable to assess the effects of a change in employment on smoking habits.
- Findings are based on a low number of subjects and must be taken with caution.

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Introduction

The Icelandic economy was severely affected by the global economic collapse of 2008. After a decade-long period of financial prosperity the nation was plunged into a recession of great severity, resulting in a severe currency crisis, as well as a drastic increase in national and household debts, runaway unemployment rates, and decreased per capita purchasing power.[1 2]

Previous research on the health consequences of the Icelandic economic collapse has suggested adverse impacts on cardiovascular and mental health among women.[3 4] In the broader literature on economic crises and population health, however, it has been debated whether health moves in a pro-cyclical or counter-cyclical direction to macro-economic conditions. The work of Brenner beginning in the 1970s suggested that mortality is counter-cyclical, i.e. when the economy is down, mortality rates – in particular, suicides – rise.[5] However, in more recent years, a series of econometric studies have suggested that mortality is pro-cyclical, i.e. during economic contractions death rates decline.[6 7 8 9] There are plausible reasons for this unexpected finding – for instance, during the 1998 Korean financial crisis, economic activity was so depressed that there was a detectable decline in traffic-related mortality.[10] Others have speculated – without direct evidence – that people are more likely to be over-worked and "stressed" during economic booms than during busts, having less time flexibility to engage in health promoting behaviours.[11 12]

Few studies, however, have used individual-level data to test the association between recession and health, especially smoking. Most of the evidence to date has been at the ecological level, though not all.[13] For instance, Shaw et al. found a direct association between economic hardship and a propensity to smoke.[14] Using U.S. data, Ruhm previously reported that economic recession was associated with a decline in the prevalence of cigarette smoking.[12~~12~~] A recent report from Gallus et al. found that the recent economic contraction in Italy has given rise to an increase in the percentage of current smokers – primarily for females.[15] In the present study, we took advantage of the natural experiment afforded by the Icelandic crisis to examine the relationship between changes in economic conditions and smoking behaviour. Utilizing a prospective cohort of Icelandic adults assessed before (in 2007) and after the start of the collapse (in 2009), we sought to examine the risk of relapse among pre-collapse former smokers, as well as quitting behaviour among current smokers in terms of economic changes. Furthermore, because of the important role of perceived stress on smoking status, we sought to examine the potential influence of stress on the studied associations.[16 17]

Formatte

Methods

Design and Samples

Cohort

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Our cohort is based on the *Health and Wellbeing in Iceland* health survey. Data was collected by a questionnaire in two waves: (1) from October to December of 2007 (10-12 months pre-collapse), then again (2) between November and December of 2009 (13-14 months post-collapse). The cohort was based on a stratified random sample of the Icelandic population (n=9807), which was selected from 12 strata: consisting of two geographic regions further stratified by six age groups. Of the initial 9807, a total of 5918 responded to the initial 2007 assessment (response rate of 60.3%), with 4092 responding again to the modified version of the survey in 2007 (response rate of 82.8% of those who responded to the pre-collapse baseline survey). Because of the importance of stress as a potential predictor of smoking behaviour, we excluded individuals who did not have complete responses to the *Perceived Stress Scale* in both 2007 and 2009. This left a final analytical sample of n=3755. Figure 1 shows the cohort attrition over questionnaire waves.

Measures

Smoking status and behaviour

In the questionnaire, we inquired about smoking status, i.e. whether respondents were current smokers, had quit smoking, or had never smoked. In order to examine the likelihood of relapsing or quitting following an economic collapse, respondents were stratified according to their smoking status: non-smoker, relapsed, and quit smoking.

Non-smoker: An individual was classified as a non-smoker if they responded that they did not currently smoke on both the 2007 and 2009 assessments.

Relapsed smoker: An individual was identified as relapsed if they indicated that they (a) were a former smoker on the 2007 questionnaire, but indicated they had (b) smoked in any frequency in 2009. In our analyses estimating the odds ratios of relapse, the base population was restricted to individuals who were former smokers at baseline.

Quit smoking: A respondent that had quit smoking must have indicated that they were (a) currently smoking in 2007, yet had (b) quit smoking by 2009. In our analyses estimating the odds ratios of quitting, our base population was restricted to individuals who were current smokers at baseline.

Change in economic status

Additional socio-economic questions pertained to employment and income status. Household income was classified into income ranges of (in terms of Icelandic currency; *ISK*) (1) low (≤ 3.4 million ISK), (2) middle (3.5-9.4 million ISK), and (3) high (≥ 9.5 million ISK); corresponding approximately to (1) ≤ 28,000 USD, (2) 28,000-77,000 USD, and (3) ≥ 77,000 USD. For analysis of income change, household income was further dichotomized into either high or "low" (which combined the middle & low income categories). We examined two types of income

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change: a) drop in income between 2007 and 2009 from high to low; and b) a rise in income between 2007 and 2009 from low to high.

Change in perceived stress

Psychological stress was measured in both 2007 and 2009 using the four-item Perceived Stress Scale (PSS-4).[18] The PSS-4 is a shortened, validated, and acceptable substitute for the original scale,[19] with scores ranging from 0-16; the higher the score, the higher the perceived stress. An increase in stress was classified as any increase from baseline to follow-up; conversely, a decrease was classified as any decrease from baseline to follow-up. For example, an individual with a score of 5 in 2007 and a score of 10 in 2009 would be classified as having an increase in stress.

Explanatory variables and demographics

Our regression models controlled for the following socio-demographic covariates: age, sex, marital status, and education. Education was categorized as (1) basic (completed primary school or less), (2) middle (completed high school or equivalent), and (3) university (a completed university degree). Employment status was categorized as (1) employed, (2) unemployed, (3) student (4) homemaker/paternal leave, (5) retired, and (6) disabled.

Statistical analyses

Table 1 presents the distribution of socio-demographic characteristics according to change in smoking status between 2007 and 2009.

Binary logistic regression was used to estimate odds ratio (corresponding 95% confidence intervals) of relapse in 2009 (table 2), and the odds of quitting smoking in 2009 (table 3) by background characteristics, change in income and stress levels. Analyses were also stratified by gender. Models were adjusted for age and sex; models for household income and income change were additionally adjusted for baseline income levels. As previous research supports the role of stress as a mediator of an individual's propensity to change smoking status, ~~1615~~ ~~1716~~ ~~2321~~ we also ran models of relapse and cessation with and without the inclusion of (1) changes in stress levels between 2007 and 2009 and (2) baseline stress levels.

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Repeated measures ANOVA (p-values, F statistic) was used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009 (table 4). Statistical analyses were conducted with IBM SPSS Statistics version 19.0 (SPSS Inc, Chicago, Illinois). Statistical significance was set at the 0.05 level, and all tests were 2-tailed.

Results

Baseline characteristics

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Table 1 describes the baseline characteristics of the cohort in 2007 (n=3755), which was 53.0% female, 76.7% married/cohabiting, and with a mean (SD) age of 52.3 (16.0). Table 1 also describes the characteristics of those that had relapsed and quit: 72.2% (n=2711) of the cohort were non-smokers, 4.0% (n=56) of the former smokers at baseline had relapsed in 2009, and 22.2% (n=149) of smokers at baseline had quit smoking in 2009. A significant reduction ($P < 0.01$) in the prevalence of smokers was observed from 2007 to 2009 in both males (17.4% to 14.8%) and females (20.0% to 17.5%).

Relapse smoking

Among individuals who were former smokers at baseline (table 2), decreased odds of relapsing in 2009 (after the collapse) were observed in the older age groups (compared to those aged 18-39), regardless of gender (age of 40-59: odds ratio 0.38; 95% confidence interval 0.21, 0.69 | age ≥ 60: 0.10; 0.04, 0.23).

While an individual's employment status was not involved in their risk of relapsing, retired females showed a significant increased risk of relapsing (4.12; 1.11, 15.29), compared to the employed.

Among men in the lower income groups at baseline (i.e. low, middle), those who moved into the high income group in 2009 experienced an increased risk of relapse (4.02; 1.15, 14.00)—while among those in the high income group at baseline, those whose incomes dropped had a decreased risk of relapsing (0.37; 0.16, 0.85). Further adjustments for a change in stress levels from 2007 to 2009, showed limited attenuation in the coefficients, suggesting some mediation by perceived stress – i.e. former smokers whose incomes increased between 2007 and 2009 may have relapsed in part because of an increase in stress.

Smoking cessation

Females were less likely to quit smoking in 2009 (0.65; 0.45, 0.93), compared to males. An increased likelihood of quitting in 2009 was observed among the following female groups: those with middle (2.78; 1.48, 5.21) or university-level (2.73; 1.38, 5.40) education compared to a basic, and the disabled (3.42; 1.23, 9.52) compared to the employed. Compared to females aged 18-29, those in the middle-aged group (0.46; 0.26, 0.83) were less likely to quit. Additional adjustments for a change in stress levels from baseline to follow-up in the cessation models revealed no diminished significance in effect sizes.

Stress and smoking

Though stress change (increase vs. stable, decrease vs. stable) did not predict a relapse in females in aforementioned analyses, further examination of changes in stress levels among smoking status displayed a significant change in mean stress levels (SD) among females that had relapsed,

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with a significant increase in stress scores from 3.96 (2.52) in 2007 to 5.24 (3.46) (P 0.01; F = 7.67).

Discussion

In response to the severe economic collapse in Iceland, we found that the prevalence of smoking continued to decrease for both genders in the short period after. This drop in smoking may be attributed to background secular trends,[20] while other factors, such as changes in the price of cigarettes, and changing norms about the acceptability of smoking, may also have played a role. The strength of our study is that we were able to document changes in individual economic status straddling the economic downturn and link these exposures to individual changes in smoking habits. Additionally, in comparison to national smoking rates (2007: 23.0% of population; 2009: 19.0%) the prevalence rates from 2007 to 2009 of this sample are relatively analogous – offering support for the generalizability of the sample.

Our findings partially corroborate previous research on the pro-cyclical nature of the association between economic downturns and smoking habit, i.e. during recessions, smoking habits may be dampened. Among male former smokers, those who experienced a decline in income during the economic recession had a significantly lower risk of relapse two years later. Conversely, among men whose incomes increased during the period of recession, their risk of relapse was considerably higher compared to those whose incomes stayed the same. Although the direction of associations was similar among women, none of the estimates were statistically significant.

Taken together, the main significant finding of our analyses is that male former smokers whose incomes fell during the period of the economic collapse experienced a reduced risk of relapse. Ruhm hypothesized that this risk reduction is possibly driven by a tendency to adopt healthier behaviours during periods of reduced income – driven by an increase in positive health behaviours (i.e. exercise) that accompanies newly acquired increased leisure time during economic contractions.[21] It could also be argued their behaviour change in a recession can be either intentional or inadvertent. When facing enforced economic inactivity – individuals may choose to fill their time by actively investing in positive personal health changes, which include stopping smoking or joining a fitness club. However, our results did not indicate an increased risk of quitting among those whose incomes fell – which is inconsistent with previous research by Siahpush & Carlin.[22]

It is possible that smoking cessation and smoking relapse are "asymmetric" behaviors with different triggers. Thus, a former smoker who experiences a drop in income may be less tempted to start smoking again because of the reduced affordability of cigarettes. On the other hand, someone who is already smoking may be less sensitive to an income drop (higher income inelasticity) –i.e. he is unable to quit his ongoing behavior because of the offsetting increase in stress (although our data on self-reported stress did not support this).

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There is an apparent discrepancy between the national decline in smoking in Iceland and the fact that smokers whose incomes declined were not more likely to quit. This underscores the point that macro-level data and individual-level patterns are often driven by a different set of causes. Thus, the overall decline in national smoking rates could be either due to the procyclical nature of smoking (i.e. recessions are good for health), or it may simply reflect a continuation of trends already in place prior to the recession (i.e. national anti-smoking campaigns, declining social acceptability of smoking, etc). In other words, national averages are driven by more than the group of smokers whose incomes decreased after the crisis.

Furthermore, we caution that our findings regarding recession, income change, and smoking habits cannot be generalized to other health outcomes. For example, observational reports found a spike in female cardiac emergency visits during the week corresponding to the economic collapse in October of 2008.3 In accordance with this, our previous analysis on changes in mental health revealed significant increases in stress for mainly women.4 This increase in stress for women, however threatening to related health outcomes, did not prove to be associated with an increased likelihood of relapsing.

Our findings are also congruent with multiple models explaining the link between stress levels and smoking behaviour. Though much research shows stress as a cause of smoking,[16~~15~~ 17~~16~~] additional research actually points to cigarette smoking as a cause of stress and, furthermore, smoking cessation as leading to a reduction in stress.[23] This is in line with our findings, as both male and female relapsed smokers had the lowest levels of stress before the collapse when they considered themselves as having quit smoking in 2007 (table 4), yet experienced an increase in stress post-collapse—significantly for women. This may also point to a vulnerability of this group to use smoking as a means of alleviating stress—explaining their relapse in smoking after the collapse.[24] This vulnerability has been discussed and supported by previous research showing economic stress as a cause of adverse mental health.[25] This increased stress may have also been amplified by a return to smoking, as Cohen & Lichtenstein have found.[26] Caution is warranted in interpreting the findings on stress, however, since smokers may be citing an increase in perceived stress to justify their relapse or failure to quit. We cannot conclusively argue that stress did not play a mediating role in the association between income change and smoking behaviour because of measurement error.

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Study limitations

Some limitations of our study should be noted. Relapsed smokers and quitters represent a small proportion of the population, and hence our odds ratios were estimated with imprecision and must be interpreted with caution. Similarly, we lacked statistical power to directly examine the effects of a change in employment status on change in smoking habits. In other words, though we were able to examine the effects of income change, we were not able to directly estimate the effects of unemployment as there were too few individuals in the sample who lost their jobs between 2007 and 2009. While our findings are based on the potential effects of an economic

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crisis on a change in smoking status, it is not clear whether these similar findings would hold true in normal scenarios and, thus, caution is warranted when generalizing our findings to other normative scenarios. Finally, smoking status was based on self-report only, and not validated by biomarkers such as cotinine. This may have produced misclassification of the outcome, though it is not clear whether this misclassification was differential by exposure status (e.g. income changes).

Conclusions

Our large population-based cohort with assessment points straddling the 2008 economic crisis in Iceland revealed a reduction in smoking rates from the short periods before and after the start of the crisis - though our study could not disentangle the direct effects of the crisis with other mechanisms, e.g. secular trends, changing cigarette prices. Chiefly, this examination revealed a role of income change on the risk of relapse after the collapse among former male smokers.

Notes

Contributors: CM and IK (study guarantor) were responsible for the design of the study and preparation of the manuscript. CM conducted data analyses. AH obtained funding. All contributors interpreted the data, contributed to the writing of the paper and approved the final version of the manuscript.

Funding: The project was funded in part by the Icelandic Centre for Research (RANNÍS). The authors are responsible for the manuscript's content, not the funding bodies.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no other authors had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years.

Ethical approval: The study was approved by the Ethics Review Board of Iceland (09-094) and the Data Protection Authority of Iceland (S4455).

Data sharing: No additional data available.

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Figures and Tables

Figure 1- The cohort of the "Health and well-being"-study.

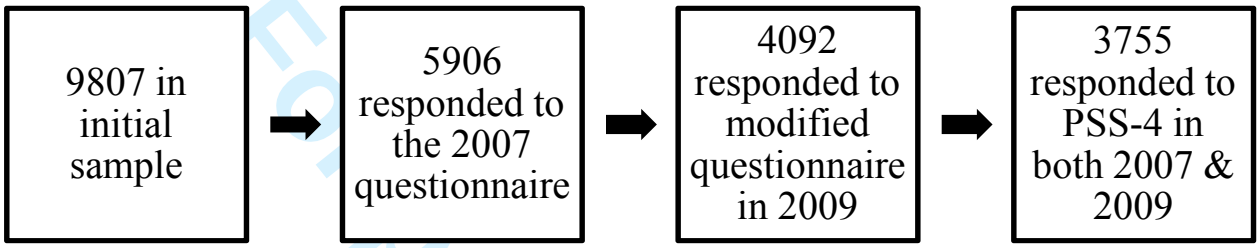

Table 1 – Baseline characteristics (in 2007) of the cohort and among differential smoking status

	Cohort	Relapsed in 2009	Quit Smoking in 2009
n	3755	56	160
Age Mean ± SD	52.3 ± 16.0	45.7 ± 14.2	47.4 ± 15.5
Sex	**n (% of category)**		
Male	1763 (47.0)	31 (55.4)	82 (51.3)
Female	1992 (53.0)	25 (44.6)	78 (48.8)
Marital status			
Single/Divorced	556 (14.9)	7 (13.0)	31 (19.9)
Committed, not cohabiting	131 (3.5)	2 (3.7)	9 (5.8)
Married, cohabiting	2871 (76.7)	45 (83.3)	116 (74.4)
Education			
Basic	1688 (47.1)	22 (40.7)	65 (42.5)
Middle	971 (27.1)	15 (27.8)	51 (33.3)
University	928 (25.9)	17 (31.5)	37 (24.2)
Employment status			
Employed	2019 (58.4)	37 (71.2)	98 (64.5)
Unemployed	169 (4.9)	3 (5.8)	10 (6.6)
Student	122 (3.5)	1 (1.9)	5 (3.3)
Homemaker/Paternal Leave	159 (4.6)	2 (3.8)	9 (5.9)
Retired	872 (25.2)	4 (7.7)	24 (15.8)
Disabled	119 (3.4)	5 (9.6)	6 (3.9)
Household income			

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Low	621 (20.6)	8 (17.0)	22 (16.5)
Middle	1855 (61.4)	25 (53.2)	80 (60.2)
High	543 (18.0)	14 (29.8)	31 (23.3)

Table 2 – The odds ratio of relapsing in 2009 among those who had quit smoking at the baseline (2007)

		OR (95% CI) a		
		Overall	Male	Female
2009 Status			Ref	0.67 (0.38, 1.18)
Household income in 2009 b	**n ***			
Low	8	0.66 (0.26, 1.70)	1.13 (0.24, 5.36)	0.56 (0.15, 2.08)
Middle	25	1.57 (0.48, 5.17)	2.28 (0.38, 13.55)	1.31 (0.21, 8.32)
High	17	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	5	Ref	Ref	Ref
Lower income in 2009	9	0.53 (0.28, 1.01)	0.37 (0.16, 0.85)	0.92 (0.29, 2.88)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	23	3.14 (1.27, 7.72)	4.02 (1.15, 14.00)	2.43 (0.64, 9.19)
Lower income in 2009	7	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	7	Ref	Ref	Ref
Decreased	15	0.91 (0.35, 2.36)	0.83 (0.23, 2.99)	1.03 (0.25, 4.28)
Increased	34	1.71 (0.86, 3.37)	1.75 (0.68, 4.53)	1.64 (0.61, 4.39)

* Totals do not include missing values from 2009
a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)

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Table 3 - The odds ratio of smoking cessation in 2009 among those who were smokers at the baseline (2007)

		OR (95% CI) a		
		Overall	Male	Female
2009 Status			Ref	0.65 (0.45, 0.93)
Household income in 2009 b	**n ***			
Low	22	0.89 (0.49, 1.60)	0.75 (0.33, 1.74)	1.01 (0.43, 2.36)
Middle	80	0.98 (0.45, 2.13)	0.80 (0.27, 2.38)	1.12 (0.36, 3.46)
High	31	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	19	Ref	Ref	Ref
Lower income in 2009	6	0.75 (0.46, 1.22)	0.82 (0.41, 1.62)	0.68 (0.34, 1.37)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	85	0.68 (0.30, 1.55)	0.61 (0.19, 1.97)	0.77 (0.24, 2.41)
Lower income in 2009	8	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	22	Ref	Ref	Ref
Decreased	62	0.84 (0.47, 1.48)	0.73 (0.34, 1.56)	0.98 (0.41, 2.31)
Increased	76	0.98 (0.64, 1.51)	0.66 (0.36, 1.22)	1.38 (0.74, 2.58)

* Totals do not include missing values from 2009
a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)

Table 4 – Average stress levels according to smoking status – among waves (2007 & 2009)

	2007	2009	
	Stress Mean (SD)	**Stress Mean (SD)**	**p-value (F) ±**
Never smoker			
Male	3.70 (2.75)	3.83 (2.69)	0.31 (1.02)
Female	4.18 (2.70)	4.40 (2.90)	0.44 (0.60)
Relapsed			
Male	3.52 (2.28)	4.94 (2.80)	0.28 (1.20)
Female	3.96 (2.52)	5.24 (3.46)	0.01 (7.67)
Quit smoking			

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Male	4.21 (2.71)	4.16 (2.78)	0.91 (0.01)
Female	4.38 (3.49)	5.03 (3.35)	0.13 (2.31)

± Repeated measures ANOVA (p-values, F statistic) used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009; adjusted for age in 2009

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Economic crisis and smoking behaviour: Prospective cohort study in Iceland

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Abstract

Objective To examine the associations between the 2008 economic collapse in Iceland and smoking behaviour at the national and individual levels. ~~determine whether the strains of a national economic collapse affect smoking cessation and risk of smoking relapse at the national and individual levelin the population.~~

Design A population-based, prospective cohort study based on a mail survey (*Health and Wellbeing in Iceland*) assessed in 2007 and 2009.

Setting National mail survey

Participants Representative cohort (n=3755) of Icelandic adults.

Main outcome measure Smoking status.

Results A significant reduction in the prevalence of smoking was observed from 2007 (pre-economic collapse) to 2009 (post-collapse) in both males (17.4% to 14.8%; P 0.01) and females (20.0% to 17.5%; P 0.01) in the cohort (n= 3755). At the individual level of analysis, male former smokers experiencing a reduction in income during the same period were less likely to relapse (OR 0.37; 95% CI 0.16, 0.85). Female smokers were less likely to quit over time compared to males (OR 0.65; 95% CI 0.45, 0.93). Among male former smokers who experienced an increase in income between 2007 and 2009, we observed an elevated risk of smoking relapse (OR 4.02; 95% CI 1.15, 14.00).

~~An increase in income from pre- to post-collapse among males (odds ratio 4.02; 95% confidence interval 1.15, 14.00) was strongly associated with an increased risk of relapse. Conversely, male former smokers experiencing a reduction in income were less likely to relapse (OR 0.37; 95% CI 0.16, 0.85). Regarding the propensity of pre-collapse smokers to quit in the period after the collapse, female smokers were less likely to quit compared to males (OR 0.65; 95% CI 0.45, 0.93).~~

Conclusions The national prevalence of smoking in Iceland declined following the 2008 economic crisis. This could be due to the pro-cyclical relationship between macro-economic conditions and smoking behaviour (i.e. hard times lead to less smoking because of lower affordability), or it may simply reflect a continuation of trends already in place prior to the crisis. In individual-level analysis, we find that former smokers who experienced a decline in income were less likely to relapse; and conversely, an increase in income raises the risk. However, caution is warranted since these findings are based on small numbers.

~~In line with on-going secular trend, the overall prevalence of smoking continued to decrease following the 2008 economic crisis in Iceland. Income increase during the period 2007-2009 was strongly associated with having relapsed in 2009, particularly among men, offering support for a~~

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~~pro-cyclical association between smoking and income. Yet the findings must be taken with caution, as they are based on a low number of subjects.~~

Article Summary

Article Focus

- An examination on the association between economic crises and smoking behaviours, i.e. is ~~a~~ change in income (at both the national and individual levels) related to a change in smoking status?

Key Messages

- National smoking prevalence declined in Iceland following the 2008 economic crisis.
- In individual-level analysis, male former smokers whose incomes declined experienced a reduced risk of smoking relapse.
- Conversely, an increase in income from 2007-2009 was associated with increased risk of relapse.
- Our findings are consistent with the hypothesis that economic downturns may result in decreased tobacco use (procyclical effect)~~, even though psychological stress increased in the aftermath of the crisis. Evidence for the association between increased income and increased risk of smoking relapse following an economic collapse.~~

~~Evidence for an association between decreased income and decreased risk of relapse.~~

- ~~Gender differences in smoking – represented by higher female prevalence rates and decreased likelihood of quitting for females compared to males.~~

Strengths and limitations of this study

- A representative prospective cohort study assessed at two time points, which straddle the start of a severe economic crisis.
- Due to the low number of individuals that change their smoking behaviours in a short period, we were unable to assess the effects of a change in employment on smoking habits.
- Findings are based on a low number of subjects and must be taken with caution.

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Introduction

The Icelandic economy was severely affected by the global economic collapse of 2008. After a decade-long period of financial prosperity the nation was plunged into a recession of great severity, resulting in a severe currency crisis, as well as a drastic increase in national and household debts, runaway unemployment rates, and decreased per capita purchasing power. ~~After a decade-long period of financial prosperity the nation was plunged into a recession of such severity that similar contractions had only been seen a handful of times before~~.[1 2]

Previous research on the health consequences of the Icelandic economic collapse has suggested adverse impacts on cardiovascular and mental health among women.[3 4] In the broader literature on economic crises and population health, however, it has been debated whether health moves in a pro-cyclical or counter-cyclical direction to macro-economic conditions. The work of Brenner beginning in the 1970s suggested that mortality is counter-cyclical, i.e. when the economy is down, mortality rates – in particular, suicides – rise.[5] However, in more recent years, a series of econometric studies have suggested that mortality is pro-cyclical, i.e. during economic contractions death rates decline.[6 7 8 9] There are plausible reasons for this unexpected finding – for instance, during the 1998 Korean financial crisis, economic activity was so depressed that there was a detectable decline in traffic-related mortality.[10] Others have speculated – without direct evidence – that people are more likely to be over-worked and "stressed" during economic booms than during busts, having less time flexibility to engage in health promoting behaviours.[11 12]

Few studies, however, have used individual-level data to test the association between recession and health, especially smoking. Most of the evidence to date has been at the ecological level, though not all.[13] For instance, Shaw et al. found a direct association between economic hardship and a propensity to smoke.[14] Using U.S. data, Ruhm previously reported that economic recession was associated with a decline in the prevalence of cigarette smoking.[12~~12~~] A recent report from Gallus et al. found that the recent economic contraction in Italy has given rise to an increase in the percentage of current smokers – primarily for females.[15] In the present study, we took advantage of the natural experiment afforded by the Icelandic crisis to examine the relationship between changes in economic conditions and smoking behaviour. Utilizing a prospective cohort of Icelandic adults assessed before (in 2007) and after the start of the collapse (in 2009), we sought to examine the risk of relapse among pre-collapse former smokers, as well as quitting behaviour among current smokers in terms of economic changes. Furthermore, because of the important role of perceived stress on smoking status, we sought to examine the potential influence of stress on the studied associations.[16 17]

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Methods

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Design and Samples

Cohort

Our cohort is based on the *Health and Wellbeing in Iceland* health survey. Data was collected by a questionnaire in two waves: (1) from October to December of 2007 (10-12 months pre-collapse), then again (2) between November and December of 2009 (13-14 months post-collapse). The cohort was based on a stratified random sample of the Icelandic population (n=9807), which was selected from 12 strata: consisting of two geographic regions further stratified by six age groups. Of the initial 9807, a total of 5918 responded to the initial 2007 assessment (response rate of 60.3%), with 4092 responding again to the modified version of the survey in 2007 (response rate of 82.8% of those who responded to the pre-collapse baseline survey). Because of the importance of stress as a potential predictor of smoking behaviour, we excluded individuals who did not have complete responses to the *Perceived Stress Scale* in both 2007 and 2009. This left a final analytical sample of n=3755. Figure 1 shows the cohort attrition over questionnaire waves.

Measures

Smoking status and behaviour

In the questionnaire, we inquired about smoking status, i.e. whether respondents were current smokers, had quit smoking, or had never smoked. In order to examine the likelihood of relapsing or quitting following an economic collapse, respondents were stratified according to their smoking status: non-smoker, relapsed, and quit smoking.

Non-smoker: An individual was classified as a non-smoker if they responded that they did not currently smoke on both the 2007 and 2009 assessments.

Relapsed smoker: An individual was identified as relapsed if they indicated that they (a) were a former smoker on the 2007 questionnaire, but indicated they had (b) smoked in any frequency in 2009. In our analyses estimating the odds ratios of relapse, the base population was restricted to individuals who were former smokers at baseline.

Quit smoking: A respondent that had quit smoking must have indicated that they were (a) currently smoking in 2007, yet had (b) quit smoking by 2009. In our analyses estimating the odds ratios of quitting, our base population was restricted to individuals who were current smokers at baseline.

Change in economic status

Additional socio-economic questions pertained to employment and income status. Household income was classified into income ranges of (in terms of Icelandic currency; *ISK*) (1) low ($\leq$ 3.4 million ISK), (2) middle (3.5-9.4 million ISK), and (3) high ($\geq$ 9.5 million ISK); corresponding

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approximately to (1) ≤ 28,000 USD, (2) 28,000-77,000 USD, and (3) ≥ 77,000 USD. For analysis of income change, household income was further dichotomized into either high or "low" (which combined the middle & low income categories). We examined two types of income change: a) drop in income between 2007 and 2009 from high to low; and b) a rise in income between 2007 and 2009 from low to high.

Change in perceived stress

Psychological stress was measured in both 2007 and 2009 using the four-item Perceived Stress Scale (PSS-4).[18] The PSS-4 is a shortened, validated, and acceptable substitute for the original scale,[19] with scores ranging from 0-16; the higher the score, the higher the perceived stress. An increase in stress was classified as any increase from baseline to follow-up; conversely, a decrease was classified as any decrease from baseline to follow-up. For example, an individual with a score of 5 in 2007 and a score of 10 in 2009 would be classified as having an increase in stress.

Explanatory variables and demographics

Our regression models controlled for the following socio-demographic covariates: age, sex, marital status, and education. Education was categorized as (1) basic (completed primary school or less), (2) middle (completed high school or equivalent), and (3) university (a completed university degree). Employment status was categorized as (1) employed, (2) unemployed, (3) student (4) homemaker/paternal leave, (5) retired, and (6) disabled.

Statistical analyses

Table 1 presents the distribution of socio-demographic characteristics according to change in smoking status between 2007 and 2009.

Binary logistic regression was used to estimate odds ratio (corresponding 95% confidence intervals) of relapse in 2009 (table 2), and the odds of quitting smoking in 2009 (table 3) by background characteristics, change in income and stress levels. Analyses were also stratified by gender. Models were adjusted for age and sex; models for household income and income change were additionally adjusted for baseline income levels. As previous research supports the role of stress as a mediator of an individual's propensity to change smoking status,[16~~15~~ 17~~16~~ 23~~21~~] we also ran models of relapse and cessation with and without the inclusion of (1) changes in stress levels between 2007 and 2009 and (2) baseline stress levels.

Repeated measures ANOVA (p-values, F statistic) was used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009 (table 4). Statistical analyses were conducted with IBM SPSS Statistics version 19.0 (SPSS Inc, Chicago, Illinois). Statistical significance was set at the 0.05 level, and all tests were 2-tailed.

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Results

Baseline characteristics

Table 1 describes the baseline characteristics of the cohort in 2007 (n=3755), which was 53.0% female, 76.7% married/cohabiting, and with a mean (SD) age of 52.3 (16.0). Table 1 also describes the characteristics of those that had relapsed and quit: 72.2% (n=2711) of the cohort were non-smokers, 4.0% (n=56) of the former smokers at baseline had relapsed in 2009, and 22.2% (n=149) of smokers at baseline had quit smoking in 2009. A significant reduction ($P < 0.01$) in the prevalence of smokers was observed from 2007 to 2009 in both males (17.4% to 14.8%) and females (20.0% to 17.5%).

Relapse smoking

Among individuals who were former smokers at baseline (table 2), decreased odds of relapsing in 2009 (after the collapse) were observed in the older age groups (compared to those aged 18-39), regardless of gender (age of 40-59: odds ratio 0.38; 95% confidence interval 0.21, 0.69 | age ≥ 60: 0.10; 0.04, 0.23).

While an individual's employment status was not involved in their risk of relapsing, retired females showed a significant increased risk of relapsing (4.12; 1.11, 15.29), compared to the employed.

Among men in the lower income groups at baseline (i.e. low, middle), those who moved into the high income group in 2009 experienced an increased risk of relapse (4.02; 1.15, 14.00)—while among those in the high income group at baseline, those whose incomes dropped had a decreased risk of relapsing (0.37; 0.16, 0.85). Further adjustments for a change in stress levels from 2007 to 2009, showed limited attenuation in the coefficients, suggesting some mediation by perceived stress – i.e. former smokers whose incomes increased between 2007 and 2009 may have relapsed in part because of an increase in stress.

Smoking cessation

Females were less likely to quit smoking in 2009 (0.65; 0.45, 0.93), compared to males. An increased likelihood of quitting in 2009 was observed among the following female groups: those with middle (2.78; 1.48, 5.21) or university-level (2.73; 1.38, 5.40) education compared to a basic, and the disabled (3.42; 1.23, 9.52) compared to the employed. Compared to females aged 18-29, those in the middle-aged group (0.46; 0.26, 0.83) were less likely to quit. Additional adjustments for a change in stress levels from baseline to follow-up in the cessation models revealed no diminished significance in effect sizes.

Stress and smoking

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Though stress change (increase vs. stable, decrease vs. stable) did not predict a relapse in females in aforementioned analyses, further examination of changes in stress levels among smoking status displayed a significant change in mean stress levels (SD) among females that had relapsed, with a significant increase in stress scores from 3.96 (2.52) in 2007 to 5.24 (3.46) (P 0.01; F = 7.67).

Discussion

In response to the severe economic collapse in Iceland, we found that the prevalence of smoking continued to decrease for both genders in the short period after. This drop in smoking may be attributed to background secular trends,[20] while other factors, such as changes in the price of cigarettes, and changing norms about the acceptability of smoking, ~~change of priorities in the favour of more health promoting behaviours or anti-smoking campaigns,~~ may also have played a role. The strength of our study is that we were able to document changes in individual economic status straddling the economic downturn and link these exposures to individual changes in smoking habits. Additionally, in comparison to national smoking rates (2007: 23.0% of population; 2009: 19.0%) the prevalence rates from 2007 to 2009 of this sample are relatively analogous – offering support for the generalizability of the sample.

Our findings partially corroborate previous research on the pro-cyclical nature of the association between economic downturns and smoking habit, i.e. during recessions, smoking habits may be dampened. Among male former smokers, those who experienced a decline in income during the economic recession had a significantly lower risk of relapse two years later. Conversely, among men whose incomes increased during the period of recession, their risk of relapse was considerably higher compared to those whose incomes stayed the same. Although the direction of associations was similar among women, none of the estimates were statistically significant.

Taken together, the main significant finding of our analyses is that male former smokers whose incomes fell during the period of the economic collapse experienced a reduced risk of relapse. Ruhm hypothesized that this risk reduction is possibly driven by a tendency to adopt healthier behaviours during periods of reduced income – driven by an increase in positive health behaviours (i.e. exercise) that accompanies newly acquired increased leisure time during economic contractions.[21] It could also be argued their behaviour change in a recession can be either intentional or inadvertent. When facing enforced economic inactivity – individuals may choose to fill their time by actively investing in positive personal health changes, which include stopping smoking or joining a fitness club. ~~It is equally plausible that a drop in income involuntarily forces smokers to give up their habit.~~ However, our results did not indicate an increased risk of quitting among those whose incomes fell – which is inconsistent with ~~the latter hypothesis, as well as~~ previous research by Siahpush & Carlin.[22]

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It is possible that smoking cessation and smoking relapse are "asymmetric" behaviors with different triggers. Thus, a former smoker who experiences a drop in income may be less tempted to start smoking again because of the reduced affordability of cigarettes. On the other hand, someone who is already smoking may be less sensitive to an income drop (higher income inelasticity) –i.e. he is unable to quit his ongoing behavior because of the offsetting increase in stress (although our data on self-reported stress did not support this).

There is an apparent discrepancy between the national decline in smoking in Iceland and the fact that smokers whose incomes declined were not more likely to quit. This underscores the point that macro-level data and individual-level patterns are often driven by a different set of causes. Thus, the overall decline in national smoking rates could be either due to the procyclical nature of smoking (i.e. recessions are good for health), or it may simply reflect a continuation of trends already in place prior to the recession (i.e. national anti-smoking campaigns, declining social acceptability of smoking, etc). In other words, national averages are driven by more than the group of smokers whose incomes decreased after the crisis.

~~Foremost, our findings support Ruhm's theory of the positive effects of recessions on a population's health behaviours.[12] Ruhm revealed an association between markers (e.g. unemployment) of economic downturns and reductions in smoking, with an increase being seen during economic expansion. Though tobacco products are likely to be procyclical goods, as Ruhm further points out, offering some explanation of the decrease we observed, it does not explain all of the mechanisms involved.~~

Furthermore, w~~W~~e caution that our findings regarding recession, income change, and smoking habits cannot be generalized to other health outcomes. For example, observational reports found a spike in female cardiac emergency visits during the week corresponding to the economic collapse in October of 2008.3 In accordance with this, our previous analysis on changes in mental health revealed significant increases in stress for mainly women.4 This increase in stress for women, however threatening to related health outcomes, did not prove to be associated with an increased likelihood of relapsing.

Our findings are also congruent with multiple models explaining the link between stress levels and smoking behaviour. Though much research shows stress as a cause of smoking,[16~~15~~ 17~~16~~] additional research actually points to cigarette smoking as a cause of stress and, furthermore, smoking cessation as leading to a reduction in stress.[23] This is in line with our findings, as both male and female relapsed smokers had the lowest levels of stress before the collapse when they considered themselves as having quit smoking in 2007 (table 4), yet experienced an increase in stress post-collapse—significantly for women. This may also point to a vulnerability of this group to use smoking as a means of alleviating stress—explaining their relapse in smoking after the collapse.[24] This vulnerability has been discussed and supported by previous research showing economic stress as a cause of adverse mental health.[25] This increased stress may have also been amplified by a return to smoking, as Cohen & Lichtenstein have found.[26] Caution is warranted in

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interpreting the findings on stress, however, since smokers may be citing an increase in perceived stress to justify their relapse or failure to quit. We cannot conclusively argue that stress did not play a mediating role in the association between income change and smoking behaviour because of measurement error.

Study limitations

Some limitations of our study should be noted. Relapsed smokers and quitters represent a small proportion of the population, and hence our odds ratios were estimated with imprecision and must be interpreted with caution. Similarly, we lacked statistical power to directly examine the effects of a change in employment status on change in smoking habits. In other words, though we were able to examine the effects of income change, we were not able to directly estimate the effects of unemployment as there were too few individuals in the sample who lost their jobs between 2007 and 2009. While our findings are based on the potential effects of an economic crisis on a change in smoking status, it is not clear whether these similar findings would hold true in normal scenarios and, thus, caution is warranted when generalizing our findings to other normative scenarios. Finally, smoking status was based on self-report only, and not validated by biomarkers such as cotinine. This may have produced misclassification of the outcome, though it is not clear whether this misclassification was differential by exposure status (e.g. income changes).

Conclusions

Our large population-based cohort with assessment points straddling the 2008 economic crisis in Iceland revealed a reduction in smoking rates from the short periods before and after the start of the crisis - though our study could not disentangle the direct effects of the crisis with other mechanisms, e.g. secular trends, changing cigarette prices. Chiefly, this examination revealed a ~~decisive~~ role of income change on the risk of relaps~~ing~~ after the collapse among former male smokers.

Notes

Contributors: CM and IK (study guarantor) were responsible for the design of the study and preparation of the manuscript. CM conducted data analyses. AH obtained funding. All contributors interpreted the data, contributed to the writing of the paper and approved the final version of the manuscript.

Funding: The project was funded in part by the Icelandic Centre for Research (RANNÍS). The authors are responsible for the manuscript's content, not the funding bodies.

Competing interests: All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no other authors had financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years.

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Ethical approval: The study was approved by the Ethics Review Board of Iceland (09-094) and the Data Protection Authority of Iceland (S4455).

Data sharing: No additional data available.

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Figures and Tables

Figure 1- The cohort of the "Health and well-being"-study.

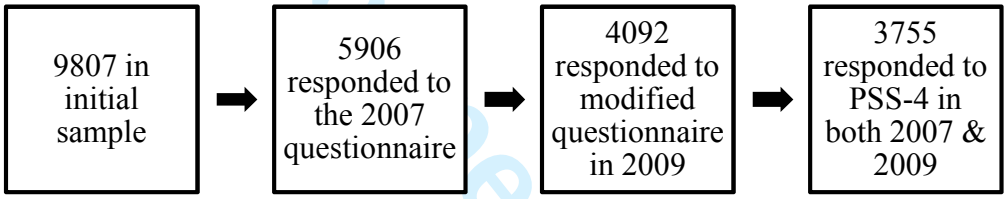

Table 1 – Baseline characteristics (in 2007) of the cohort and among differential smoking status

	Cohort	Relapsed in 2009	Quit Smoking in 2009
n	3755	56	160
Age Mean ± SD	52.3 ± 16.0	45.7 ± 14.2	47.4 ± 15.5
Sex	**n (% of category)**		
Male	1763 (47.0)	31 (55.4)	82 (51.3)
Female	1992 (53.0)	25 (44.6)	78 (48.8)
Marital status			
Single/Divorced	556 (14.9)	7 (13.0)	31 (19.9)
Committed, not cohabiting	131 (3.5)	2 (3.7)	9 (5.8)
Married, cohabiting	2871 (76.7)	45 (83.3)	116 (74.4)
Education			
Basic	1688 (47.1)	22 (40.7)	65 (42.5)
Middle	971 (27.1)	15 (27.8)	51 (33.3)
University	928 (25.9)	17 (31.5)	37 (24.2)
Employment status			
Employed	2019 (58.4)	37 (71.2)	98 (64.5)
Unemployed	169 (4.9)	3 (5.8)	10 (6.6)
Student	122 (3.5)	1 (1.9)	5 (3.3)
Homemaker/Paternal Leave	159 (4.6)	2 (3.8)	9 (5.9)
Retired	872 (25.2)	4 (7.7)	24 (15.8)
Disabled	119 (3.4)	5 (9.6)	6 (3.9)
Household income			

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Low	621 (20.6)	8 (17.0)	22 (16.5)
Middle	1855 (61.4)	25 (53.2)	80 (60.2)
High	543 (18.0)	14 (29.8)	31 (23.3)

Table 2 – The odds ratio of relapsing in 2009 among those who had quit smoking at the baseline (2007)

		OR (95% CI) a		
	Overall		Male	Female
2009 Status			Ref	0.67 (0.38, 1.18)
Household income in 2009 b	**n ***			
Low	8	0.66 (0.26, 1.70)	1.13 (0.24, 5.36)	0.56 (0.15, 2.08)
Middle	25	1.57 (0.48, 5.17)	2.28 (0.38, 13.55)	1.31 (0.21, 8.32)
High	17	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	5	Ref	Ref	Ref
Lower income in 2009	9	0.53 (0.28, 1.01)	0.37 (0.16, 0.85)	0.92 (0.29, 2.88)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	23	3.14 (1.27, 7.72)	4.02 (1.15, 14.00)	2.43 (0.64, 9.19)
Lower income in 2009	7	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	7	Ref	Ref	Ref
Decreased	15	0.91 (0.35, 2.36)	0.83 (0.23, 2.99)	1.03 (0.25, 4.28)
Increased	34	1.71 (0.86, 3.37)	1.75 (0.68, 4.53)	1.64 (0.61, 4.39)

* Totals do not include missing values from 2009
a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)

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Table 3 - The odds ratio of smoking cessation in 2009 among those who were smokers at the baseline (2007)

		OR (95% CI) a		
		Overall	Male	Female
2009 Status			Ref	0.65 (0.45, 0.93)
Household income in 2009 b	**n ***			
Low	22	0.89 (0.49, 1.60)	0.75 (0.33, 1.74)	1.01 (0.43, 2.36)
Middle	80	0.98 (0.45, 2.13)	0.80 (0.27, 2.38)	1.12 (0.36, 3.46)
High	31	Ref	Ref	Ref
Household income in 2009 (among high income at baseline) b				
High income in 2009	19	Ref	Ref	Ref
Lower income in 2009	6	0.75 (0.46, 1.22)	0.82 (0.41, 1.62)	0.68 (0.34, 1.37)
Household income in 2009 (among low incomes at baseline) b				
High income in 2009	85	0.68 (0.30, 1.55)	0.61 (0.19, 1.97)	0.77 (0.24, 2.41)
Lower income in 2009	8	Ref	Ref	Ref
Change in stress from 2007 to 2009 c				
Same	22	Ref	Ref	Ref
Decreased	62	0.84 (0.47, 1.48)	0.73 (0.34, 1.56)	0.98 (0.41, 2.31)
Increased	76	0.98 (0.64, 1.51)	0.66 (0.36, 1.22)	1.38 (0.74, 2.58)

* Totals do not include missing values from 2009
a OR adjusted for statuses in 2009: age, sex
b OR adjusted for statuses in 2009: age, sex, baseline income in 2007
c OR additionally adjusted for baseline stress (2007)

Table 4 – Average stress levels according to smoking status – among waves (2007 & 2009)

	2007	2009	
	Stress Mean (SD)	**Stress Mean (SD)**	**p-value (F) ±**
Never smoker			
Male	3.70 (2.75)	3.83 (2.69)	0.31 (1.02)
Female	4.18 (2.70)	4.40 (2.90)	0.44 (0.60)
Relapsed			
Male	3.52 (2.28)	4.94 (2.80)	0.28 (1.20)
Female	3.96 (2.52)	5.24 (3.46)	0.01 (7.67)
Quit smoking			

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Male	4.21 (2.71)	4.16 (2.78)	0.91 (0.01)
Female	4.38 (3.49)	5.03 (3.35)	0.13 (2.31)

± Repeated measures ANOVA (p-values, F statistic) used to examine overall and gender-specific mean differences in stress levels from 2007 to 2009; adjusted for age in 2009

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