Economic conditions and health behaviours during the 'Great Recession'

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ABSTRACT

Background The adoption of healthier behaviours has been hypothesised as a mechanism to explain empirical findings of population health improvements during some economic downturns.

Methods We estimated the effect of the local unemployment rate on health behaviours using pooled annual surveys from the 2003–2010 Behavioral Risk Factor Surveillance Surveys, as well as population-based telephone surveys of the US adult general population. Analyses were based on approximately 1 million respondents aged 25 years or older living in 90 Metropolitan Statistical Areas and Metropolitan Divisions (MMSAs). The primary exposure was the quarterly MMSA-specific unemployment rate. Outcomes included alcohol consumption, smoking status, attempts to quit smoking, body mass index, overweight/obesity and past-month physical activity or exercise.

Results The average unemployment rate across MMSAs increased from a low of 4.5% in 2007 to a high of 9.3% in 2010. In multivariable models accounting for individual-level sociodemographic characteristics and MMSA and quarter fixed effects, a one percentage-point increase in the unemployment rate was associated with 0.15 (95% CI −0.31 to 0.01) fewer drinks consumed in the past month and a 0.14 (95% CI −0.28 to 0.00) percentage-point decrease in the prevalence of past-month heavy drinking; these effects were driven primarily by men. Changes in the unemployment rate were not consistently associated with other health behaviours. Although individual-level unemployment status was associated with higher levels of alcohol consumption, smoking and obesity, the MMSA-level effects of the recession were largely invariant across employment groups.

Conclusions Our results do not support the hypothesis that health behaviours mediate the effects of local-area economic conditions on mortality.

INTRODUCTION

Empirical research continues to endeavour to reconcile the divergent findings of individual-level studies that imply a negative effect of *unemployment* on health and recent population-level studies concluding a positive 'net-effect' of *unemployment rates* on health.[1 2] Since the early debates about the effects of economic conditions on health,[3 4] procyclical variation in mortality has been observed in a variety of high-income contexts,[5–13] with some evidence suggesting that the effects were stronger for men compared with women.[5 9] For example, an analysis using aggregate data from 23 Organisation for Economic Co-operation and Development countries showed that a one percentage-point decrease in the national unemployment rate was associated with a 0.4% increase in total mortality over the period from 1960 to 1997.[13] Important exceptions to studies showing procyclical variation in mortality are instances of severe economic crisis.[14 15]

Health behaviours, including tobacco use, alcohol consumption and physical inactivity, are among the leading preventable contributors to mortality, and are one of the primary mechanisms posited to explain procyclical patterns of mortality when they occur.[16–18] First, during economic downturns, households may reduce consumption of goods, including those that are harmful to health like alcohol and tobacco. Second, average hours worked may decline during downturns, resulting in a lower opportunity cost to engaging in health-promoting activities, including exercise and physical activity. Third, following the 'self-medication' hypothesis, reductions in employment-related stress may result in decreased substance use, although this may be outweighed by the stresses of unemployment and of remaining employed during periods of high job loss.[19–21] A mediating role of health behaviours in explaining procyclical variation in mortality implies that, on average, health behaviours improve during economic downturns, although, according to the 'inhibition hypothesis', the effects of downturns may vary depending on individual employment circumstances,[2 22] implying a potentially heterogeneous effect of economic conditions on health behaviours.[23]

The effect of economic conditions on health behaviours, as well as whether the effect is modified by individual-level characteristics such as gender or employment status, remains unclear. Using microdata from the US Behavioral Risk Factor Surveillance System (BRFSS), Ruhm[7 9 24] showed that an increase in the state unemployment rate was associated with lower prevalence of smoking, alcohol consumption, obesity and physical inactivity, with effects concentrated among the heaviest substance users, the severely obese and the completely inactive. Conversely, other US and European evidence suggests that unemployment is positively associated with excessive alcohol consumption and alcohol-related mortality.[25 26]

In this study, we estimated the total and gender-specific effects of local economic conditions in US metropolitan areas before and after the onset of the 'Great Recession' beginning in 2007[27] on smoking, alcohol consumption, weight and physical activity. Additionally, we examined the 'inhibition hypothesis' by testing whether the effect of local economic conditions on health behaviours varied by individual-level employment status.

METHODS

Sample

Data were drawn from the 2003–2010 BRFSS Selected Metropolitan/Micropolitan Area Risk Trends (SMART) project.[28] BRFSS is a telephone survey administered collaboratively by the Centers for Disease Control and the US state and territory governments for the purpose of measuring health risk behaviours, preventive health practices and healthcare access among the non-institutionalised adult population aged 18 years and older.[29] BRFSS SMART provides estimates for selected metropolitan and micropolitan statistical areas and metropolitan divisions (together labelled Metropolitan Statistical Areas and Metropolitan Divisions (MMSAs)[30]) with at least 500 BRFSS respondents. Whereas BRFSS is designed to provide state-level estimates, SMART utilises sampling weights poststratified by demographic characteristics, including age and gender, to provide MMSA-level estimates. Our sampling frame included 1 231 517 BRFSS respondents from 90 distinct metropolitan statistical areas (MSAs) and metropolitan divisions in 46 states, plus the District of Columbia, which were included in all BRFSS quarters between 2003 and 2010. For the purposes of these analyses, we limited our data set to 944 159 respondents 25 years of age or older with complete information on covariates of interest; sample sizes per MMSA are shown in online supplementary eTable 1. The Institutional Review Board of McGill University approved the study.

Outcome measures

Outcomes included self-reported measures of alcohol consumption, smoking, obesity and exercise. We used the number of days a respondent reported drinking (with a drink defined as one 12 oz beer, one 5 oz glass of wine or one shot of liquor) and the average number of drinks per day when drinking over the past 30 days to estimate the number of alcoholic drinks consumed in the past month and average daily alcohol consumption over the past 30 days. Heavy alcohol consumption was defined as average daily consumption greater than two drinks for men and one for women based on the NIAAA definition of at-risk or heavy drinking.[31] Consistent with prior studies, we censored 329 (0.03%) observations exceeding an average of 16 drinks/day or 24 drinks on days when drinking.[24] Self-report of smoking cigarettes every day or on some days was used to create binary indicators for regular and occasional smoking, respectively. A binary indicator for attempted smoking cessation identified current smokers who had, in the previous 12 months, ceased smoking for at least a day with the intention of quitting.

Nutritional status was measured by body mass index (BMI), calculated using self-reported height and weight (weight(kg)/(height(m)^2)).[32] Binary indicators for 'overweight or obese', 'obese' and 'severely obese' were created based on BMI cut-points of ≥25, ≥30 and ≥35, respectively. Differential misreporting of height and weight may bias measurement of BMI.[33] We adopted the correction method described by Cawley and Burkhauser[34] and used coefficients from a nationally representative regression of measured weight and height on self-reported values in the Third National Health and Nutrition Examination Survey to predict true BMI values in BRFSS that were corrected for self-report bias. Values of BMI <14 or BMI >80 (n=439, 0.06%) were considered improbable and censored. A binary exercise variable indicated whether respondents reported participating in any form of physical activity or exercise outside of their regular occupation in the previous month.

Primary exposure

The primary indicator of economic conditions was the quarterly MMSA-level unemployment rate, defined as the proportion of the civilian labour force unemployed among those actively seeking work.[35] Seasonally adjusted unemployment rates, which smooth month-to-month volatility attributable to changes in weather, harvests, major holidays and the opening and closing of schools, were collected from the Bureau of Labor Statistics Local Area Unemployment Statistics database.[36] Seasonally adjusted unemployment rates were unavailable for MMSAs within six New England states; rates for these MMSAs were computed from county-level data for New England MMSAs and were not seasonally adjusted.

Individual-level covariates

Individual level sociodemographic characteristics included age, gender, employment status (employed, unemployed >1 year, unemployed <1 year, retired, being a student or homemaker or unable to work), race/ethnicity (white, black, Hispanic, other), educational attainment (less than high-school, high-school completion, some college/technical school, college graduate or higher), annual household income (<$10 000–$14 999, $15 000–$24 999, $25 000–$34 999, $35 000–$49 999, $50 000–$74 999, ≥$75 000) and marital status (married or cohabitating, divorced or separated, widowed, never married).

Statistical analyses

We estimated, for individual *i*, the effect of the local unemployment rate on health behaviours using a series of ordinary least squares (OLS) regression models of the general form $Y_{ijt} = \alpha_j + \beta_1 E_{jt} + \lambda_t + \varepsilon_{ijt}$, where β_1 measures the effect of a one percentage-point increase in the quarterly MMSA-level unemployment rate (E_{jt}, where j indexes the MMSA and t the quarter) on our health behavioural outcomes of interest (Y_{ijt}). All models included fixed effects for MMSA (α_j) and quarter (λ_t) to control for unobserved time-invariant confounders that vary across MMSAs, and any temporal trends in health behaviours that are shared across MMSAs, respectively. The effects of economic conditions were therefore identified by changes occurring within an MMSA relative to corresponding changes within others.[8 9 24]

In the first model, we estimated the age-adjusted and gender-adjusted effect of the unemployment rate on health behaviours, controlling for MMSA and quarter fixed effects (model 1). The coefficient for the unemployment rate, β_1, gives the causal effect of unemployment on health behaviours provided that the MMSA and quarter fixed effects suffice to control for confounding of the effect of the unemployment rate on individual health behaviours. Model 1 assumes that there are no omitted state-specific trends that may confound the effect of the unemployment rate. Second, in model 2, we additionally controlled for measured individual-level sociodemographic characteristics. Third, to address potential unobserved confounding by MMSA-specific temporal trends, we added an interaction between MMSA and time represented by the product of the MMSA fixed effect and a continuous indicator for quarter (model 3). Fourth, we investigated the effect of the unemployment rate on health behaviours (model 2) after lagging unemployment by one-quarter, E_{jt-1} (model 4). Fifth, we estimated gender-specific effects of the unemployment rate on health behaviours. For these analyses, we estimated models 1–4 as described above, but included a product term between the unemployment rate and gender. We additionally included

product terms between gender and MMSA fixed effects (to control for time-invariant differences across MMSAs in the effect of gender on health behaviours) and between gender and quarter fixed effects (to control for gender differences in overall secular trends). Similar analyses were used to assess whether the effect of the unemployment rate on health behaviours varied by individual employment status (a test of the 'inhibition hypothesis'). All models used the BRFSS SMART sampling weights and we used robust SEs to account for clustering at the MMSA level.[37]

Sensitivity analyses

We assessed the robustness of our principal findings in several ways. First, for binary outcomes we compared our least squares regression estimates (model 2) with those from logistic regression models. Second, we repeated all analyses using unemployment rates unadjusted for seasonality. Third, we tested for a non-linear effect of the unemployment rate on health behaviours by introducing a quadratic unemployment rate to model 2. Fourth, we assessed the effect of another proxy for economic conditions, the MMSA-specific employment-population ratio (EP ratio), on health behaviours in place of the unemployment rate, E_{jt}. The EP ratio includes discouraged workers and represents the proportion of the civilian non-institutional population that is employed.[38] Details regarding the calculation of MMSA-specific EP ratios are provided in the eAppendix. Fifth, we assessed whether the effect of the EP ratio on health behaviours was modified by individual-level gender and employment status.

RESULTS

Table 1 shows the frequencies and distributions of the primary exposure, outcome measures and other covariates over the study period from 2003 through 2010. The mean MMSA-specific unemployment rate increased markedly between 2007 (4.5%) and 2010 (9.3%). On average, respondents consumed 11.6 drinks of alcohol in the previous month and 5% of the sample reported heavy alcohol consumption. There was a monotonic decline in prevalence of current smoking over the study period, decreasing from 15.8% in 2003 to 10.8% in 2010. The mean BMI increased monotonically from 27.5 in 2003 to 28.3 in 2010. On average, 1.3% of respondents were classified as underweight, 32.1% as normal weight, 37.2% as overweight and 29.3% as obese. Roughly, 75% of respondents reported participating in exercise outside of their occupation in the previous month.

As indicated by model 2, a one percentage-point increase in unemployment (0.4 SDs) was associated with 0.15 (95% CI −0.31 to 0.01) fewer drinks consumed in the past month or a decrease of 1.3% relative to the sample mean (table 2). Similarly, a one percentage-point increase in unemployment was associated with a 0.14 (95% CI −0.28 to 0.00) percentage-point decrease in the prevalence of heavy drinking, equivalent to a 2.8% decrease relative to the sample mean. Unemployment was not consistently associated with the average number of drinks consumed when drinking. The general conclusion of an inverse effect of unemployment on alcohol consumption was robust to alternative model specifications (eg, inclusion of MMSA-specific time trends in model 3). The effects of the lagged unemployment rate on alcohol consumption (model 4) were similar to the contemporaneous effects from model 2.

Changes in the unemployment rate were not associated with the probability of being a regular or occasional smoker. However, a one percentage-point increase in the unemployment rate was associated with a 0.78 (95% CI −1.38 to −0.17) percentage-point decrease in the prevalence of attempting to quit smoking in the previous year (corresponding to a 1.4% decrease relative to the sample mean), although this result was not robust to inclusion of MMSA-specific time trends (model 3). Changes in the unemployment rate were consistently not associated with changes in BMI, obesity or physical activity in the past month across model specifications.

The effect of the unemployment rate varied by gender for certain health behaviours (table 3). For example, a one percentage-point increase in unemployment was associated with 0.27 (95% CI −0.55 to 0.00) and 0.03 (95% CI −0.13 to 0.07) fewer drinks consumed in the past month among men and women, respectively. Additionally, a one percentage-point increase in the unemployment rate was associated with a 0.32 (95% CI −0.61 to −0.02) percentage-point decrease in the prevalence of regular smoking among men, but a 0.01 (95% CI −0.22 to 0.23) increase among women. There was limited evidence of gender differences in the effect of the unemployment rate on health behaviours for other outcomes.

Variations in the effect of unemployment on health behaviours by individual employment status are given in table 4. Effects among the employed, who comprised two-thirds of the sample, were similar in magnitude to those for the total sample. For some health behaviours, the effect of the unemployment rate was stronger in magnitude for individuals unemployed for greater than 1 year than for the total sample. For example, among those unemployed for greater than 1 year, a one percentage-point increase in the unemployment rate was associated with a 0.78 (95% CI −1.78 to 0.20) fewer drinks consumed in the past month, a 0.25 (95% CI −0.74 to 0.25) percentage-point decrease in the prevalence of heavy drinking, and a 2.8 percentage-point decrease in the prevalence of attempting to quit smoking in the previous year; however, this group comprised 2% of the sample and we were most likely underpowered to detect these effects. An increase in the unemployment rate was positively associated with obesity and negatively associated with physical activity in the past month among retirees.

We used alternative model specifications to test the robustness of our main results presented in table 2. For binary health behaviours, results using logistic regression models were similar to those from OLS specifications (eTable 2). The effects on health behaviours of a one percentage-point increase in the seasonally unadjusted unemployment rate were nearly equivalent to those for the seasonally adjusted unemployment rate (eTable 3). There was no evidence for a non-linear effect of the unemployment rate for any health behaviours (eTable 4). As anticipated, the effects of the MSA-specific EP ratio on health behaviours were generally in the direction opposite to those reported for the unemployment rate; however, these effects were not statistically significant, most likely due to the smaller sample used in the EP ratio analyses (eTable 5), and there was no evidence of modification of the effect of the EP ratio on health behaviours by gender (eTable 6). Similar to the unemployment rate, the effects of the EP ratio on health behaviours were, for alcohol-related health behaviours, most pronounced among individuals unemployed for greater than 1 year (eTable 7).

DISCUSSION

We used the most recent data available from the US BRFSS to estimate the effect of the recent recession on preventable contributors to mortality, including alcohol consumption, cigarette use and obesity and exercise. Our analyses suggest that an increase in the unemployment rate was associated with a small decrease in alcohol-related health behaviours and that men

Table 1 Frequencies and distributions of exposures, outcomes and other covariates, 2003–2010; n=944 159 BRFSS respondents from 90 MMSAs*

Variable name	Category	N (unweighted)	Weighted mean value								
			2003	2004	2005	2006	2007	2008	2009	2010	Average
Unemployment rate, seasonally adjusted		90	5.97	5.45	4.98	4.51	4.46	5.58	9.01	9.34	6.18
Unemployment rate, unadjusted		90	5.97	5.45	4.99	4.50	4.46	5.55	9.01	9.33	6.18
Employment population ratio		55			63.73	64.21	64.34	63.50	60.65	59.77	62.68
Number of drinks in past month		944 159	12.50	11.54	11.86	11.08	11.35	11.65	11.64	11.48	11.63
Heavy drinker indicator	No	895 757	94.91	95.30	94.86	95.17	95.00	94.89	94.83	94.89	94.98
	Yes	48 402	5.09	4.70	5.14	4.83	5.00	5.11	5.17	5.11	5.02
Average number of drinks when drinking		532 658	2.12	2.17	2.31	2.19	2.25	2.21	2.19	2.18	2.20
Smoking status	Regular smoker	122 286	15.82	14.10	13.88	12.86	12.35	12.02	11.37	10.82	12.87
	Occasional smoker	42 777	5.19	5.59	5.38	4.99	5.48	4.93	5.07	4.69	5.16
	Former smoker	286 179	27.38	25.67	26.63	26.76	26.19	26.93	27.16	26.71	26.68
	Never smoker	492 917	51.60	54.64	54.11	55.39	55.99	56.11	56.41	57.77	55.29
Smoking quit attempt in past 12 months	No	73 683	46.64	45.35	43.29	42.60	40.86	40.95	39.80	40.79	42.68
	Yes	91 020	53.36	54.65	56.71	57.40	59.14	59.05	60.20	59.21	57.32
BMI		944 159	27.54	27.68	27.79	27.88	28.00	28.09	28.23	28.33	27.95
BMI category	Normal weight	301 253	34.36	33.34	32.87	32.63	32.05	31.17	30.72	30.21	32.14
	Underweight	13 197	1.48	1.46	1.42	1.20	1.35	1.32	1.22	1.25	1.34
	Overweight	342 563	37.63	37.89	37.40	37.41	36.72	37.28	36.78	36.77	37.23
	Obese class I	176 651	17.23	17.50	18.17	18.38	18.70	18.94	19.43	19.43	18.49
	Obese class II	67 958	5.85	6.16	6.40	6.45	7.05	7.09	7.24	7.74	6.76
	Obese class III	42 537	3.45	3.65	3.74	3.93	4.12	4.20	4.61	4.60	4.05
Leisure physical activity in past month	No	220 808	22.90	22.45	23.01	21.89	21.94	24.11	22.71	22.19	22.65
	Yes	723 351	77.10	77.55	76.99	78.11	78.06	75.89	77.29	77.81	77.35
Employment status	Employed	562 235	66.55	67.35	67.37	67.83	66.89	66.18	63.68	63.13	66.10
	Unemployed >1 year	19 421	1.90	2.10	2.00	1.68	1.56	2.09	3.03	4.42	2.36
	Unemployed <1 year	24 427	3.43	2.99	2.51	2.53	2.29	3.25	4.84	3.78	3.21
	NA (student, homemaker, unable to work)	123 008	12.49	12.58	12.72	12.95	13.83	13.18	13.11	13.20	13.02
	Retired	215 068	15.62	14.98	15.39	15.01	15.44	15.30	15.34	15.46	15.32
Gender	Male	380 999	50.33	50.42	50.53	50.32	50.19	50.20	50.05	50.24	50.28
	Female	563 160	49.67	49.58	49.47	49.68	49.81	49.80	49.95	49.76	49.72
Race/ethnicity	White	750 997	69.09	67.92	67.48	68.13	67.02	67.29	67.12	66.80	67.59
	Black	91 137	11.50	11.60	11.97	11.08	11.26	11.87	12.02	12.42	11.72
	Hispanic	58 038	12.30	13.90	13.34	13.58	13.74	13.50	13.34	13.16	13.36
	Other	43 987	7.11	6.59	7.21	7.21	7.99	7.34	7.52	7.62	7.33
Age		944 159	47.82	47.72	48.03	48.10	48.29	48.72	48.80	49.04	48.33
Educational attainment	Less than high school	66 777	8.75	9.43	8.95	8.96	8.52	8.72	7.68	7.66	8.57
	High school graduate or GED	238 673	25.32	24.61	24.46	23.29	23.63	23.14	22.62	22.54	23.68
	Some college/technical school	244 672	25.46	24.90	25.12	24.55	24.69	24.81	24.65	24.63	24.85
	College/tech school grad or higher	394 037	40.47	41.06	41.46	43.20	43.16	43.33	45.06	45.17	42.90
Annual household income	<$10 000–<$15 000	84 515	8.48	8.86	8.42	7.96	7.70	7.45	7.80	8.02	8.08
	$15 000–<$25 000	138 480	14.31	14.33	13.67	12.86	12.45	12.43	12.84	13.07	13.23
	$25 000–<$35 000	106 520	12.19	11.46	10.77	10.22	9.59	9.35	9.24	8.86	10.19
	$35 000–<$50 000	144 705	16.31	15.77	15.17	13.99	13.94	13.22	13.09	13.12	14.30
	$50 000–<$75 000	165 794	18.29	18.26	18.61	17.91	17.31	17.27	16.32	15.87	17.46
	>$75 000	304 145	30.43	31.31	33.35	37.04	39.01	40.28	40.71	41.05	36.74
Marital status	Married or cohabitating	555 540	66.54	67.42	68.41	69.56	69.70	69.86	70.14	70.57	69.05
	Divorced or separated	165 790	13.44	13.41	12.70	12.48	12.25	12.27	11.77	11.46	12.46
	Widowed	107 592	6.70	6.12	6.13	5.89	5.93	5.86	5.81	5.58	6.00
	Never married	115 237	13.31	13.05	12.75	12.07	12.12	12.00	12.28	12.39	12.49

*Weights are MMSA-specific poststratified for age, gender and usually race.
BMI, body mass index; BRFSS, Behavioral Risk Factor Surveillance System; MMSAs, Metropolitan Statistical Areas and Metropolitan Divisions.

primarily drove these procyclical effects. The effects of the recession on other health behaviours were largely null. Additionally, the effects of local-area unemployment were similar across employment groups, although the prevalence of unhealthy behaviours was higher among unemployed individuals.

Earlier findings indicating countercyclical variation in mortality[4 39 40] have been challenged over time[41–43] by the inference that economic downturns may be beneficial to health,[5–12] although there are exceptions in the case of severe economic crises, including the collapse of the Former Soviet Union[15] and the Mexican financial crisis.[14] While individual unemployment is detrimental to health, it may be less problematic for one's health to be unemployed at a time when many others are unemployed, and those who remain employed may have better health during recessions, these recent empirical studies suggest. Health behaviours have been one of the primary mechanisms hypothesised to explain procyclical variation in mortality, yet

Table 2 Effect of one percentage-point increase in quarterly MMSA-specific unemployment rate on health behaviours, 2003–2010; n=944 159 BRFSS respondents from 90 MMSAs*

	Model 1†		Model 2‡		Model 3§		Model 4¶	
	β**	95% CI	β**	95% CI	β**	95% CI	β**	95% CI
Number of drinks in past month	−0.167	(−0.322 to -0.013)	−0.153	(−0.311 to 0.005)	−0.279	(−0.531 to -0.027)	−0.131	(−0.291 to 0.029)
Heavy drinker	−0.148	(−0.287 to −0.008)	−0.143	(−0.281 to −0.004)	−0.171	(−0.316 to −0.027)	−0.136	(−0.267 to −0.004)
Average number of drinks when drinking	−0.012	(−0.036 to 0.013)	−0.011	(−0.034 to 0.013)	−0.035	(−0.071 to 0.000)	−0.01	(−0.032 to 0.013)
Regular smoker	−0.091	(−0.316 to 0.135)	−0.158	(−0.378 to 0.061)	−0.205	(−0.425 to 0.015)	−0.122	(−0.345 to 0.102)
Occasional smoker	−0.130	(−0.307 to 0.047)	−0.146	(−0.324 to 0.032)	−0.069	(−0.310 to 0.172)	−0.149	(−0.326 to 0.028)
Smoking quit attempt in past 12 months	−0.731	(−1.332 to −0.130)	−0.775	(−1.381 to −0.169)	−0.091	(−0.900 to 0.718)	−0.818	(−1.422 to −0.214)
BMI score	0.003	(−0.034 to 0.041)	0.000	(−0.038 to 0.037)	0.049	(−0.022 to 0.120)	0.012	(−0.027 to 0.051)
Overweight or obese	0.058	(−0.215 to 0.332)	0.063	(−0.233 to 0.358)	0.397	(−0.043 to 0.838)	0.108	(−0.175 to 0.391)
Obese	0.051	(−0.345 to 0.446)	0.026	(−0.373 to 0.425)	0.369	(−0.043 to 0.782)	0.071	(−0.328 to 0.470)
Severely obese	0.023	(-0.193 to 0.239)	0.000	(−0.216 to 0.216)	0.162	(−0.119 to 0.444)	0.075	(−0.182 to 0.331)
Leisure physical activity in past month	0.123	(−0.154 to 0.400)	0.196	(−0.144 to 0.536)	−0.155	(−0.501 to 0.191)	0.264	(−0.083 to 0.611)

*Sample size 944 159 except for average number of drinks when drinking (532 658) and smoking quit attempts (164 703).
†Model 1 includes fixed effects for MMSA and quarter and controls for age and gender.
‡Model 2 includes fixed effects for MMSA and quarter and individual-level covariates (age, gender, employment status, race/ethnicity, household income, educational attainment and marital status).
§Model 3 includes fixed effects for MMSA and quarter, individual-level covariates (age, gender, employment status, race/ethnicity, household income, educational attainment and marital status) and incorporates MMSA-specific temporal trends represented by the product of the MMSA fixed effect and a continuous indicator for quarter.
¶Model 4 includes fixed effects for MMSA and quarter, individual-level covariates (age, gender, employment status, race/ethnicity, household income, educational attainment and marital status) and lags the unemployment rate by one-quarter.
**Coefficients represent predicted effects of a one percentage-point increase in the quarterly MMSA-level unemployment rate on health behaviours.
BMI, body mass index; BRFSS, Behavioral Risk Factor Surveillance System; MMSAs, Metropolitan Statistical Areas and Metropolitan Divisions.

few studies have explored this empirically and they have yielded mixed results. For example, US studies with model specifications similar to ours concluded that the state unemployment rate was negatively associated with heavy alcohol consumption using data from the 1987–1999 BRFSS surveys[24] and positively associated with binge drinking, alcohol-induced driving and alcohol abuse and/or dependence using 2001–2002 and 2004–2005 panel data from the National Epidemiological Survey on Alcohol and Related Conditions.[32]

With respect to drinking behaviours, we found that the MMSA-specific unemployment rate was associated with fewer drinks consumed in the past month, a decreased prevalence of heavy drinking, and fewer drinks consumed when drinking, results that are consistent with the hypothesis that health behaviours explain procyclical fluctuations in mortality. These effect sizes, however, were relatively small. For example, a one percentage-point increase in unemployment was estimated to decrease the number of drinks consumed on drinking occasions and, in the past month, by approximately one-hundredth and one-sixth of a drink, respectively. There was some evidence that men drove the procyclical effects we observed for alcohol-related health behaviours. Our results contrast with recent work, also using BRFSS, which suggests that the Great Recession was associated with an increase in abstention from alcohol consumption, as well as increases in heavy drinking and frequent binge drinking.[44] However, this analysis used a pre–post design that makes it difficult to rule out bias, particularly unmeasured confounding.

In contrast to prior work covering periods that predate the Great Recession,[7 9] our results essentially showed no effect of the unemployment rate on health behaviours aside from alcohol consumption, including smoking and physical activity in the prior month, although the unemployment rate was negatively associated with the prevalence of regular smoking among men, but not women. Disparate findings may reflect true heterogeneity in the effect of the unemployment rate on health behaviours. It is plausible, for instance, that the effect may vary depending on the severity of the economic downturn.[25]

We tested whether the effect of economic conditions on health behaviours was modified by individual-level employment status. The negative effects of the MMSA-specific unemployment rate on the prevalence of alcohol-related health behaviours were greater in magnitude for the longer-term unemployed than for other employment groups, a finding inconsistent with the hypothesis that procyclical fluctuations in mortality are explained by the adoption of healthier behaviours among those who remain employed during downturns.[2 22] A negative association between the unemployment rate and alcohol-related health behaviours among the unemployed may be explained by income effects or the individual experience of unemployment having less detrimental effects when experienced in the context of large numbers of people losing jobs than when experienced in isolation. The results are consistent with previous findings that incident job loss is associated with the adoption of unhealthier behaviours at the individual level[45] but suggest that the impact is moderated by the environment. Conversely, if individuals who lose jobs during recessions are, on average, healthier than those already unemployed and unhealthier than those who remain employed, then an increase in the unemployment rate may have the effect of improving health behaviours, on average, for both the employed and unemployed groups over time.

There were several limitations to our analyses. First, assessment of health behaviours in BRFSS is based on self-report and may be measured with error. For example, the assessment of physical activity in BRFSS does not solicit information on the frequency or duration of exercise. We attempted to account for measurement error when possible, including a correction for misreporting of height and weight, and any under-reporting of unhealthy behaviours would only bias results if the extent of under-reporting fluctuated with economic conditions. Second, residual confounding is always a concern, but we attempted to

Table 3 Effect of one percentage-point increase in quarterly MMSA-specific unemployment rate on health behaviours by gender, 2003–2010; n=944 159 BRFSS respondents from 90 MMSAs*

	Model 1†			Model 2‡			Model 3§			Model 4¶		
	Female β** (95% CI)	Male β (95% CI)	p Value††	Female β (95% CI)	Male β (95% CI)	p Value	Female β (95% CI)	Male β (95% CI)	p Value	Female β (95% CI)	Male β (95% CI)	p Value
Number of drinks in past month	−0.043 (−0.157 to 0.071)	−0.288 (−0.550 to −0.025)	0.076	−0.027 (−0.128 to 0.073)	−0.274 (−0.551 to 0.003)	0.087	−0.185 (−0.304 to −0.066)	−0.365 (−0.823 to 0.093)	0.438	−0.010 (−0.112 to 0.091)	−0.249 (−0.541 to 0.044)	0.132
Heavy drinker	−0.108 (−0.269 to 0.052)	−0.185 (−0.392 to 0.022)	0.542	−0.100 (−0.248 to 0.049)	−0.184 (−0.396 to 0.028)	0.498	−0.232 (−0.426 to −0.038)	−0.109 (−0.365 to 0.148)	0.494	−0.076 (−0.218 to 0.067)	−0.194 (−0.409 to 0.020)	0.360
Average number of drinks when drinking	0.000 (−0.012 to 0.012)	−0.020 (−0.058 to 0.018)	0.258	0.003 (−0.007 to 0.013)	−0.021 (−0.058 to 0.016)	0.196	−0.010 (−0.027 to 0.006)	−0.054 (−0.108 to 0.000)	0.080	0.004 (−0.005 to 0.014)	−0.020 (−0.058 to 0.017)	0.203
Regular smoker	0.028 (−0.224 to 0.281)	−0.204 (−0.489 to 0.081)	0.131	0.005 (−0.219 to 0.229)	−0.315 (−0.614 to −0.016)	0.038	0.008 (−0.272 to 0.287)	−0.414 (−0.847 to 0.018)	0.161	0.020 (−0.205 to 0.246)	−0.258 (−0.574 to 0.058)	0.095
Occasional smoker	−0.089 (−0.248 to 0.070)	−0.171 (−0.434 to 0.092)	0.533	−0.091 (−0.256 to 0.074)	−0.200 (−0.459 to 0.058)	0.399	0.111 (−0.074 to 0.295)	−0.242 (−0.698 to 0.214)	0.180	−0.090 (−0.256 to 0.077)	−0.210 (−0.468 to 0.047)	0.359
Smoking quit attempt in past 12 months	−0.456 (−1.161 to 0.250)	−0.966 (−1.967 to 0.035)	0.452	−0.468 (−1.125 to 0.190)	−1.041 (−2.037 to −0.045)	0.375	0.542 (−0.718 to 1.801)	−0.576 (−1.720 to 0.568)	0.213	−0.502 (−1.184 to 0.179)	−1.109 (−2.156 to −0.063)	0.389
BMI score	−0.006 (−0.063 to 0.050)	0.014 (−0.043 to 0.070)	0.648	−0.009 (−0.060 to 0.041)	0.009 (−0.050 to 0.068)	0.663	0.025 (−0.058 to 0.108)	0.071 (−0.000 to 0.142)	0.207	0.000 (−0.053 to 0.053)	0.025 (−0.028 to 0.078)	0.498
Overweight or obese	0.057 (−0.282 to 0.397)	0.062 (−0.466 to 0.590)	0.989	0.052 (−0.257 to 0.360)	0.073 (−0.488 to 0.634)	0.952	0.113 (−0.381 to 0.608)	0.669 (0.077 to 1.261)	0.111	0.128 (−0.201 to 0.458)	0.092 (−0.432 to 0.616)	0.916
Obese	0.032 (−0.356 to 0.421)	0.071 (−0.506 to 0.647)	0.901	0.018 (−0.356 to 0.392)	0.035 (−0.552 to 0.622)	0.955	0.314 (−0.141 to 0.770)	0.410 (−0.141 to 0.961)	0.763	0.052 (−0.336 to 0.440)	0.094 (−0.469 to 0.658)	0.883
Severely obese	−0.099 (−0.324 to 0.126)	0.144 (−0.148 to 0.436)	0.121	−0.112 (−0.330 to 0.106)	0.111 (−0.179 to 0.401)	0.131	−0.005 (−0.392 to 0.382)	0.314 (0.049 to 0.580)	0.098	−0.038 (−0.297 to 0.221)	0.188 (−0.138 to 0.513)	0.146
Leisure physical activity in past month	0.300 (−0.006 to 0.606)	−0.049 (−0.405 to 0.307)	0.080	0.343 (−0.050 to 0.737)	0.055 (−0.306 to 0.415)	0.114	0.075 (−0.354 to 0.504)	−0.390 (−0.945 to 0.164)	0.206	0.415 (0.026 to 0.804)	0.117 (−0.266 to 0.500)	0.111

*Sample size 944 159 except for average number of drinks when drinking (532 658) and smoking quit attempts (164 703).
†Model 1 includes gender-specific fixed effects for MMSA and quarter, controls for individual age, and includes a product term between gender and the unemployment rate.
‡Model 2 includes gender-specific fixed effects for MMSA and quarter, individual-level covariates (age, employment status, race/ethnicity, household income, educational attainment and marital status) and a product term between gender and the unemployment rate.
§Model 3 includes gender-specific fixed effects for MMSA and quarter, individual-level covariates (age, employment status, race/ethnicity, household income, educational attainment and marital status), allows for gender and MMSA-specific temporal trends represented by the product of gender, the MMSA fixed effect and a continuous indicator for quarter, and includes a product term between gender and the unemployment rate.
¶Model 4 includes gender-specific fixed effects for MMSA and quarter, individual-level covariates (age, employment status, race/ethnicity, household income, educational attainment and marital status) and a product term between gender and the unemployment rate lagged by one-quarter.
**Coefficients represent predicted effects of a one percentage-point increase in the quarterly MMSA-level unemployment rate on health behaviours.
††pValues represent the significance of the interaction between gender and the unemployment rate or the lagged unemployment rate.
BMI, body mass index; BRFSS, Behavioral Risk Factor Surveillance System; MMSAs, Metropolitan Statistical Areas and Metropolitan Divisions.

Table 4 Effect of one percentage-point increase in quarterly MMSA-specific unemployment rate by employment status for health behaviours, 2003–2010; n=944 159 BRFSS respondents from 90 MMSAs*,†

	Number of drinks in past month		Heavy drinker		Average number of drinks when drinking		Regular smoker		Occasional smoker	
	β‡	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Employed	−0.161	(−0.363 to 0.040)	−0.170	(−0.361 to 0.020)	−0.014	(−0.044 to 0.017)	−0.228	(−0.540 to 0.085)	−0.137	(−0.339 to 0.064)
Unemployed >1 year	−0.784	(−1.772 to 0.203)	−0.245	(−0.738 to 0.248)	−0.062	(−0.225 to 0.101)	−0.232	(−1.426 to 0.962)	−0.940	(−1.986 to 0.107)
Unemployed<1 year	−0.319	(−1.048 to 0.410)	−0.116	(−0.810 to 0.577)	−0.013	(−0.103 to 0.076)	−0.014	(−1.051 to 1.023)	0.037	(−0.840 to 0.914)
NA (student, homemaker, unable to work)	−0.080	(−0.255 to 0.095)	−0.070	(−0.273 to 0.132)	−0.016	(−0.047 to 0.014)	0.052	(−0.426 to 0.530)	−0.249	(−0.541 to 0.044)
Retired	−0.055	(−0.322 to 0.213)	−0.103	(−0.349 to 0.144)	0.009	(−0.025 to 0.043)	−0.029	(−0.285 to 0.226)	−0.008	(−0.194 to 0.178)

	Smoking quit attempt in past 12 months		BMI score		Overweight or obese		Obese		Severely obese		Leisure physical activity in past month	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Employed	−0.763	(−1.635 to 0.108)	0.009	(−0.033 to 0.052)	0.149	(−0.156 to 0.454)	0.043	(−0.410 to 0.496)	0.009	(−0.168 to 0.186)	0.233	(−0.231 to 0.697)
Unemployed >1 year	−2.817	(−4.741 to -0.894)	−0.001	(−0.190 to 0.189)	0.508	(−0.946 to 1.962)	−0.862	(−1.924 to 0.199)	0.048	(−1.120 to 1.215)	0.104	(−1.280 to 1.489)
Unemployed <1 year	−1.254	(−3.070 to 0.562)	−0.094	(−0.283 to 0.095)	−0.570	(−1.630 to 0.491)	-0.553	(−2.031 to 0.926)	−0.535	(−1.386 to 0.316)	0.722	(−0.599 to 2.042)
NA (student, homemaker, unable to work)	−0.502	(−1.331 to 0.327)	−0.094	(−0.176 to -0.012)	−0.235	(−0.935 to 0.466)	−0.547	(−1.236 to 0.142)	−0.175	(−0.631 to 0.281)	0.243	(−0.263 to 0.749)
Retired	0.175	(−1.136 to 1.485)	0.067	(−0.005 to 0.140)	0.194	(−0.464 to 0.852)	0.753	(0.251 to 1.255)	0.214	(−0.143 to 0.571)	−0.367	(−0.668 to -0.065)

*Sample size 944 159 except for average number of drinks when drinking (532 658) and smoking quit attempts (164 703).
†Results are from a model that includes employment status, specific fixed effects for MMSA and quarter, individual-level covariates (age, gender, employment status, race/ethnicity, household income, educational attainment and marital status) and a product term representing the interaction between the unemployment rate and individual-level employment status.
‡Coefficients represent predicted effects of a one percentage-point increase in the quarterly MMSA-level unemployment rate on health behaviours.
BMI, body mass index; BRFSS, Behavioral Risk Factor Surveillance System; MMSAs, Metropolitan Statistical Areas and Metropolitan Divisions.

Nandi A, *et al*. *J Epidemiol Community Health* 2013;**67**:1038–1046. doi:10.1136/jech-2012-202260

account for it by including MMSA and quarter fixed effects in our regressions, as well as MMSA-specific time trends. Additionally, it is unlikely that many unmeasured factors, such as cigarette taxes, fluctuated with economic conditions. Third, we used established measures of economic conditions, specifically the unemployment rate and employment population ratio. It is possible that these measures are removed from the everyday experience of individuals and may not represent the most relevant indicators of economic conditions in relation to health outcomes. Future work should investigate whether other features of the Great Recession, including the pervasive impact on the crisis on the housing market, affected health behaviours and other outcomes.

There has been speculation over the predicted effects of the Great Recession on health behaviours and population health outcomes. If the recent recession was associated with a modest improvement in population health, then health behaviours, particularly alcohol consumption, may play a mediating role. However, our estimates are inconsistent with the results that we would expect if the Great Recession had a substantial effect on mortality that was mediated by health behaviours, potentially implicating other mechanisms.

Additional work investigating the consequences of recessions on conditions affecting health, morbidity and mortality is warranted. First, alternative measures of the economic environment besides gross domestic product and unemployment, such as the prevalence of home foreclosures in the local area that was characteristic of the recent recession, should be considered. Second, future work should explore whether the effect of economic conditions on health is modified by the severity of crises or the effectiveness of public policy responses to crises, as has been suggested elsewhere.[25] Third, cohort data with information on incident job loss should be used to test the 'inhibition hypothesis'.

What is already known on this subject

- The adoption of healthier behaviours is hypothesised to explain observations that recessions may be associated with improvements in population health.
- However, the effect of economic conditions on health behaviours remains unclear.

What this study adds

- This study estimated the effects of the local unemployment rate on health behaviours in the USA during the recent 'Great Recession'.
- We found that the unemployment rate was associated with a small decrease in alcohol use; however, the effects of the recession on other health behaviours were largely null.
- Our results are inconsistent with the findings that would be expected if the Great Recession had effects on mortality mediated by changes in health behaviours.

Contributors All authors contributed to the conceptualisation of research questions and design of the analysis. TC led the analyses and all authors interpreted the results. AN drafted the manuscript and all authors critically reviewed the article and approved the final version of the manuscript.

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