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Lack of private health insurance is associated with higher mortality from cancer and other chronic diseases, poor diet quality, and inflammatory biomarkers in the United States

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ABSTRACT

Objective. The lack of health insurance reduces access to care and often results in poorer health outcomes. The present study simultaneously assessed the effects of health insurance on cancer and chronic disease mortality, as well as the inter-relationships with diet, obesity, smoking, and inflammatory biomarkers. We hypothesized that public/no insurance versus private insurance would result in increased cancer/chronic disease mortality due to the increased prevalence of inflammation-related lifestyle factors in the underinsured population.

Methods. Data from the Third National Health and Nutrition Examination Survey participants (NHANES III;1988–1994) were prospectively examined to assess the effects of public/no insurance versus private insurance and inflammation-related lifestyle factors on mortality risk from cancer, all causes, cardiovascular disease (CVD) and diabetes. Cox proportional hazards regression was performed to assess these relationships.

Results. Multivariate regression analyses revealed substantially greater risks of mortality ranging from 35% to 245% for public/no insurance versus private insurance for cancer (HR = 1.35; 95% CI = 1.09,1.66), all causes (HR = 1.54; 95% CI = 1.39,1.70), CVD (HR = 1.62; 95% CI = 1.38,1.90) and diabetes (HR = 2.45; 95% CI = 1.45,4.14). Elevated CRP, smoking, reduced diet quality and higher BMI were more prevalent in those with public insurance, and were also associated with increased risks of cancer/chronic disease mortality.

Discussion. Insurance status was strongly associated with cancer/chronic disease mortality after adjusting for lifestyle factors. The results suggest that inadequate health insurance coverage results in a substantially greater need for preventive strategies that focus on tobacco control, obesity, and improved dietary quality. These efforts should be incorporated into comprehensive insurance coverage programs for all Americans.

Introduction

The availability of quality health insurance remains a prevalent barrier to optimal health in the United States despite recent strategies targeting health care reform. Although the Affordable Care Act has resulted in an additional 12 million individuals gaining health insurance, it has been estimated that 31 million Americans will remain uninsured by 2024 (Congressional Budget Office (CBO)). Gaps in coverage, including lack of uniform Medicaid coverage among states, personal choice to remain uninsured, lack of awareness of the new health reform laws, and problems enrolling contribute to limit access to care (Congressional Budget Office (CBO); Institute of Medicine (IOM), 2009; McWilliams, 2009).

According to the Institute of Medicine and other reports (Institute of Medicine (IOM), 2009; Wilper et al., 2009; Ayanian et al., 2000), adults who lack insurance and suffer from cancer, cardiovascular disease (CVD), stroke, asthma and other chronic conditions are more likely to experience poorer health outcomes, reduced quality of life, and premature death, compared to their insured counterparts. Adequate insurance coverage protects against devastating costs of catastrophic illness, provides access to preventive health care and screening, and may provide care earlier in the disease process for improved outcomes (Institute of Medicine (IOM), 2009; Hadley, 2003; Baker et al., 2002; Institute of Medicine (IOM), 2002; Kronick, 2009; Robinson and Shavers). The lack of adequate insurance is especially prevalent in segments of the population experiencing social and economic disparities (DeNavas-Walt et al., 2011; Smedley et al., 2003; The Agency for Healthcare Research and Quality, 2007). The associations between cancer mortality and multiple lifestyle factors, such as dietary intakes (World Cancer Research Fund (WCRF)/American Institute for Cancer

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Research(AICR), 2007), physical activity (World Cancer Research Fund (WCRF)/American Institute for Cancer Research(AICR), 2007; Thune and Furberg, 2001; Haskell et al., 2007), smoking and alcohol (World Cancer Research Fund (WCRF)/American Institute for Cancer Research(AICR), 2007; Seitz et al., 2012; Shiels et al., 2013; International Agency for Research on Cancer (IARC), 2004; International Agency for Research on Cancer (IARC), 2010), obesity (World Cancer Research Fund (WCRF)/American Institute for Cancer Research(AICR), 2007; Rohrmann et al., 2007; Parekh et al., 2010; Vucenik and Stains, 2012), and exposure to environmental carcinogens (US Department of Health and Human Services (USDDHS), 2010; International Agency for Research on Cancer (IARC), 2012) have also been well-documented.

The current study examined the hypothesis that higher mortality in those lacking adequate health insurance is partly due to the greater prevalence of disease-associated lifestyle risk factors. Our objective was to provide a deeper understanding of the relationships between health insurance and risk of mortality from cancer and other chronic diseases, such as CVD and type-2 diabetes. Furthermore, we simultaneously examined the effects of insurance status in relation to lifestyle factors associated with disease risk and mortality. For example, smoking is clearly linked to CVD and cancer, yet its prevalence relative to health insurance status is not well-documented (Charafeddine et al., 2013; Jorm et al., 2012). We also assessed the effect of dietary patterns, using the Healthy Eating Index (HEI), which is based on US Dietary Guidelines for Americans 2010, and provides a more optimal approach than examining individual nutrients relative to mortality risk (World Cancer Research Fund/American Institute for Cancer Research, 2007; Kant, 2004; Kennedy et al., 1995; Kennedy, 2008). In addition, the obesity epidemic in America contributes significantly to the risk of diabetes (World Health Organization (WHO), 2000; Day and Bailey, 2011) and mortality from CVD (Association AH, 2014) and several cancers (World Cancer Research Fund/American Institute for Cancer Research, 2007; Calle, 2007). We, therefore, explored the association between obesity and insurance status on mortality risk. Finally, we examined the relationship between C-reactive protein (CRP), an inflammatory biomarker that has shown associations with cancer and other chronic disease (Manabe, 2011; Chaturvedi et al., 2010), and insurance status on mortality. We hypothesized that private insurance status would result in better cancer/chronic disease mortality outcomes, and that diet, lifestyle, and inflammation-related factors would significantly impact the insurance–mortality relationship.

Methods

The data in this study were from the Third National Health and Nutrition Examination Survey (NHANES III), which was conducted by the National Center for Health Statistics (NCHS) (U.S. Department of Health and Human Services Third National Health and Nutrition Examination Survey, 1996; NCHS (National Center for Health Statistics), 1992). NHANES III was used versus more recent NHANES datasets because it provided a longer follow-up time and larger sample size. NHANES III used a complex, multi-stage, stratified sample of civilian, non-institutionalized persons aged two months or greater (National Center for Health Statistics (NCHS), 1994), and was conducted from October 1988–1994 in two phases. In NHANES III, 33,994 (86%) of the 39,695 total participants were interviewed in their homes. Participants were then invited to mobile examination centers (MECs) for a medical exam. A detailed description of design specifications and methods can be found in the Plan and Operation of the Third National Health and Nutrition Examination Survey, 1988–1994 (U.S. Department of Health and Human Services Third National Health and Nutrition Examination Survey, 1996; National Center for Health Statistics (NCHS), 1994).

For the present study, data from NHANES III participants were prospectively examined to determine the effects of public/no insurance versus private insurance on the risk of mortality from cancer, all causes, CVD (included heart disease, hypertension, cerebrovascular disease and diseases of the arteries and circulatory system) and diabetes. The criteria for inclusion in this study were: (a) age > 40 years, and (b) study participants were cancer-free when they began the study (i.e. they had never been told by a doctor that they had cancer, with the exception of non-melanoma skin cancer). This prospective study followed cancer-free individuals from the time of entry into the NHANES III study until death or December 1, 2006.

Measures

Household adult questionnaire

The NHANES III Household Adult Questionnaire included all data collected during the household interviews for adults aged >17 years. Demographic and lifestyle data, such as age, sex, race, education, and smoking were obtained from the Household Adult Questionnaire. At the end of the interview, the respondent's blood pressure was measured three times (a second set of measurements was obtained at the MEC). Interviews were conducted by field staff, who received intensive initial training and formal retraining to ensure that high skill levels were maintained. The data collection system was automated in Phase 2, during which interviews were conducted using computer-assisted personal interview. Details on survey instruments and forms, training manuals and data collection procedures are published elsewhere (U.S. Department of Health and Human Services Third National Health and Nutrition Examination Survey, 1996).

MEC physical examination

Blood and urine specimens were obtained at the MEC within one month of the interview, where several lab tests and measurements were performed, including anthropometric measurements, such as height, weight, and body mass index (BMI). While some of the blood and urine analyses were performed in the MEC laboratory, most analyses were conducted elsewhere by contract laboratories (U.S. Department of Health and Human Services Third National Health and Nutrition Examination Survey, 1996; National Center for Health Statistics (NCHS), 1994). For those who could not visit the MEC, a limited home examination was conducted.

Healthy eating index

The HEI provides a measure of overall quality of an individual's diet by assessing compliance with federal dietary guidelines and recommendations (Kennedy et al., 1995). The US Department of Agriculture calculated HEI components and overall scores from dietary recall interviews collected for NHANES. The overall HEI score is the sum of 10 dietary components, which includes grains, fruits, vegetables, dairy, meat, dietary fats, saturated fats, cholesterol, sodium and variety. Each component has a maximum score of 10 and a minimum score of zero. The maximum overall HEI score is 100. A score of zero was assigned to a food group if no items from that category were consumed. For each of the five food group components of the HEI, individuals who consumed the recommended number of servings received a maximum score of 10.

CRP analysis

CRP was obtained from serum samples stored at −70 °C, which were analyzed within 2 months of collection. CRP was analyzed using a fully automated Behring Nephelometer Analyzer System (Behring Diagnostics, Inc, Somerville, NJ). Additional details about the specific methods for quantifying CRP are provided elsewhere (Gunter and McQuillan, 1990).

Ascertainment of mortality through National Death Index linkage

The outcome measure for this prospective study was mortality from cancer, all causes, CVD and diabetes, which was ascertained through a record linkage process using mortality data from the National Death Index (NDI). The NHANES III database was linked with NDI mortality records through December 31, 2006 (Madans and Hunter, 1996; National Center for Health Statistics (NCHS), 2005). This linkage was performed through probabilistic matching using several criteria to confirm a match, such as name, social security, and date of birth (National Center for Health Statistics (NCHS), 2005). The underlying cause of death was established from ICD-9 codes through 1998 and ICD-10 codes for 1999–2000, but the final cause of death data was determined by ICD-10 codes after adjusting for changes between coding systems (National Center for Health Statistics (NCHS), 2006).

Statistical analysis

Descriptive statistics

Descriptive statistics were calculated for all variables, with frequencies and percentages shown for discrete variables and means and standard deviations (SDs) calculated for continuous variables. Tests of statistical significance were also shown, with chi-squares performed for discrete variables and t-tests performed for continuous variables. The level of statistical significance was alpha = 0.05.

Regression analysis

Cox proportional hazards regression analysis was performed to assess the relationship between insurance status and mortality from all causes, cancer, CVD and type-2 diabetes. Effects were quantified by estimating hazard ratios (HRs) with *P*-values from univariate and multivariate regression models. Regression models were developed to examine the relationship between insurance status and mortality, as well as covariates and inflammatory-related factors. Insurance status was classified into 2 categories: public/uninsured compared to private insurance. The public and uninsured categories were combined due to the small sample size for assessing mortality in the uninsured category.

The effect of demographic and inflammation-related lifestyle factors on the relationship between insurance and mortality was assessed using the following factors: age (years), gender (male, female), race (white, African American/other), education (<high school graduate/GED, >high school/GED), smoking status, BMI (kg/m2; per 5-unit change), CRP (<3 mg/L, >3 mg/L), HEI Score (range 0–100; score <50 = poor, 51–80 = needs improvement and >80 = good) (Ervin, 2008). The CRP cutoff of 3 was based on established cut points that have been previously defined in the literature (Imayama et al., 2012; Pearson et al., 2003). Graphical checks of the data and covariates (using Proc Lifetest) revealed that the proportional hazards assumption was met. Analyses were conducted using SAS 9.3 (SAS, 2010).

Results

Participants

Out of 10,735 participants who met the eligibility criteria for inclusion (age > 40 and cancer free at baseline), a total of 1785 participants did not have a measurement for mortality and/or covariate factors, and were, therefore, excluded, providing a total of 8950 participants for analysis in this study (see Fig. 1).

Demographic and clinical characteristics

Participant demographic and clinical characteristics by insurance status are shown in Table 1. Regardless of insurance type, participants were almost equally split according to gender and were about three-fourths non-Hispanic white. The public/uninsured group was older (67 versus 51 years; *P* < 0.0001). Only 39% of the public/uninsured had a high school education or greater compared to 71% of the privately insured (*P* < 0.001). A significantly greater proportion (58% versus 53%) of the private versus public/uninsured, respectively, reported a smoking history (*P* < 0.0001). Among smokers, however the public/uninsured group showed a slightly greater number of pack-years smoked. Mean

Table 1
Demographic and clinical characteristics of participants by insurance status in the Third National Health and Nutrition Examination Survey (1988–1994).

	Variable	Private insurance (n = 3509) n (%)	Public/no insurance (n = 5441) n (%)	Total (n = 8950) n (%)
Gender	Male	1723 (49.1)	2582 (47.5)	4305 (48.1)
	Female	1786 (50.9)	2859 (52.6)	4645 (51.9)
Race	White[a]	2484 (70.8)	4072 (74.8)	6556 (73.3)
	Non-white	1025 (29.2)	1369 (25.2)	2394 (26.7)
Education	<High school[a]	1011 (28.8)	3306 (60.8)	4317 (48.2)
	>High school	2498 (71.2)	2135 (39.2)	4633 (51.8)
Age	40–49 years[a]	1587 (45.2)	811 (14.9)	2398 (26.8)
	50–59 years	1195 (34.1)	520 (9.6)	1715 (19.2)
	60–69 years	680 (19.4)	1428 (26.3)	2108 (23.6)
	70–79 years	34 (1.0)	1524 (28.0)	1558 (17.4)
	>80 years	13 (0.4)	1158 (21.3)	1171 (13.1)
	Mean (SD)[b]	51.4 (8.2)	67.4 (13.3)	61.1 (14.0)
Smoking status	Current[a]	1140 (32.5)	1789 (32.9)	2929 (32.8)
	Former	903 (25.7)	1075 (19.8)	1978 (22.1)
	Never	1466 (41.8)	2577 (47.4)	4043 (45.2)
	Pack-years: mean (SD)	18.0 (18.5)	19.5 (22.6)	18.8 (20.8)
Body mass index	<18.5 underweight[a]	40 (1.1)	157 (2.9)	197 (2.2)
	18.5–24.9 normal	1074 (30.6)	1766 (32.5)	2840 (31.7)
	25.0–29.9 overweight	1355 (38.6)	2085 (38.3)	3440 (38.4)
	>30 obese	1040 (29.6)	1433 (26.3)	2473 (27.6)
	Mean (SD)[b]	27.3 (5.6)	28.0 (5.6)	7.6 (5.6)
CRP levels	CRP <3 mg/L[a]	2298 (65.5)	3107 (57.1)	5405 (60.3)
	CRP >3 mg/L	1211 (34.5)	2334 (42.9)	1748 (39.6)
	Mean (SD)[b]	4.5 (6.5)	6.0 (10.2)	5.4 (9.0)

[a] *P* < 0.0001 (frequencies).
[b] *P* < 0.0001 (means).

BMI was slightly higher for the privately insured group (*P* < 0.0001). The privately insured group had a greater proportion of individuals classified with normal CRP levels < 3 mg/L (66% versus 57%; *P* < 0.0001), but also had significantly higher overall mean serum CRP levels (6.0 versus 4.5; *P* <0.0001).

Table 2 displays demographics and personal characteristics by type of mortality in this study. Significantly more males than females (over 50%) died for each type of mortality (*P* < 0.0001), except diabetes. More deaths (over 70%) occurred among whites than non-whites for each type of mortality, which was only statistically significant for all-cause and CVD mortality. In all groups, those who died from each disease were less likely to have a high school education (*P* < 0.0001) and were significantly older (*P* < 0.0001). Smoking was statistically

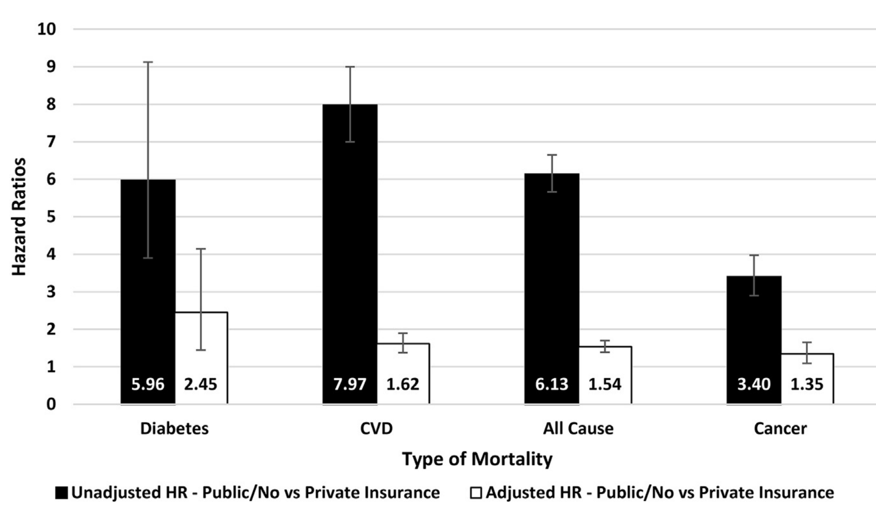

Fig. 1. Unadjusted and adjusted hazard ratios (HRs) by type of mortality for public/no insurance versus private insurance^{+}.

Table 2
Demographic characteristics of participants in the Third National Health and Nutrition Examination Survey (1988–1994) by mortality status.

	Variable	All cause mortality (n = 3508) n (%)	All cancer mortality (n = 714) n (%)	All CVD mortality (n = 1662) n (%)	Diabetes mortality (n = 123) n (%)
Gender	Male	1862 (53.1)***	419 (58.7)***	866 (52.1)**	50 (40.6)
	Female	1646 (46.9)	295 (41.3)	796 (47.9)	73 (59.3)
Race	White	2671 (76.1)***	511 (71.6)	1290 (77.6)***	87 (70.7)
	Non-white	837 (23.9)	203 (28.3)	372 (22.4)	36 (29.3)
Education	<High school	2081 (59.3)***	396 (55.5)***	999 (60.1)***	87 (70.7)***
	>High school	1427 (40.7)	318 (44.5)	663 (39.9)	36 (29.3)
Age	40–49 years	221 (6.3)***	61 (8.5)***	83 (5.0)***	7 (5.7)***
	50–59 years	316 (9.0)	115 (16.1)	106 (6.4)	15 (12.2)
	60–69 years	840 (24.0)	212 (29.7)	361 (21.7)	47 (38.2)
	70–79 years	1046 (29.8)	218 (30.5)	492 (29.6)	33 (26.8)
	>80 years	1085 (30.9)	108 (15.1)	620 (37.3)	21 (17.1)
	Mean (SD)	71.4 (1.8)***	67.1 (11.3)***	73.3 (11.4)***	68.1 (10.3)***
Smoking status	Current	768 (26.9)	236 (33.1)	277 (17.9)	19 (15.5)
	Former	1292 (36.8)	259 (36.3)	621 (37.4)	45 (36.6)
	Never	1448 (41.3)***	219 (30.7)***	744 (44.8)***	59 (48.0)
Body mass index	<18.5 underweight	137 (3.9)***	19 (2.7)*	60 (3.6)***	3 (2.4)
	18.5–24.9 normal	1239 (35.3)	257 (36.0)	570 (34.3)	28 (22.8)
	25.0–29.9 overweight	1335 (38.1)	266 (37.3)	648 (39.0)	48 (39.0)
	>30 obese	797 (22.7)	172 (24.1)	384 (23.1)	44 (35.8)
	Mean (SD)	26.8 (5.4)***	26.9 (5.4)***	26.8 (5.3)***	29.4 (6.6)**
CRP levels	CRP <3 mg/L	1947 (55.5)***	403 (56.4)*	925 (55.7)***	52 (42.3)***
	CRP >3 mg/L	1561 (44.5)	311 (43.6)	737 (44.3)	71 (57.7)
	Mean (SD)	6.5 (10.6)***	6.2 (9.8)***	6.4 (10.5)***	8.5 (12.0)**

CVD mortality includes heart disease, hypertension, cerebrovascular disease and all diseases of the arteries and circulatory system.
* $P < 0.05$.
** $P < 0.001$.
*** $P < 0.0001$.

significant for all-cause and all-cancer mortality, with the highest percentage of current and former smokers observed for cancer mortality (69%) and the lowest percentage for diabetes mortality (55%). For each type of mortality, 37 to 39% of participants had a BMI in the overweight category (25–29 kg/m^2) (WHO, 1995), with the highest mean BMI (29) observed for diabetes mortality, versus a mean BMI of 27 for the remaining groups ($P < 0.0001$). CRP levels were highest for diabetes mortality (8.0 mg/L; $P < 0.0001$), but were significantly lower for the remaining death types.

Regression analysis

Fig. 1 shows the HRs for each type of mortality according to insurance type. The unadjusted HRs reflected substantial increases in mortality risks ranging from 3.4 times greater (HR = 3.40; 95% CI = 2.9,3.97; $P < 0.001$) for cancer to nearly 8-fold (HR = 7.97; 95% CI = 7.01,9.06; $P < 0.001$) for CVD in public/uninsured versus privately insured individuals. When adjusted for demographic and lifestyle risk factors, however, the increase in mortality risk for the public/uninsured was significantly attenuated to 1.4 times greater for cancer (HR = 1.35; 95% CI = 1.09,1.66; $P < 0.001$) compared to 2.5 times greater (HR = 2.45; 95% CI = 1.45,4.14; P < 0.001) for diabetes, respectively.

Fig. 2 displays the HRs for the adjusted multivariate models that include demographic, lifestyle and inflammation-related risk factors for public/uninsured versus privately insured individuals. Older age was significantly related to a 5 to 10% increased risk of all types of mortality, independent of insurance status and other risk factors, including cancer (HR = 1.06; 95% CI = 1.05,1.07; $P < 0.0001$), all causes (HR = 1.09; 95% CI = 1.08, 1.09; $P < 0.0001$), CVD (HR = 1.10; 95% CI = 1.09,1.11; $P < 0.0001$), and diabetes (HR = 1.05; 95% CI = 1.02, 1.07; $P < 0.0001$). Males showed significantly greater risks of 30 to 52% for mortality from cancer (HR = 1.52; 95% CI = 1.30,1.77; $P < 0.0001$), all causes (HR = 1.30; 95% CI = 1.21,1.39; $P < 0.0001$), and CVD (HR = 1.30; 95% CI = 1.18,1.44; $P < 0.0001$). Non-white race showed significantly increased risks of 30 and 12%, respectively, for cancer (HR = 1.30; 95% CI = 1.11,1.52; $P < 0.05$) and all-cause mortality (HR = 1.12; 95% CI = 1.04,1.20; $P < 0.001$). Significantly increased risks of 1.7 to almost 3-fold were observed for current smokers who died of cancer (HR = 2.78; 95% CI = 2.29,3.39; $P < 0.0001$), all causes (HR = 1.84; 95% CI = 1.67,2.02; $P < 0.0001$) and CVD (HR = 1.58; 95% CI = 1.37,1.82; $P < 0.0001$). Increased BMI was associated with a 28% increased diabetes mortality risk (per 5-unit change; HR = 1.28; 95% CI = 1.12,1.48; $P < 0.001$), and a significant 4% decreased risk for all-cause mortality (HR = 0.96; 95% CI = 0.93,0.99; $P < 0.05$). Lower HEI scores (<50 versus >80) showed significantly increased mortality risks of 44, 58, and 52%, respectively, for cancer (HR = 1.44; 95% CI = 1.11,1.86; $P < 0.01$), all-cause mortality (HR = 1.58; 95% CI = 1.45,1.77; $P < 0.0001$), and CVD (HR = 1.52; 95% CI = 1.30, 1.77; $P < 0.0001$). Elevated CRP levels were significantly associated with increased risks of approximately 20% for cancer (HR = 1.19; 95% CI = 1.02,1.38; $P < 0.05$), all-cause (HR = 1.23; 95% CI = 1.15,1.31; $P < 0.0001$) and CVD mortality (HR = 1.20; 95% CI = 1.09,1.32; $P < 0.001$), with the largest increased risk of 69% observed for diabetes mortality (HR = 1.69; 95% CI = 1.18,2.42; $P < 0.01$).

Discussion

This study provides a unique opportunity to align national nutrition monitoring efforts with prospective epidemiological tracking to assess the effects of private versus pubic or no insurance on the risk of mortality from cancer, all causes, CVD and diabetes. Since millions of Americans continue to remain uninsured or underinsured, we sought to examine not only the effects of variation in insurance (public/no insurance versus private) on mortality, but also to simultaneously exam the effects of inflammation-related lifestyle factors, such as obesity, smoking, and diet on this relationship. We hypothesized that public/uninsured status would result in increased cancer/other chronic disease mortality outcomes, even in the presence of inflammation-related lifestyle factors, and that these factors would affect the insurance–mortality relationship.

The results showed that insurance status was strongly related to the risk of mortality from cancer, all causes, CVD and diabetes, both in

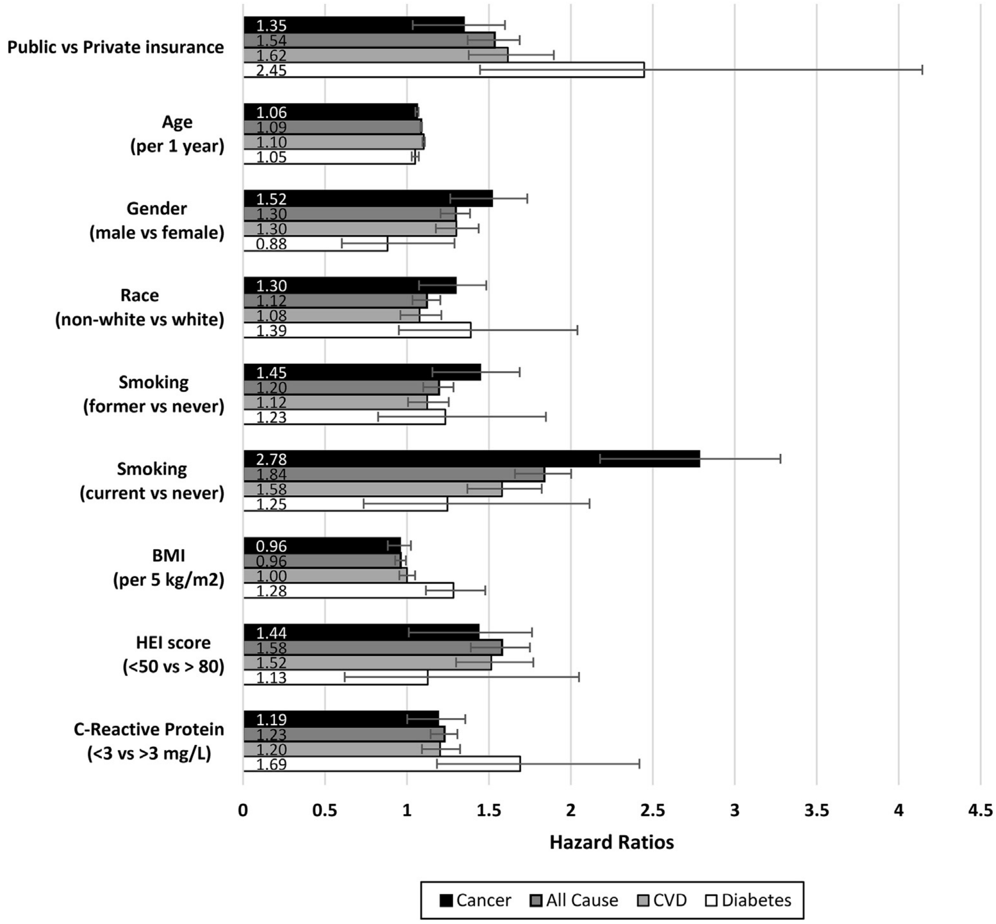

Fig. 2. Adjusted regression model factor hazard ratios by type of mortality for private versus public/no insurance and inflammation/lifestyle risk factors^{+}.

unadjusted and adjusted models, as hypothesized. Although unadjusted models showed the largest increases in risk of mortality for the public/uninsured versus insured groups, when models were adjusted for demographic and lifestyle risk factors, substantially increased mortality risks were observed for cancer, all-cause and CVD mortality (35 to 62%), and especially for diabetes (245%). Our data show that insurance is one factor likely contributing to poor health outcomes, but that insurance status is associated with other lifestyle and biological factors that jointly account for greater mortality risk in the public/uninsured group.

Previous studies examining the effects of insurance and mortality have used various approaches. Cheung et al (Cheung, 2014) examined the effect of no health insurance coverage versus government and private insurance, and observed a 70% increased risk of all-cause mortality and 3-fold increased risk of cancer mortality for those lacking insurance. In controlling for covariates, they observed significantly increased risks of all-cause and cancer mortality for older age, non-white race, and increased alcohol consumption, but also found an 18% decreased risk of all-cause mortality for a higher poverty income index ratio. Wilper et al. (2009) examined private versus no insurance but excluded government-funded insurance. The results showed a 40% decreased risk in all-cause mortality for private versus no insurance. Their adjusted models also revealed that male gender, older age, and current smoking were associated with increased risks of mortality, which was similar to our results on all-cause mortality and lifestyle factors. However, they did not examine important inflammation-related lifestyle factors, such as the effect of healthier diets, obesity and elevated CRP on mortality, which were shown to be significantly associated with the insurance–mortality relationship in our study.

Past studies that have examined lifestyle and mortality have shown a similar range of reductions in risk of mortality as those from the current study. For example, Lopez et al. (2006), estimated that 45% of global mortality was attributable to lifestyle risk factors. A recent meta-analysis of lifestyle behaviors showed that a combination of 5 healthy lifestyle factors (obesity, alcohol consumption, smoking, diet and physical activity) was associated with a 66% reduction in risk of all-cause mortality (Loef and Walach, 2012). van Dam et al. (2008) observed 3-, 4-, and 8-fold increases in risk of cancer, all-cause mortality, and diabetes for middle-aged women who had few healthy lifestyle behaviors. Carlsson et al. (2013) recently reported reductions in CVD risk of 40% and 60% for men with 3–5 and 6–7 healthy lifestyle factors, respectively; also, women with 4–7 healthy lifestyle factors showed a 40% reduction in CVD risk. Elevated CRP is also associated with higher mortality for many chronic diseases (Heikkila et al., 2007) with one report showing an 80% increase risk of death for those with elevated CRP levels (Allin and Borge, 2011). While our data corroborates these studies, none of the previous studies examined lifestyle factors simultaneously with health insurance status.

Having public/no insurance showed the greatest increase in risk of diabetes mortality (245%) in this study compared to 35–62% for other types of mortality. This result may indicate that the potential for more intensive medical care and management has a greater impact on mortality from diabetes than for other diseases examined in this study. Indeed, with modern laboratory testing and knowledge of risk factors, individuals with greater risk of diabetes can be identified earlier, and proven diet, exercise, and pharmacologic strategies applied to manage metabolic derangements, thereby reducing the risk of common complications of diabetes that lead to life-threatening outcomes. Thus, we hypothesize that access to quality insurance with appropriate medical and dietetic support can have a major impact on diabetes mortality.

A large body of observational research conducted prior to 2002 shows that uninsured adults with cancer are diagnosed at more advanced stages of disease, have poorer outcomes, and die sooner, even after adjusting for stage of disease (Institute of Medicine (IOM), 2009; Institute of Medicine (IOM), 2002). Halpern et al (Halpern et al., 2008). observed that uninsured patients diagnosed with cancer between 1998 and 2004 were more likely than privately insured patients to be diagnosed at advanced stages of disease, especially cancers that can be detected early by screening (e.g., breast, colorectal) or by symptom assessment (e.g., melanoma, bladder). Several other studies that have examined associations between screening, treatment, and/or outcomes in selected cancers and insurance coverage have also suggested that patients with private insurance experienced better outcomes (McWilliams, 2009; Carney et al., 2012; Smith et al., 2013). Similar results have been reported for all-cause mortality and heart disease (Institute of Medicine (IOM), 2009; McWilliams, 2009). Our study reinforces these observations, but also indicates that this relationship is partly due to poorly controlled lifestyle, smoking, and dietary risk factors that are associated with suboptimal access to quality insurance.

The passage of the Affordable Care Act will change the insurance landscape in this country. As previously mentioned, gaps still exist for those who refuse to get insurance and would rather pay the penalty, and for states who opt to not enroll in Medicaid (Institute of Medicine (IOM), 2009). Furthermore, the Affordable Care Act allows for a number of levels of insurance to choose from, and there may be significant differences in risk based on the amount of coverage versus simply having coverage itself. The evidence from our study suggests that more comprehensive coverage typically found in private insurance has a significant impact on mortality rates for chronic disease. Most critically, our work indicates that preventive measures focusing upon tobacco, obesity, diet and exercise should be key components of optimal insurance to reduce morbidity, mortality and health care costs. Simply providing coverage does not guarantee maximum public health benefits, but comprehensive coverage is needed for better health outcomes. Incorporating wellness programs, with incentives for healthier lifestyle habits, has been attempted by some insurance companies, but the effects on mortality have not been well-documented (Bleyer et al., 2012). Additional research is needed.

The primary strength of this study was the use of the NHANES cohort, which is a large national probability sample. Our results are, therefore, more generalizable to the US population. NHANES was a well-planned and executed study with well-trained staff, and many quality controls to ensure high quality data and consistent data collection. CRP and other anthropometric study data were obtained from blood draws that were analyzed by an independent lab; anthropometric data were obtained through physical exams conducted at baseline versus self-report.

Limitations of this study were that insurance status was self-reported and was only assessed at a single time point. Several lifestyle behaviors were also self-reported. The duration of insurance and out-of-pocket expenses are unknown, however. There have also been fundamental changes in services covered by public versus private insurance since these data were collected. For example, coverage for medications in Medicare only began several years ago. Preventive care was also not previously covered. Unmeasured factors, such as socioeconomic conditions, additional comorbid conditions, and treatment adherence unrelated to cost and health awareness could have resulted in residual confounding in this study. In addition, unmeasured changes in lifestyle factors could have occurred during the follow-up period.

In conclusion, our study shows that having private insurance was, in fact, associated with reduced risks of mortality from cancer and other chronic diseases. Our results corroborate those of past studies, with an additional focus on inflammation-related lifestyle risk factors in the underinsured population. This study suggests that even with health care reform, our ability to reduce morbidity and mortality for chronic diseases may strongly depend upon quality insurance programs that address critical diet, obesity, tobacco, and lifestyle factors. Therefore, comprehensive coverage for all with a focus on improving lifestyle factors is greatly needed.

Conflict of interest

The authors declare that there are no conflicts of interest.

Transparency document

The Transparency document associated with this article can be found, in online version.

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