# Osong Public Health and Research Perspectives

Original Article

# Impact of Cardiovascular Disease on Health Insurance Coverage and Healthcare Use under Economic Stress: The National Health and Nutrition Examination Survey, 2003-2012

Ji Li [a], Hong Lai [b], Dong Chen [c], Shaoguang Chen [a], Shenghan Lai [a, b, d,*]

[a] Department of Pathology, Johns Hopkins School of Medicine, Baltimore, MD, United States
[b] Department of Radiology, Johns Hopkins School of Medicine, Baltimore, MD, United States
[c] Department of Accounting, Finance and Economics, Merrick School of Business, University of Baltimore, Baltimore, MD, United States
[d] Department of Medicine, Johns Hopkins School of Medicine, Baltimore, MD, United States

## ABSTRACT

*Objectives:* Cardiovascular disease (CVD) has a substantial financial impact on healthcare systems in the US. This study aimed to examine the impact of CVD on health insurance coverage and health service use under economic stress as indicated by the Great Recession in the US (December 2007-June 2009).
*Methods:* Data of 26,483 adults aged ≥ 20 years from the 2003-2012 National Health and Nutrition Examination Survey were analyzed. There were 9,479 adults assigned to the group "before the Great Recession" (2003-2006), 5,674 adults assigned to "during the Great Recession" (2007-2008), and 11,330 adults assigned to "after the Great Recession" (2009-2012).
*Results:* Patients with CVD from low-income families were more likely to have health insurance during the recession (OR:1.57, 95% CI: 1.01,2.45). Those participants without CVD, who were from low-income families or < 65 years, were more likely to use the emergency room rather than primary care facilities to gain access to routine healthcare ($p < 0.05$). Patients with CVD from high-income families were also more likely to use the emergency room ($p < 0.05$). Patients with CVD but not those without CVD, who reported a high family income or were ≥ 65 years old, were less likely to use mental health services during the recession than before the recession.
*Conclusion:* Effective strategies need to be developed to promote primary care use among the general adult American population. In addition, use of mental health services among patients with CVD needs to be improved when financial stress occurs.

## Introduction

Cardiovascular disease (CVD) is a leading cause of death in the US [1]. Each year, approximately 800,000 Americans die from CVD [1]. Despite advances in prevention and treatment of CVD at population and individual levels, socioeconomic inequalities in CVD morbidity and mortality have been widely observed in both developed and developing countries [2]. In the US, individuals with a lower socioeconomic status (SES) were at a greater risk for developing CVD and had more CVD-associated risk factors such as smoking, obesity, hypertension, and diabetes than those with a higher SES [3]. Lack of access to healthcare and barriers to healthcare use in low SES groups partly explained SES differences in CVD outcomes [4], and financial strain may further compromise affordability of health insurance and use of health services [5].

Financial insecurity and employment instability may have direct adverse effects on health such as depression, suicide,

*Corresponding author: Shenghan Lai
Department of Pathology, Johns Hopkins School of Medicine, 600 N. Wolfe Street, Pathology 301, Baltimore, MD 21287, United States
E-mail address: slai@jhmi.edu

and general mortality [6,7]. However, the detrimental effects of economic decline on CVD are unclear. Studies in the US and Australia reported higher risks for heart attack, stroke and CVD mortality following the loss of a job [8,9]. It has been observed recently in a longitudinal study in UK households that economic insecurity worsened metabolic, inflammatory and liver function biomarkers [10]. However, increased unemployment rates have been positively associated with heart-healthy lifestyles in some European populations [6,11]. The "CARDIA" data showed that CVD risk factors tended to decline during joblessness or recessions, while depressive symptoms significantly increased among unemployed individuals [12].

The Great Recession, which officially lasted from December 2007 till June 2009, was considered as the worst global economic crisis since the Second World War [13]. Less access to employer-sponsored health insurance and forgone healthcare have been observed during the Great Recession [14,15]. However, given the possible serious consequences and high healthcare costs of CVD, these associations observed in the general population, may not be applied to those with CVD. The objective of this study was to use nationally representative data from the 2003-2012 National Health and Nutrition Examination Survey (NHANES), to investigate whether associations between the macro-level economic stress and health insurance coverage/health service use, varied for people with and without CVD in the US. These associations were examined separately by SES (i.e., family income and employment status) and age groups. The findings of this study may provide additional information on the impact of having CVD when there is a national economic downturn which may help policy makers adapt appropriate health services and resource allocations for target populations, such as those with pre-existing medical conditions, the elderly, and the unemployed.

## Materials and Methods

### 1. Study Population

The continuous NHANES is a surveillance program initiated in 1999 and conducted annually by the National Center for Health Statistics, the Centers for Disease Control and Prevention. Participants were sampled from civilian, non-institutionalized Americans, using stratified multistage probability design. The elderly, African Americans, and Hispanics were over-sampled to provide reliable estimates for these groups. NHANES aims to assess the health and nutritional status of adults and children, in the general US population. The research protocols for NHANES were approved by National Center for Health Statistics

Institutional Review Board (Hyattsville, MD, USA). Details on the study designs and data collection procedures have been previously published [16].

NHANES collected information on all sampled participants' health insurance coverage and healthcare use outcomes during the previous 12 months. The cardiovascular history was recorded among participants aged 20 years and older. Five 2-year NHANES cycles (2003-2004, 2005-2006, 2007-2008, 2009-2010, and 2011-2012) were combined for this study. This yielded the final sample of 26,483 participants aged 20 years and older. There were 9,479 adults surveyed before the Great Recession (2003-2006), 5,674 adults surveyed during the Great Recession (2007-2008), and 11,330 adults surveyed after the Great Recession (2009-2012). Multiyear NHANES data have been widely analyzed in previous research to examine the impact of the Great Recession on various health-related outcomes by categorizing years before, during, and after the Great Recession [17-20]. As compared to other population-based data sources, NHANES data have several advantages, such as large sample size, stable and robust sampling strategies, and standardized interview components [16].

### 2. Health Insurance Status

The Health Insurance Questionnaire was administered to participants in their homes by trained NHANES staff. The interview included questions on insurance status, type of insurance coverage, and prescription drug coverage during the past 12 months. Participants were classified as; 1) "Covered by health insurance" if they answered "Yes" to the question "Are you covered by health insurance or some other kind of healthcare plan?", 2) "Prescriptions covered by health plans" if they answered "Yes" to the question "Do any of these plans cover any part of the cost of prescriptions?", and 3) "Covered by private insurance" if they answered "Yes" to the question "Are you covered by private insurance?"

### 3. Self-Rated General Health Conditions

During face-to-face interviews, participants were asked to evaluate their general health and health condition now, compared with 1 year ago. Responses to the question "Would you say your health in general is …" were collapsed into 2 categories 1) Excellent or Very Good vs. 2) Good, Fair, or Poor. Participants' present health was categorized into 3 groups 1) better compared with 12 months ago (Yes vs. No), 2) about the same compared with 12 months ago (Yes vs. No), and 3) worse compared with 12 months ago (Yes vs. No).

### 4. Healthcare Access and Use Outcomes

Participants' access to healthcare was measured by the location for routine healthcare (primary care facilities,

Emergency Department, other or more than one location, and no routine location). The participants were considered to have used inpatient healthcare if they had spent at least 1 overnight hospital stay in the previous year. The participants' outpatient healthcare was categorized into 2 groups, 1) more than 4 outpatient visits vs. 2) 0-3 outpatient visits in the previous year. Use of mental healthcare was identified if the participants reported a visit to a mental health professional in the previous year.

## 5. Diagnosis of CVD

Participants were asked the questions "Has a doctor or other health professional ever told you that you had … …" for congestive heart failure, coronary heart disease, angina/angina pectoris, heart attack, or stroke. If they answered "Yes" to any of these 5 questions, participants were considered to have had a diagnosis of CVD. Although NHANES did not validate self-reported CVD, previous validation studies have shown high sensitivity and specificity of deriving CVD history from self-administered questionnaire [21].

## 6. Statistical Analysis

Descriptive and regression analyses were weighted for the complex cluster sample design and conducted using Proc Survey in SAS Version 9.3 (SAS Institute, Cary, NC, US). Distributions of selected demographic characteristics, lifestyle variables, insurance status, and healthcare use outcomes were described using unweighted frequencies. The weighted proportions were compared using the Rao-Scott chi-square goodness-of-fit tests.

Multiple logistic regression models were used to compare insurance status and healthcare use during the Great Recession and after the Great Recession, with those before the Great Recession for the participants with and without CVD. The models were stratified by income-to-poverty ratio (IPR, IPR < 2, IPR 2-4.49, and IPR ≥ 4.5), employment status (employed vs. unemployed), and age groups (< 65 years vs. ≥ 65 years). Health insurance and healthcare use outcome variables were treated as binary variables. Demographic and lifestyle covariates were adjusted for multivariate logistic regression models that included age, gender, ethnicity/race, education, body weight status, smoking status, and physical activity (see Appendix I) [22]. Statistical significance was reached when the value of $p < 0.05$.

## Results

### 1. Distribution of Selected Demographic Variables of the Study Participants

A total of 26,483 adults who participated in the 2003-2012 NHANES were included in the analyses (Table 1). Of the total, approximately 82.8% were < 65 years, 48.1% were males, 69.5% were non-Hispanic white, 67.9% were overweight or obese, and 8.8% (3,045 adults) had a diagnosis of CVD. The participants with CVD were significantly older, less educated, had lower family income, and were more likely to be obese, unemployed, and physically inactive compared with those without CVD before, during, and after the Great Recession ($p < 0.05$).

### 2. Insurance Status and Healthcare Use by Selected Demographic Variables

As shown in Table 2, approximately 80.6% of the participants were covered by health insurance, 93.7% had health plans to cover part of the cost of prescriptions, 78.4% had private insurance, less than half reported excellent or very good health, 82.1% used primary care facilities for routine healthcare, 38.1% used inpatient services and had overnight stays in hospital in the previous year, 11.0% used outpatient services more than 4 times in the previous year, and only 7.8% reported the use of mental health services in the previous year. The participants who had a diagnosis of CVD were more likely to be insured, receive routine healthcare at primary care facilities, have overnight hospital stay in the previous year, and use outpatient services over the previous year as compared with their counterparts without CVD, before, during, and after the Great Recession ($p < 0.05$; Table 2).

### 3. The Associations of the Great Recession with Insurance Status and Healthcare Use According to CVD Diagnosis

The associations of insurance status and healthcare use with the Great Recession were outlined by family income, employment status and age for the participants diagnosed with CVD (Table 3). Unlike the associations observed in the participants without CVD (Table 4), the majority of insurance and healthcare use indicators for the participants with CVD, did not differ significantly during and after the Great Recession as compared to those before the recession. However, after adjusting for various covariates such as age, gender, ethnicity/race, education, body weight status, smoking, and physical activity level, people with CVD from lower income families (IPR < 2) were more likely to have health insurance during the Great Recession (OR: 1.57, 95% CI: 1.01, 2.45). People with CVD from higher income families were more likely to receive routine healthcare from an Emergency Department rather than primary care facilities during the Great Recession (OR: 57.65,

Table 1. Selected demographic characteristics of the study participants (≥ 20 years), NHANES 2003-2012*.

| Characteristics | All | Before recession (2003-2006) | | |
| --- | --- | --- | --- | --- |
| | | No CVD | CVD | $p^{\dagger}$ |
| N | 26,483 | 8,309 | 1,170 | |
| Age (y) | | | | < 0.001 |
|   20-64 | 19,944 (82.77) | 6,619 (87.02) | 385 (42.53) | |
|   ≥ 65 | 6,539 (17.23) | 1,690 (12.98) | 785 (57.47) | |
| Gender | | | | 0.301 |
|   Male | 12,843 (48.08) | 3,904 (47.85) | 636 (49.91) | |
|   Female | 13,640 (51.92) | 4,405 (52.15) | 534 (50.09) | |
| Race/Ethnicity | | | | < 0.001 |
|   Non-Hispanic white | 12,374 (69.49) | 4,141 (71.21) | 733 (79.24) | |
|   Non-Hispanic black | 5,695 (11.39) | 1,795 (11.41) | 225 (10.95) | |
|   Mexican American | 4,490 (8.08) | 1,745 (8.28) | 159 (3.94) | |
|   Other Hispanic | 2,067 (4.71) | 278 (3.73) | 12 (1.10) | |
|   Other | 1,857 (6.33) | 350 (5.37) | 41 (4.77) | |
| Body weight status | | | | < 0.001 |
|   Underweight | 436 (1.74) | 136 (1.82) | 13 (1.29) | |
|   Normal weight | 7,424 (30.32) | 2,482 (32.51) | 263 (21.74) | |
|   Overweight | 8,842 (33.70) | 2,834 (33.22) | 389 (35.35) | |
|   Obese | 9,351 (34.24) | 2,729 (32.45) | 448 (41.62) | |
| Education | | | | < 0.001 |
|   < high school | 7,438 (18.45) | 2,263 (16.90) | 456 (29.74) | |
|   High school, GED or equivalent | 6,212 (24.01) | 2,039 (25.92) | 274 (26.39) | |
|   > high school | 12,795 (57.54) | 3,996 (57.18) | 435 (43.88) | |
| Family income-to-poverty ratio | | | | < 0.001 |
|   < 2 | 11,674 (34.73) | 3,384 (31.16) | 584 (44.07) | |
|   2-4.49 | 7,594 (35.21) | 2,719 (38.73) | 362 (39.04) | |
|   ≥ 4.5 | 5,161 (30.06) | 1,790 (30.11) | 147 (16.89) | |
| Employment | | | | < 0.001 |
|   Yes | 14,381 (63.75) | 5,015 (69.68) | 226 (27.30) | |
|   No | 12,097 (36.25) | 3,292 (30.32) | 944 (72.70) | |
| Smoking status | | | | < 0.001 |
|   Non-smoker | 14,152 (53.11) | 4,423 (51.57) | 461 (37.69) | |
|   Former smoker | 6,576 (24.51) | 1,971 (23.31) | 511 (41.81) | |
|   Currently smoking | 5,735 (22.38) | 1,908 (25.12) | 196 (20.50) | |
| Recreational/work/transportation physical activities | | | | < 0.001 |
|   Vigorous or moderate intensity | 19,349 (76.50) | 6,438 (77.06) | 691 (63.37) | |
|   Light intensity | 7,125 (23.50) | 1,865 (22.94) | 476 (36.64) | |

Data are presented as n (%).
* Unweighted frequencies and weighted proportions were presented.
† Rao-Scott chi-square goodness-of-fit tests adjusted for the sample design were used to compare frequencies for each of the selected demographic characteristics.

Table 1. (Continued).

| Characteristics | During recession (2007-2008) | | | After recession (2009-2012) | | |
|---|---|---|---|---|---|---|
| | No CVD | CVD | $p^{\dagger}$ | No CVD | CVD | $p^{\dagger}$ |
| N | 4,996 | 678 | | 10,133 | 1,197 | |
| Age (y) | | | < 0.001 | | | < 0.001 |
| 20-64 | 3,963 (87.22) | 258 (42.22) | | 8,245 (85.83) | 474 (44.53) | |
| ≥ 65 | 1,033 (12.78) | 420 (57.78) | | 1,888 (14.17) | 723 (55.47) | |
| Gender | | | 0.137 | | | < 0.001 |
| Male | 2,397 (47.69) | 378 (52.20) | | 4,854 (47.52) | 674 (54.68) | |
| Female | 2,599 (52.31) | 300 (47.80) | | 5,279 (52.48) | 523 (45.32) | |
| Race/Ethnicity | | | < 0.001 | | | < 0.001 |
| Non-Hispanic white | 2,263 (68.94) | 389 (74.45) | | 4,217 (66.70) | 631 (72.90) | |
| Non-Hispanic black | 1,032 (11.19) | 151 (12.75) | | 2,214 (11.35) | 278 (12.46) | |
| Mexican American | 909 (8.74) | 67 (4.15) | | 1,492 (8.41) | 118 (5.10) | |
| Other Hispanic | 583 (5.08) | 49 (2.87) | | 1,053 (5.96) | 92 (3.79) | |
| Other | 209 (6.05) | 22 (5.77) | | 1,157 (7.58) | 78 (5.75) | |
| Body weight status | | | < 0.001 | | | < 0.001 |
| Underweight | 81 (1.61) | 9 (1.23) | | 179 (1.80) | 18 (1.49) | |
| Normal weight | 1,388 (31.10) | 140 (22.96) | | 2,907 (29.94) | 244 (20.22) | |
| Overweight | 1,708 (34.39) | 212 (33.76) | | 3,342 (33.97) | 357 (30.20) | |
| Obese | 1,756 (32.90) | 281 (42.05) | | 3,598 (34.29) | 539 (48.09) | |
| Education | | | < 0.001 | | | < 0.001 |
| < high school | 1,484 (19.43) | 266 (30.96) | | 2,519 (16.94) | 450 (27.71) | |
| High school, GED or equivalent | 1,232 (25.16) | 178 (28.51) | | 2,199 (20.99) | 290 (26.77) | |
| > high school | 2,275 (55.41) | 233 (40.53) | | 5,401 (62.07) | 455 (45.52) | |
| Family income-to-poverty ratio | | | < 0.001 | | | < 0.001 |
| < 2 | 2,148 (34.06) | 345 (48.61) | | 4,570 (36.01) | 643 (45.04) | |
| 2-4.49 | 1,390 (33.06) | 177 (30.22) | | 2,655 (33.03) | 291 (32.05) | |
| ≥ 4.5 | 1,000 (32.88) | 87 (21.17) | | 1,980 (30.96) | 157 (22.91) | |
| Employment | | | < 0.001 | | | < 0.001 |
| Yes | 2,999 (68.55) | 113 (22.02) | | 5,804 (64.51) | 224 (28.40) | |
| No | 1,995 (31.45) | 565 (77.98) | | 4,328 (35.49) | 973 (71.60) | |
| Smoking status | | | < 0.001 | | | < 0.001 |
| Non-smoker | 2,733 (54.55) | 258 (39.01) | | 5,797 (57.11) | 480 (40.36) | |
| Former smoker | 1,130 (22.47) | 284 (41.15) | | 2,228 (22.98) | 452 (38.07) | |
| Currently smoking | 1,128 (22.98) | 136 (19.84) | | 2,102 (19.91) | 265 (21.57) | |
| Recreational/work/transportation physical activities | | | < 0.001 | | | < 0.001 |
| Vigorous or moderate intensity | 3,639 (78.82) | 339 (54.15) | | 7,621 (78.95) | 621 (56.40) | |
| Light intensity | 1,357 (21.18) | 339 (45.85) | | 2,512 (21.05) | 576 (43.60) | |

Data are presented as $n$ (%).
* Unweighted frequencies and weighted proportions were presented.
† Rao-Scott chi-square goodness-of-fit tests adjusted for the sample design were used to compare frequencies for each of the selected demographic characteristics.

Table 2. Health insurance coverage and healthcare use of the study participants (≥ 20 years), NHANES 2003-2012*.

| | | Before recession (2003-2006) | | |
| | All | No CVD | CVD | $p^\dagger$ |
|---|---|---|---|---|
| Covered by health insurance | | | | < 0.001 |
|   Yes | 20,339 (80.60) | 6,414 (80.67) | 1,060 (90.26) | |
|   No | 6,082 (19.40) | 1,851 (19.33) | 106 (9.74) | |
| Prescriptions covered by health plans | | | | < 0.001 |
|   Yes | 15,140 (93.70) | 2,920 (93.13) | 409 (87.86) | |
|   No | 1,297 (6.30) | 259 (6.87) | 71 (12.14) | |
| Covered by private insurance | | | | < 0.001 |
|   Yes | 13,843 (78.35) | 4,598 (81.07) | 525 (58.02) | |
|   No | 6,480 (21.65) | 1,802 (18.93) | 533 (41.98) | |
| Self-reported general health condition | | | | < 0.001 |
|   Excellent or very good | 10,735 (48.50) | 3,902 (52.98) | 211 (20.06) | |
|   Good, fair, or poor | 15,735 (51.50) | 4,400 (47.02) | 958 (79.94) | |
| Location of routine healthcare | | | | < 0.001 |
|   Primary care facilities | 21,414 (82.10) | 6,695 (81.22) | 1,097 (93.17) | |
|   Emergency department | 762 (2.26) | 169 (1.66) | 19 (1.59) | |
|   Other or > 1 location | 330 (1.22) | 105 (1.29) | 18 (1.54) | |
|   No routine location | 3,973 (14.42) | 1,337 (15.83) | 36 (3.70) | |
| Overnight hospital stay in last y | | | | < 0.001 |
|   Yes | 10,679 (38.05) | 3,169 (35.27) | 840 (70.75) | |
|   No | 15,788 (61.95) | 5,133 (64.73) | 329 (29.25) | |
| No. of healthcare visits over past y | | | | < 0.001 |
|   ≥ 4 | 3,482 (10.96) | 830 (8.42) | 397 (32.93) | |
|   0-3 | 22,991 (89.04) | 7,476 (91.58) | 769 (67.07) | |
| Mental health visits over past y | | | | 0.213 |
|   Yes | 1,922 (7.84) | 566 (7.94) | 112 (9.33) | |
|   No | 24,553 (92.16) | 7,739 (92.06) | 1,055 (90.67) | |

Data are presented as n (%).
* Unweighted frequencies and weighted proportions were presented.
† Rao-Scott chi-square goodness-of-fit tests adjusted for the sample design were used to compare frequencies for health insurance status and healthcare use outcomes.

95% CI: 9.32, 356.77). People with CVD who had higher family income (OR: 0.58, 95% CI: 0.34, 0.99) or worked (OR: 0.58, 95% CI: 0.36, 0.94) were less likely to use outpatient services after the Great Recession. People < 65 years who had a diagnosis of CVD were more likely to have health plans to cover part of the cost of prescriptions after the Great Recession (OR: 3.51, 95% CI: 1.23, 9.99), less likely to have private insurance during the Great Recession (OR: 0.53, 95% CI: 0.28, 0.997), and had less outpatient visits during the recession (OR: 0.60, 95% CI: 0.38, 0.96). In addition, people with CVD who reported intermediate family income (OR: 0.41, 95% CI: 0.17, 0.99), high family income (OR: 0.03, 95% CI: 0.002, 0.49), or were aged 65 years and over (OR: 0.33, 95% CI: 0.16, 0.66) were less likely to use mental health services during the recession.

After adjusting for various covariates, people without CVD from low-income families (IPR < 2) were more likely to have health plans to cover part of the cost of prescriptions during (OR: 1.44, 95% CI: 1.03, 2.03) and after (OR: 1.54, 95% CI: 1.15, 2.07) the Great Recession (Table 4). They were more likely to use an Emergency Department rather than a primary care facility as their routine healthcare during (OR: 1.98, 95% CI: 1.26, 3.13) and after (OR: 2.67, 95% CI: 1.73, 4.12) the Great

Table 2. (Continued).

| | During recession (2007-2008) | | | After recession (2009-2012) | | |
|---|---|---|---|---|---|---|
| | No CVD | CVD | $p^\dagger$ | No CVD | CVD | $p^\dagger$ |
| Covered by health insurance | | | < 0.001 | | | < 0.001 |
| Yes | 3,709 (79.57) | 617 (91.45) | | 7,464 (78.68) | 1,075 (90.90) | |
| No | 1,284 (20.43) | 59 (8.55) | | 2,663 (21.32) | 119 (9.10) | |
| Prescriptions covered by health plans | | | < 0.001 | | | 0.010 |
| Yes | 3,378 (93.96) | 542 (88.72) | | 6,915 (94.60) | 976 (91.99) | |
| No | 299 (6.04) | 76 (11.28) | | 491 (5.40) | 101 (8.01) | |
| Covered by private insurance | | | < 0.001 | | | < 0.001 |
| Yes | 2,703 (82.76) | 310 (57.63) | | 5,218 (79.23) | 489 (56.57) | |
| No | 1,006 (17.24) | 307 (42.37) | | 2,246 (20.77) | 586 (43.43) | |
| Self-reported general health condition | | | < 0.001 | | | < 0.001 |
| Excellent or very good | 2,131 (50.97) | 93 (15.65) | | 4,219 (50.04) | 179 (19.06) | |
| Good, fair, or poor | 2,863 (49.03) | 585 (84.35) | | 5,911 (49.96) | 1,018 (80.94) | |
| Location of routine healthcare | | | < 0.001 | | | < 0.001 |
| Primary care facilities | 3,960 (81.22) | 632 (93.58) | | 7,919 (80.72) | 1,111 (93.63) | |
| Emergency department | 165 (2.41) | 15 (2.20) | | 361 (2.86) | 33 (1.85) | |
| Other or > 1 location | 60 (1.22) | 7 (0.45) | | 126 (1.18) | 14 (0.94) | |
| No routine location | 811 (15.15) | 24 (3.77) | | 1,726 (15.24) | 39 (3.58) | |
| Overnight hospital stay in last y | | | < 0.001 | | | < 0.001 |
| Yes | 1,822 (35.38) | 476 (67.97) | | 3,522 (34.77) | 850 (67.43) | |
| No | 3,173 (64.62) | 201 (32.03) | | 6,606 (65.23) | 346 (32.57) | |
| No. of healthcare visits over past y | | | < 0.001 | | | < 0.001 |
| ≥ 4 | 526 (8.85) | 227 (31.87) | | 1,078 (9.27) | 424 (33.34) | |
| 0-3 | 4,469 (91.15) | 450 (68.13) | | 9,054 (90.73) | 773 (66.66) | |
| Mental health visits over past y | | | 0.865 | | | 0.220 |
| Yes | 332 (7.32) | 58 (7.63) | | 733 (7.76) | 121 (8.88) | |
| No | 4,664 (92.68) | 620 (92.37) | | 9,400 (92.24) | 1,075 (91.12) | |

Data are presented as *n* (%).
* Unweighted frequencies and weighted proportions were presented.
† Rao-Scott chi-square goodness-of-fit tests adjusted for the sample design were used to compare frequencies for health insurance status and healthcare use outcomes.

Recession. People aged 65 and older were more likely to have private insurance during (OR: 1.41, 95% CI: 1.05, 1.89) and after (OR: 1.56, 95% CI: 1.21, 2.00) the Great Recession.

## Discussion

The majority of the research on the Great Recession, health insurance, and health services was based on medical expenditure data of individuals with employer-sponsored health insurance [23]. This study used a nationally representative sample of American adults aged ≥ 20 years to examine the potential effects of the Great Recession on health insurance coverage and healthcare use by people with and without CVD. In terms of healthcare use, the study participants without CVD, who had a lower family income, no employment, and a younger age were affected more during and after the recession, than the other participants without CVD. Unlike the associations observed in the participants without CVD, most of insurance and healthcare use indicators for the participants with CVD, did not differ significantly during and after the

Table 3. Multivariate logistic regressions for the associations of recession periods with health insurance coverage and healthcare use by study participants with CVD (≥ 20 years), NHANES 2003-2012.

| Outcome variables | Family income-to-poverty ratio < 2* | | Family income-to-poverty ratio 2-4.49* | | Family income-to-poverty ratio ≥ 4.5* | |
|---|---|---|---|---|---|---|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Covered by health insurance (Yes vs. No) | | | | | | |
| During recession | 1.57 | (1.01, 2.45) | 1.98 | (0.79, 4.96) | 0.91 | (0.35, 2.33) |
| After recession | 1.49 | (0.95, 2.34) | 0.95 | (0.40, 2.24) | 1.38 | (0.65, 2.96) |
| Prescriptions covered by health plans (Yes vs. No) | | | | | | |
| During recession | 0.72 | (0.36, 1.42) | 1.39 | (0.53, 3.63) | 1.28 | (0.11, 15.47) |
| After recession | 1.32 | (0.67, 2.59) | 1.72 | (0.69, 4.33) | 0.25 | (0.04, 1.77) |
| Covered by private insurance (Yes vs. No) | | | | | | |
| During recession | 1.19 | (0.85, 1.67) | 1.31 | (0.71, 2.43) | 1.08 | (0.47, 2.47) |
| After recession | 0.89 | (0.66, 1.21) | 0.99 | (0.64, 1.51) | 1.11 | (0.57, 2.13) |
| Self-reported general health condition | | | | | | |
| Excellent or very good vs. Good, fair, or poor | | | | | | |
| During recession | 1.10 | (0.62, 1.94) | 0.73 | (0.39, 1.35) | 0.60 | (0.28, 1.27) |
| After recession | 1.16 | (0.63, 2.15) | 1.05 | (0.66, 1.69) | 0.70 | (0.36, 1.35) |
| Current health compared with 1 y ago: better vs. no change | | | | | | |
| During recession | 1.05 | (0.67, 1.67) | 0.68 | (0.40, 1.16) | 1.45 | (0.64, 3.31) |
| After recession | 1.32 | (0.90, 1.92) | 0.96 | (0.56, 1.63) | 0.91 | (0.44, 1.88) |
| Current health compared with 1 y ago: worse vs. no change | | | | | | |
| During recession | 1.03 | (0.64, 1.67) | 0.57 | (0.27, 1.18) | 0.52 | (0.14, 1.94) |
| After recession | 1.19 | (0.77, 1.86) | 0.59 | (0.34, 1.01) | 0.85 | (0.36, 2.05) |
| Location of routine healthcare | | | | | | |
| Primary care facilities vs. Others | | | | | | |
| During recession | 1.17 | (0.63, 2.17) | 1.30 | (0.42, 4.05) | 1.89 | (0.26, 13.72) |
| After recession | 1.28 | (0.68, 2.41) | 1.40 | (0.54, 3.62) | 1.23 | (0.25, 5.97) |
| Emergency department vs. Primary care facilities | | | | | | |
| During recession | 1.01 | (0.30, 3.39) | 0.57 | (0.11, 2.96) | 57.65 | (9.32, 356.77) |
| After recession | 1.31 | (0.52, 3.27) | 0.09 | (0.002, 4.59) | 0.70 | (0.11, 4.65) |
| Overnight hospital stay in last y (Yes vs. No) | | | | | | |
| During recession | 0.93 | (0.60, 1.44) | 0.85 | (0.53, 1.36) | 1.01 | (0.46, 2.21) |
| After recession | 1.11 | (0.84, 1.47) | 0.93 | (0.62, 1.37) | 0.84 | (0.41, 1.74) |
| No. of healthcare visits over past y (≥ 4 vs. 0-3) | | | | | | |
| During recession | 0.88 | (0.63, 1.24) | 0.74 | (0.45, 1.20) | 0.67 | (0.34, 1.31) |
| After recession | 1.01 | (0.71, 1.43) | 0.71 | (0.42, 1.21) | 0.58 | (0.34, 0.99) |
| Mental health visits over past y (Yes vs. No) | | | | | | |
| During recession | 1.21 | (0.69, 2.10) | 0.41 | (0.17, 0.99) | 0.03 | (0.002, 0.49) |
| After recession | 1.30 | (0.80, 2.12) | 0.36 | (0.17, 0.75) | 0.58 | (0.19, 1.79) |

* Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level) in the study participants with family income-to-poverty ratio <2.
† Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/ race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level) in the study participants with employment.
‡ Survey logistic regression models were adjusted for gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level) in the study participants 19-64 years.

Table 3. (Continued).

| Outcome variables | Employed[†] | | Unemployed[†] | | 19-64 y[‡] | | ≥65 y[‡] | |
|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Covered by health insurance (Yes vs. No) | | | | | | | | |
| During recession | 1.38 | (0.43, 4.42) | 1.50 | (0.87, 2.60) | 1.53 | (0.91, 2.55) | 0.87 | (0.35, 2.17) |
| After recession | 1.30 | (0.56, 3.06) | 1.56 | (0.90, 2.69) | 1.43 | (0.94, 2.17) | 0.73 | (0.21, 2.54) |
| Prescriptions covered by health plans (Yes vs. No) | | | | | | | | |
| During recession | 0.68 | (0.11, 4.05) | 1.16 | (0.60, 2.24) | 1.65 | (0.62, 4.37) | 1.01 | (0.51, 2.01) |
| After recession | 0.50 | (0.10, 2.50) | 1.52 | (0.76, 3.04) | 3.51 | (1.23, 9.99) | 1.18 | (0.59, 2.36) |
| Covered by private insurance (Yes vs. No) | | | | | | | | |
| During recession | 0.62 | (0.27, 1.43) | 1.28 | (0.88, 1.88) | 0.53 | (0.28, 0.997) | 1.65 | (1.03, 2.64) |
| After recession | 0.86 | (0.41, 1.80) | 0.93 | (0.68, 1.27) | 0.79 | (0.44, 1.43) | 1.09 | (0.80, 1.50) |
| Self-reported general health condition | | | | | | | | |
| Excellent or very good vs. Good, fair, or poor | | | | | | | | |
| During recession | 0.54 | (0.22, 1.31) | 1.03 | (0.67, 1.59) | 0.66 | (0.35, 1.24) | 0.90 | (0.61, 1.34) |
| After recession | 0.92 | (0.48, 1.76) | 1.13 | (0.78, 1.66) | 0.91 | (0.53, 1.55) | 1.12 | (0.78, 1.60) |
| Current health compared with 1 y ago: better vs. no change | | | | | | | | |
| During recession | 1.17 | (0.50, 2.75) | 0.86 | (0.63, 1.17) | 1.02 | (0.56, 1.86) | 0.96 | (0.65, 1.41) |
| After recession | 1.32 | (0.77, 2.25) | 0.90 | (0.68, 1.19) | 1.33 | (0.84, 2.11) | 0.91 | (0.65, 1.28) |
| Current health compared with 1 y ago: worse vs. no change | | | | | | | | |
| During recession | 0.53 | (0.16, 1.77) | 0.82 | (0.55, 1.21) | 0.89 | (0.50, 1.57) | 0.70 | (0.44, 1.10) |
| After recession | 0.61 | (0.24, 1.55) | 1.01 | (0.69, 1.48) | 0.83 | (0.45, 1.53) | 0.97 | (0.67, 1.40) |
| Location of routine healthcare | | | | | | | | |
| Primary care facilities vs. Others | | | | | | | | |
| During recession | 0.99 | (0.30, 3.29) | 1.59 | (0.91, 2.77) | 0.98 | (0.51, 1.88) | 1.62 | (0.72, 3.67) |
| After recession | 0.96 | (0.36, 2.56) | 1.34 | (0.77, 2.34) | 1.06 | (0.58, 1.94) | 1.35 | (0.68, 2.70) |
| Emergency department vs. Primary care facilities | | | | | | | | |
| During recession | 1.33 | (0.21, 8.53) | 1.15 | (0.40, 3.30) | 1.54 | (0.49, 4.86) | 0.66 | (0.17, 2.56) |
| After recession | 1.62 | (0.35, 7.39) | 0.83 | (0.40, 1.72) | 1.07 | (0.37, 3.05) | 0.71 | (0.25, 2.01) |
| Overnight hospital stay in last y (Yes vs. No) | | | | | | | | |
| During recession | 0.95 | (0.41, 2.22) | 0.88 | (0.66, 1.18) | 0.82 | (0.51, 1.32) | 1.01 | (0.72, 1.40) |
| After recession | 1.00 | (0.55, 1.80) | 1.02 | (0.81, 1.29) | 1.00 | (0.67, 1.50) | 1.08 | (0.80, 1.44) |
| No. of healthcare visits over past y (≥ 4 vs. 0-3) | | | | | | | | |
| During recession | 0.75 | (0.42, 1.36) | 0.78 | (0.59, 1.03) | 0.60 | (0.38, 0.96) | 0.94 | (0.69, 1.28) |
| After recession | 0.58 | (0.36, 0.94) | 0.89 | (0.66, 1.22) | 0.73 | (0.47, 1.13) | 0.88 | (0.63, 1.22) |
| Mental health visits over past y (Yes vs. No) | | | | | | | | |
| During recession | 0.36 | (0.11, 1.17) | 0.78 | (0.49, 1.23) | 1.04 | (0.57, 1.92) | 0.33 | (0.16, 0.66) |
| After recession | 0.98 | (0.42, 2.28) | 0.83 | (0.56, 1.24) | 1.04 | (0.62, 1.75) | 0.72 | (0.34, 1.50) |

* Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level) in the study participants with family income-to-poverty ratio <2.

† Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level) in the study participants with employment.

‡ Survey logistic regression models were adjusted for gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level) in the study participants 19-64 years.

Table 4. Multivariate logistic regressions for the associations of recession periods with health insurance coverage and healthcare use by study participants without CVD (≥ 20 years), NHANES 2003-2012.

| Outcome variables | Family income-to-poverty ratio < 2* | | Family income-to-poverty ratio 2-4.49* | | Family income-to-poverty ratio ≥ 4.5* | |
|---|---|---|---|---|---|---|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Covered by health insurance (Yes vs. No) | | | | | | |
| During recession | 0.94 | (0.76, 1.17) | 1.02 | (0.76, 1.37) | 0.98 | (0.54, 1.79) |
| After recession | 0.89 | (0.74, 1.08) | 0.83 | (0.66, 1.05) | 1.02 | (0.58, 1.78) |
| Prescriptions covered by health plans (Yes vs. No) | | | | | | |
| During recession | 1.44 | (1.03, 2.03) | 1.05 | (0.70, 1.57) | 0.96 | (0.46, 2.00) |
| After recession | 1.54 | (1.15, 2.07) | 1.28 | (0.83, 2.00) | 1.40 | (0.70, 2.79) |
| Covered by private insurance (Yes vs. No) | | | | | | |
| During recession | 1.12 | (0.86, 1.45) | 1.42 | (1.10, 1.83) | 1.27 | (0.73, 2.20) |
| After recession | 0.99 | (0.83, 1.19) | 1.07 | (0.83, 1.38) | 1.00 | (0.69, 1.46) |
| Self-reported general health condition | | | | | | |
| Excellent or very good vs. Good, fair, or poor | | | | | | |
| During recession | 1.03 | (0.88, 1.21) | 1.02 | (0.84, 1.25) | 0.78 | (0.62, 0.999) |
| After recession | 0.88 | (0.75, 1.02) | 0.86 | (0.74, 0.995) | 0.96 | (0.80, 1.15) |
| Current health compared with 1 y ago: better vs. no change | | | | | | |
| During recession | 0.89 | (0.72, 1.10) | 0.83 | (0.67, 1.02) | 0.86 | (0.68, 1.09) |
| After recession | 1.05 | (0.86, 1.28) | 1.00 | (0.86, 1.15) | 0.89 | (0.74, 1.08) |
| Current health compared with 1 y ago: worse vs. no change | | | | | | |
| During recession | 1.00 | (0.81, 1.23) | 1.01 | (0.76, 1.35) | 0.93 | (0.64, 1.37) |
| After recession | 0.95 | (0.78, 1.16) | 0.94 | (0.75, 1.18) | 0.69 | (0.51, 0.91) |
| Location of routine healthcare | | | | | | |
| Primary care facilities vs. Others | | | | | | |
| During recession | 0.90 | (0.73, 1.12) | 1.21 | (0.90, 1.62) | 1.01 | (0.73, 1.41) |
| After recession | 0.78 | (0.65, 0.92) | 1.02 | (0.82, 1.26) | 1.22 | (0.95, 1.57) |
| Emergency department vs. Primary care facilities | | | | | | |
| During recession | 1.98 | (1.26, 3.13) | 0.91 | (0.56, 1.50) | 2.74 | (0.80, 9.42) |
| After recession | 2.67 | (1.73, 4.12) | 1.44 | (0.91, 2.26) | 1.08 | (0.32, 3.69) |
| Overnight hospital stay in last y (Yes vs. No) | | | | | | |
| During recession | 1.10 | (0.89, 1.38) | 1.03 | (0.77, 1.39) | 1.00 | (0.74, 1.35) |
| After recession | 1.17 | (0.97, 1.41) | 0.84 | (0.67, 1.06) | 1.18 | (0.84, 1.66) |
| No. of healthcare visits over past y (≥ 4 vs. 0-3) | | | | | | |
| During recession | 0.85 | (0.70, 1.02) | 1.04 | (0.88, 1.24) | 1.07 | (0.87, 1.30) |
| After recession | 0.90 | (0.77, 1.04) | 0.87 | (0.73, 1.03) | 0.96 | (0.79, 1.16) |
| Mental health visits over past y (Yes vs. No) | | | | | | |
| During recession | 0.82 | (0.59, 1.12) | 1.27 | (0.84, 1.93) | 0.83 | (0.55, 1.26) |
| After recession | 0.95 | (0.75, 1.21) | 1.02 | (0.75, 1.40) | 0.91 | (0.63, 1.32) |

* Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level) in the study participants with family income-to-poverty ratio < 2.
† Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level) in the study participants with employment.
‡ Survey logistic regression models were adjusted for gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level) in the study participants 19-64 years.

Table 4. (Continued).

| Outcome variables | Employed[†] | | Unemployed[†] | | 19-64 y[‡] | | ≥65 y[‡] | |
|---|---|---|---|---|---|---|---|---|
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| Covered by health insurance (Yes vs. No) | | | | | | | | |
| During recession | 1.03 | (0.82, 1.29) | 0.84 | (0.64, 1.09) | 0.98 | (0.82, 1.17) | 0.84 | (0.36, 1.96) |
| After recession | 0.91 | (0.75, 1.09) | 0.84 | (0.65, 1.08) | 0.90 | (0.76, 1.07) | 0.59 | (0.29, 1.20) |
| Prescriptions covered by health plans (Yes vs. No) | | | | | | | | |
| During recession | 0.96 | (0.64, 1.43) | 1.37 | (0.88, 2.14) | 1.00 | (0.67, 1.49) | 1.38 | (0.77, 2.49) |
| After recession | 1.14 | (0.75, 1.75) | 1.75 | (1.17, 2.63) | 1.29 | (0.90, 1.86) | 1.57 | (0.93, 2.67) |
| Covered by private insurance (Yes vs. No) | | | | | | | | |
| During recession | 1.14 | (0.84, 1.56) | 1.27 | (1.04, 1.56) | 1.15 | (0.90, 1.46) | 1.41 | (1.05, 1.89) |
| After recession | 0.87 | (0.70, 1.07) | 1.14 | (0.95, 1.37) | 0.85 | (0.71, 1.02) | 1.56 | (1.21, 2.00) |
| Self-reported general health condition | | | | | | | | |
| Excellent or very good vs. Good, fair, or poor | | | | | | | | |
| During recession | 0.94 | (0.82, 1.09) | 0.98 | (0.82, 1.17) | 0.92 | (0.80, 1.05) | 1.18 | (0.98, 1.42) |
| After recession | 0.86 | (0.78, 0.95) | 0.98 | (0.83, 1.16) | 0.87 | (0.79, 0.95) | 1.11 | (0.90, 1.36) |
| Current health compared with 1 y ago: better vs. no change | | | | | | | | |
| During recession | 0.90 | (0.79, 1.03) | 0.79 | (0.63, 1.003) | 0.87 | (0.78, 0.98) | 0.79 | (0.59, 1.06) |
| After recession | 1.01 | (0.90, 1.12) | 0.93 | (0.77, 1.11) | 0.96 | (0.87, 1.07) | 1.06 | (0.79, 1.42) |
| Current health compared with 1 y ago: worse vs. no change | | | | | | | | |
| During recession | 1.01 | (0.80, 1.28) | 0.93 | (0.74, 1.17) | 1.01 | (0.83, 1.23) | 0.80 | (0.61, 1.05) |
| After recession | 0.87 | (0.74, 1.03) | 0.92 | (0.76, 1.13) | 0.86 | (0.75, 0.98) | 0.99 | (0.76, 1.30) |
| Location of routine healthcare | | | | | | | | |
| Primary care facilities vs. Others | | | | | | | | |
| During recession | 1.04 | (0.88, 1.24) | 0.92 | (0.71, 1.18) | 1.03 | (0.87, 1.22) | 0.94 | (0.58, 1.52) |
| After recession | 1.01 | (0.88, 1.17) | 0.74 | (0.61, 0.90) | 0.95 | (0.83, 1.08) | 1.17 | (0.75, 1.83) |
| Emergency department vs. Primary care facilities | | | | | | | | |
| During recession | 1.55 | (1.10, 2.18) | 1.68 | (0.98, 2.89) | 1.59 | (1.11, 2.29) | 1.11 | (0.41, 3.02) |
| After recession | 1.87 | (1.33, 2.65) | 2.44 | (1.46, 4.07) | 2.09 | (1.52, 2.88) | 0.49 | (0.18, 1.33) |
| Overnight hospital stay in last y (Yes vs. No) | | | | | | | | |
| During recession | 1.01 | (0.83, 1.25) | 1.05 | (0.83, 1.33) | 1.06 | (0.88, 1.27) | 0.93 | (0.67, 1.30) |
| After recession | 1.06 | (0.86, 1.31) | 1.01 | (0.82, 1.24) | 1.01 | (0.84, 1.22) | 1.08 | (0.84, 1.39) |
| No. of healthcare visits over past y (≥ 4 vs. 0-3) | | | | | | | | |
| During recession | 1.03 | (0.89, 1.21) | 0.89 | (0.75, 1.05) | 0.98 | (0.87, 1.10) | 1.10 | (0.92, 1.31) |
| After recession | 0.96 | (0.87, 1.07) | 0.82 | (0.70, 0.95) | 0.94 | (0.86, 1.03) | 0.84 | (0.70, 0.995) |
| Mental health visits over past y (Yes vs. No) | | | | | | | | |
| During recession | 0.95 | (0.72, 1.25) | 0.91 | (0.67, 1.24) | 0.95 | (0.75, 1.19) | 0.62 | (0.37, 1.04) |
| After recession | 1.01 | (0.78, 1.30) | 0.89 | (0.70, 1.13) | 0.93 | (0.77, 1.13) | 1.09 | (0.65, 1.83) |

\* Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, employment, smoking, and physical activity level) in the study participants with family income-to-poverty ratio <2.

[†] Survey logistic regression models were adjusted for age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, age, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, smoking, and physical activity level) in the study participants with employment.

[‡] Survey logistic regression models were adjusted for gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level, for example, Model Y (Covered by health insurance) = Exposures (during recession, gender, ethnicity/race, body weight status, education level, family income-to-poverty ratio, employment, smoking, and physical activity level) in the study participants 19-64 years.

recession, as compared with those before the recession. However, people with CVD from lower income families were more likely to have health insurance during the recession. People with CVD from high-income families were more likely to receive routine healthcare from an Emergency Department rather than primary care facilities during the recession, and less likely to use outpatient services after the recession. People < 65 years who had a diagnosis of CVD were more likely to have health plans to cover part of the cost of prescriptions after the recession, less likely to have private insurance during the recession, and had less outpatient visits during the recession. People with CVD who reported a high family income, or ≥ 65 years were less likely to use mental health services during the recession.

Although low rates of health insurance coverage persistently exist among low-income groups in countries with or without universal health insurance [24], this study found that people diagnosed with CVD from low-income families were more likely to be covered by health insurance during the Great Recession (OR: 1.57, 95% CI: 1.01, 2.45) than before the recession. There was no such change for low-income people without CVD. According to the 2003-2012 NHANES data, the percentage of people with CVD who were covered by any type of government insurance was 66.6% before the recession, increased to 70.7% during the recession, and then decreased to 68.3% after the recession, although this difference was not statistically significant ($p$ = 0.204). In addition, research has shown that health insurance may significantly reduce the out-of-pocket health expenditures among insured individuals [25]. Given income decline or unemployment during the Great Recession and serious pre-existing conditions such as CVD, it may be a natural response of people diagnosed with CVD to seek financial protection against possible catastrophic cardiac events, by acquiring health insurance coverage [26,27].

The results of this study showed that people with CVD, from high-income families were more likely to receive routine healthcare from an Emergency Department rather than primary care facilities during the recession ($p$ < 0.05). The adverse impact of job loss and job insecurity on cardiovascular morbidity and mortality in the US populations has been previously reported [6]. Cardiovascular conditions such as hypertension and chest pain are among the most common reasons for Emergency Department visits during the Great Recession [28,29]. Although high-income households may lose larger absolute wealth resources during the Great Recession, low-income and minority families experienced greater relative declines in wealth [30]. It has been postulated that an increased use of Emergency Department services was only observed among CVD patients from high-income families probably because patients from low-income families may forego medical care due to financial concerns [14].

According to data in this study, individuals < 65 years who had a diagnosis of CVD, had less outpatient visits during the Great Recession, and those with CVD that had a high family income or worked, were less likely to use outpatient services after the recession. Previous studies have demonstrated a negative relationship between unemployment rate and use of outpatient services among people < 65 years [31]. Long working week hours, in combination with increased copayments or deductibles, may result in reduced use of outpatient services among people not covered by government health programs during or after the Great Recession [32,33].

A large body of literature has linked economic crisis and mental disorders such as depression [6, 34-36]. Despite no significant improvement in self-reported general health condition among our study population, significant decreases in the use of mental healthcare among CVD patients were observed, particularly during the Great Recession. High cost and lack of insurance coverage are the major barriers to accessing mental healthcare [37]. Given the potential financial strains during a recession, CVD patients may forego mental healthcare, in order to meet their care needs and treatment for pre-existing cardiovascular conditions.

In this study it was observed that people aged 65 years and over, regardless of their CVD status, were more likely to be covered by private insurance during the Great Recession, while people < 65 years with CVD were less likely to have private insurance coverage during the same period (OR: 0.53, 95% CI: 0.28, 0.997). About 75% of the seniors who had Medicare public health insurance, also had some form of private health insurance [38]. A main reason for holding private insurance is to fill the gaps for services that public health programs, e.g., Medicare, does not cover [39]. Other reasons include timely access to healthcare, flexibility to choose service providers, and self-reliance [40].

This study has several limitations. Firstly, due to the cross-sectional nature of NHANES, longitudinal relationships of changes in health insurance coverage and healthcare use with the Great Recession could not be investigated. Therefore, causal relationships based on present findings could not be established. Secondly, information on insurance coverage and use of health services was self-reported and not verified through medical records, which may contain reporting bias. Lastly, this study performed multiple statistical tests which provided a few significant results. Unlike confirmatory studies, this study was exploratory and adjustments for multiple comparisons were not conducted to avoid additional problems that "$p$ value correction" may cause [41]. However, we suggest readers to be cautious when interpreting the results from this study. Further studies are needed to confirm these findings.

# Conclusion

In this study it was observed that an economic crisis may significantly affect health insurance coverage and health service use among the adult population of the US. Coverage of health insurance and possession of health plans for prescriptions increased significantly among those with and without CVD. Emergency rooms rather than primary care facilities were more likely to be used for routine healthcare among individuals with and without CVD during the Great Recession. Use of mental health services was reduced significantly among CVD patients during the recession. Longitudinal studies are warranted to confirm these findings, clarify their temporal relationships, and evaluate possible long-term effects of the Great Recession on people's health and healthcare systems in the US. As one of the costliest health problems, CVD has a substantial financial impact on total health expenditures in the US [42]. During 2010, the direct care expenditures for diagnosis and treatment of CVD were $273 billion in the US, and the estimated costs of lost productivity and premature mortality associated with CVD were an additional $172 billion [42]. According to the findings in this study, it is critically important for stakeholders, policy makers, and health professionals to minimize the adverse impact of potential economic downturns by; 1) promoting knowledge, transparency, and availability of public and private health insurance among low-income populations with or without pre-existing chronic diseases such as CVD, 2) enhancing public healthcare services for the elderly (≥ 65 years), and 3) improving access to primary care, and reducing Emergency Department use by redirecting non-urgent patients to primary care providers, or providing alternatives such as retail clinics and urgent care centers. In addition, special efforts are needed to reduce the barriers to mental healthcare and promote the use of mental health services among CVD patients.

# Conflicts of Interest

The authors declare that there is no conflicts of interest.

# Acknowledgments

# References

[1] Kochanek KD, Xu J, Murphy SL, et al. Deaths: Preliminary data for 2009. Natl Vital Stat Rep 2011;59(4):1-51.

[2] Kreatsoulas C, Anand SS. The impact of social determinants on cardiovascular disease. Can J Cardiol 2010;26(Suppl C):8C-13C.

[3] Franks P, Winters PC, Tancredi DJ, et al. Do changes in traditional coronary heart disease risk factors over time explain the association between socio-economic status and coronary heart disease? BMC Cardiovasc Disord 2011;11:28.

[4] Anderson NB, Armstead CA. Toward understanding the association of socioeconomic status and health: A new challenge for the biopsychosocial approach. Psychosom Med 1995;57(3):213-25.

[5] Veugelers PJ, Yip AM. Socioeconomic disparities in health care use: Does universal coverage reduce inequalities in health? J Epidemiol Community Health 2003;57(6):424-8.

[6] Catalano R, Goldman-Mellor S, Saxton K, et al. The health effects of economic decline. Annu Rev Public Health 2011;32:431-50.

[7] Phillips JA, Nugent CN. Suicide and the Great Recession of 2007-2009: The role of economic factors in the 50 U.S. states. Soc Sci Med 2014;116:22-31.

[8] Bunn AR. Ischaemic heart disease mortality and the business cycle in Australia. Am J Public Health 1979;69(8):772-81.

[9] Gallo WT, Teng HM, Falba TA, et al. The impact of late career job loss on myocardial infarction and stroke: A 10 year follow up using the health and retirement survey. Occup Environ Med 2006;63(10):683-7.

[10] Niedzwiedz CL, Katikireddi SV, Reeves A, et al. Economic insecurity during the Great Recession and metabolic, inflammatory and liver function biomarkers: Analysis of the UK Household Longitudinal Study. J Epidemiol Community Health 2017;71:1005-13.

[11] Filippidis FT, Schoretsaniti S, Dimitrakaki C, et al. Trends in cardiovascular risk factors in Greece before and during the financial crisis: The impact of social disparities. Eur J Public Health 2014;24(6):974-9.

[12] Tapia Granados JA, Christine PJ, Ionides EL, et al. Cardiovascular risk factors, depression, and alcohol consumption during joblessness and during recessions among young adults in CARDIA. Am J Epidemiol 2018;187(11):2339-45.

[13] Norström T, Grönqvist H. The Great Recession, unemployment and suicide. J Epidemiol Community Health 2015;69(2):110-6.

[14] Burgard SA, Hawkins JM. Race/Ethnicity, educational attainment, and foregone health care in the United States in the 2007-2009 recession. Am J Public Health 2014;104(2):e134-40.

[15] Cawley J, Moriya AS, Simon K. The impact of the macroeconomy on health insurance coverage: Evidence from the Great Recession. Health Econ 2015;24(2):206-23.

[16] Johnson CL, Paulose-Ram R, Ogden CL, et al. National Health and Nutrition Examination Survey: Analytic guidelines, 1999 -2010. Vital Health Stat 2 2013;(161):1-24.

[17] Berkowitz SA, Berkowitz TSZ, Meigs JB, et al. Trends in food insecurity for adults with cardiometabolic disease in the United States: 2005-2012. PloS One 2017;12(6):e0179172.

[18] Marcotte-Chenard A, Deshayes TA, Ghachem A, et al. Prevalence of the metabolic syndrome between 1999 and 2014 in the U.S. adult population and the impact of the 2007-2008 recession: A NHANES study. Appl Physiol Nutr Metab 2019 Jan 14. doi: 10.1139/apnm-2018-0648. [Epub ahead of print].

[19] Cui W, Zack MM. Trends in health-related quality of life among adolescents in the United States, 2001-2010. Prev Chronic Dis 2013;10:E111.

[20] Scholes S, Bann D. Education-related disparities in reported physical activity during leisure-time, active transportation, and work among US adults: Repeated cross-sectional analysis from the National Health and Nutrition Examination Surveys, 2007 to 2016. BMC Public Health 2018;18(1):926.

[21] Haapanen N, Miilunpalo S, Pasanen M, et al. Agreement between questionnaire data and medical records of chronic diseases in middle-aged and elderly Finnish men and women. Am J Epidemiol 1997;145(8):762-9.

[22] Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults-The Evidence Report. National Institutes of Health. Obes Res 1998;6 Suppl 2:51S-209S.

[23] Mortensen K, Chen J. The Great Recession and racial and ethnic disparities in health services use. JAMA Intern Med 2013;173(4):315-7.

[24] Schoen C, Davis K, DesRoches C, et al. Health insurance markets and income inequality: Findings from an international health policy survey. Health Policy 2000;51(2):67-85.

[25] Waters HR, Anderson GF, Mays J. Measuring financial protection in health in the United States. Health Policy 2004;69(3):339-49.

[26] Daivadanam M, Thankappan KR, Sarma PS, et al. Catastrophic health expenditure & coping strategies associated with acute coronary syndrome in Kerala, India. Indian J Med Res 2012;136(4):585-92.

[27] Jan S, Laba TL, Essue BM, et al. Action to address the household economic burden of non-communicable diseases. Lancet 2018;391(10134):2047-58.

[28] Skinner HG, Blanchard J, Elixhauser A [Internet]. Trends in emergency department visits, 2006-2011. Rockville (MD): HCUP Statistical Brief #179 Agency for Healthcare Research and Quality; September 2014. Available from: http://www.hcup-us.ahrq.gov/reports/statbriefs/sb179-Emergency-Department-Trends.pdf.

[29] Venkatesh AK, Geisler BP, Gibson Chambers JJ, et al. Use of observation care in US emergency departments, 2001 to 2008. PloS One 2011;6(9):e24326.

[30] Pfeffer FT, Danziger S, Schoeni RF. Wealth Disparities before and after the Great Recession. Ann Am Acad Pol Soc Sci 2013;650(1):98-123.

[31] Tefft N, Kageleiry A. State-level unemployment and the utilization of preventive medical services. Health Serv Res 2014;49(1):186-205.

[32] Fell DB, Kephart G, Curtis LJ, et al. The relationship between work hours and utilization of general practitioners in four Canadian provinces. Health Serv Res 2007;42(4):1483-98.

[33] Fronstin P. The Impact of the recession on employment-based health coverage. In: EBRI Issue Brief, no. 342. Washington, DC (WA): Employee Benefit Research Institute; May 2010.

[34] Uutela A. Economic crisis and mental health. Curr Opin Psychiatry 2010;23(2):127-30.

[35] Ng KH, Agius M, Zaman R. The global economic crisis: Effects on mental health and what can be done. J R Soc Med 2013;106(6):211-4.

[36] Frasquilho D, Matos MG, Salonna F, et al. Mental health outcomes in times of economic recession: A systematic literature review. BMC Public Health 2016;16:115.

[37] Sareen J, Jagdeo A, Cox BJ, et al. Perceived barriers to mental health service utilization in the United States, Ontario, and the Netherlands. Psychiatr Serv 2007;58(3):357-64.

[38] Chulis GS, Eppig FJ, Hogan MO, et al. Health insurance and the elderly: Data from MCBS (Medicare Current Beneficiary Survey). Health Care Financ Rev 1993;14(3):163-81.

[39] Yamada T, Chen CC, Murata C, et al. Access disparity and health inequality of the elderly: Unmet needs and delayed healthcare. Int J Environ Res Public Health 2015;12(2):1745-72.

[40] Jeon YH, Black A, Govett J, et al. Private health insurance and quality of life: Perspectives of older Australians with multiple chronic conditions. Aust J Prim Health 2012;18(3):212-9.

[41] Feise RJ. Do multiple outcome measures require p-value adjustment? BMC Med Res Methodol 2002;2:8.

[42] Heidenreich PA, Trogdon JG, Khavjou OA, et al. Forecasting the future of cardiovascular disease in the United States: A policy statement from the American Heart Association. Circulation 2011;123(8):933-44.

# Appendix I.

## Potential confounders

Information on participant's age and gender was collected using questionnaires. Groups were formed using 5-year age gaps in the regression models. Race/ethnicity was categorized into non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, and other. Body weight and height were measured by trained health technicians and used to calculate body mass index (BMI). Weight status was classified as underweight if BMI < 18.5 kg/m$^2$, normal weight if 18.5 kg/m$^2$ ≤ BMI < 25 kg/m$^2$, overweight if 25 kg/m$^2$ ≤ BMI < 30 kg/m$^2$, and obese if BMI ≥ 30 kg/m$^2$ [22]. Participant's education was categorized as less than high school, high school with diploma or General Equivalency Diploma (GED), and some college or above. Family income-to-poverty ratio (IPR) was grouped into three categories: < 2, 2 to 4.5, and ≥ 4.5.

Participants were considered to be not employed if they reported "looking for work" or "not working at a job or business" in the week before the interview. Participants who were identified as currently smoking reported smoking at least 100 cigarettes during their entire life and reported smoking either every day or some days at the time of interview. Former smokers were those that had smoked at least 100 cigarettes during their lifetime but currently did not smoke. Physical Activity Questionnaire changed between 2001-2006 and 2007-2010 cycles. Participants were considered to be physically active 1) if they reported walking/standing a lot, carrying loads often, or taking heavy work during the day in the 2003-2006 NHANES; or 2) if they had vigorous or moderate-intensity activities for at least 10 minutes continuously for work or recreation, or walked or used a bicycle for at least 10 minutes continuously for transportation during a typical week in the 2007-2012 NHANES.