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Cardiovascular Mortality Associated With 5 Leading Risk Factors: National and State Preventable Fractions Estimated From Survey Data

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Background: Impressive decreases in cardiovascular mortality have been achieved through risk factor reduction and clinical intervention, yet cardiovascular disease remains a leading cause of death nationally.

Objective: To estimate up-to-date preventable fractions of cardiovascular mortality associated with elimination and reduction of 5 leading risk factors nationally and by state in the United States.

Design: Cross-sectional and cohort studies.

Setting: Nationally representative and state-representative samples of the U.S. population.

Participants: Adults aged 45 to 79 years.

Measurements: Self-reported risk factor status in the BRFSS (Behavioral Risk Factor Surveillance System) 2009–2010 was corrected to approximate clinical definitions. The relative hazards of cardiovascular death (International Classification of Diseases, 10th Revision, codes I00 to I99) associated with risk factors were estimated using data from NHANES (National Health and Nutrition Examination Survey) (1988–1994 and 1999–2004, followed through 2006).

Results: The preventable fraction of cardiovascular mortality associated with complete elimination of elevated cholesterol levels, diabetes, hypertension, obesity, and smoking was 54.0% for men and 49.6% for women in 2009 to 2010. When the more feasible target of reducing risk factors to the best achieved levels in U.S. states was considered, diabetes (1.7% and 4.1%), hypertension (3.8% and 7.3%), and smoking (5.1% and 4.4%) were independently associated with the largest preventable fractions among men and women, respectively. With both targets, southern states had the largest preventable fractions, and western states had the smallest.

Limitation: Self-reported state data; mortality hazards relied on baseline risk factor status.

Conclusion: Major modifiable cardiovascular risk factors collectively accounted for half of cardiovascular deaths in U.S. adults aged 45 to 79 years in 2009 to 2010. Fewer than 10% of cardiovascular deaths nationally could be prevented if all states were to achieve risk factor levels observed in the best-performing states.

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In the past 3 decades, U.S. cardiovascular mortality has been halved, an achievement that is attributable roughly equally to reductions in risk factors and improvements in treatments (1). Despite these gains, coronary heart disease and stroke remain leading causes of years of life lost, and cardiovascular disease was responsible for more than 780 000 deaths in 2010 (2). Furthermore, relative to other high-income countries, the United States continues to rank poorly in terms of cardiovascular mortality, overall mortality, and disability levels (3). National statistics mask considerable disparities in cardiovascular mortality across U.S. states, with southern states being particularly disadvantaged (4–8). For example, average age-standardized cardiovascular mortality in southern states was 29% to 43% higher than that of states in the Midwest, Northeast, and West in 2009 to 2010 (2).

Modifiable cardiovascular-related risk factors (such as elevated cholesterol levels, diabetes, hypertension, obesity, and smoking) are responsible for much of the national burden of cardiovascular disease mortality (9, 10). The comparative and cumulative contribution of risk factors to each state's cardiovascular mortality burden is unknown. Comparative assessment of the contribution of multiple modifiable risk factors to cardiovascular mortality at the state level can inform prioritization of state-specific health policy. Recent estimates of state-level attributable cardiovascular mortality have been produced only for hypertension (11); those results indicated geographic concentration of hypertension-attributable cardiovascular mortality in states in the South. Smoking has also been found to be a major contributor to the high all-cause mortality in this region (12). To date, there have been no comparisons of preventable cardiovascular mortality associated with multiple known cardiovascular risk factors within or across states. Moreover, the extent to which national cardiovascular mortality could be expected to decrease if all states were successful at reducing modifiable risk factor levels to specified target levels is unknown.

In a comparative framework, we assessed the contribution of 5 leading modifiable risk factors for cardiovascular disease—elevated cholesterol levels, diabetes, hypertension, obesity, and smoking—to cardiovascular mortality for the nation and for each state. We report the fraction of cardiovascular deaths that could have been prevented in 2009 to 2010 under 2 scenarios:

See also:

Web-Only
Supplement

EDITORS' NOTES

Context

Understanding the contribution of multiple modifiable cardiovascular risk factors to cardiovascular mortality could inform state-specific health policies.

Contribution

Data from state and national health surveys from 2009 to 2010 were analyzed to describe the preventable fractions of cardiovascular mortality associated with either complete elimination or reduction to best achieved levels in states of hypercholesterolemia, diabetes, hypertension, obesity, and smoking.

Caution

State-level data on objectively measured cardiovascular risk levels are lacking.

Implication

Modifiable cardiovascular risk factors together accounted for nearly half of cardiovascular deaths in U.S. adults in 2009 to 2010. Reducing specific cardiovascular risk factors in states to the best achieved levels could prevent 0% to 7% of cardiovascular deaths.

complete elimination of risk factors, and reduction of risk factors to the best achieved levels observed in U.S. states in 2009 to 2010. Although elimination of risk factors is the conventional target used in studies of preventable mortality, we also considered the best achieved levels in U.S. states to provide a more realistic assessment of decreases in mortality that could be leveraged through risk reduction both nationally and among states.

METHODS

Data Sources

Self-reported cardiovascular risk factor data from 533 306 respondents aged 45 to 79 years in the BRFSS (Behavioral Risk Factor Surveillance System) 2009–2010 were analyzed. The BRFSS, which was conducted via landline telephone in 2009 and 2010, is the only survey with national coverage that is designed to measure state-level health-related risk factors, treatment, and outcomes among U.S. adults (13). Median response rates across states were 52.4% in 2009 and 54.6% in 2010; 8% of the age-eligible sample was excluded because of missing covariates. The hazard ratio (HR) of cardiovascular death associated with each risk factor was estimated from the most recent NHANES (National Health and Nutrition Examination Survey) data with public-use mortality linkages available (1988–1994 and 1999–2004). NHANES is a multistage probability sample of adults and children that is designed to represent the U.S. noninstitutionalized civilian population. In relevant age groups, response rates ranged from 60% to 73% for NHANES III (1988–1994) and from 66% to 76% for NHANES 1999–2004. Participants who were underweight, died within 1 year of examination, or were assigned a zero sample weight were excluded by design; an additional 12% of the eligible sample was excluded because of missing covariates. Data from 14 307 participants who were aged 45 to 79 years at the time of death from cardiovascular disease or censoring and had complete covariates of interest were analyzed; 706 cardiovascular deaths were observed through 2006. Finally, data from NHANES 2009–2010 were used to correct for bias in self-reported risk factor data from the BRFSS 2009–2010. Of 3150 respondents aged 45 to 79 years who were eligible for the correction analysis, 2651 with complete covariates were analyzed (16% were excluded).

Clinical Risk Factor Definitions

Clinical definitions of risk factors were as follows. Elevated cholesterol level was defined as a measured total blood cholesterol level of at least 6.21 mmol/L (≥240 mg/dL) or use of medication (14). Diabetes was defined as a measured HbA_{1c} level of at least 6.5% or medication use (15). Hypertension was defined as a measured average systolic blood pressure of at least 140 mm Hg, a measured average diastolic blood pressure of at least 90 mm Hg, or use of medication (16). Obesity was defined as a body mass index of at least 30 kg/m^2 computed from measured height and weight (17). A current smoker was defined as one who currently smoked or had a measured serum cotinine level greater than 56.8 nmol/L. A former smoker had smoked at least 100 cigarettes during his or her lifetime but was not currently smoking and had a measured serum cotinine level of 56.8 nmol/L or less. Finally, a never-smoker had smoked fewer than 100 cigarettes during his or her lifetime and had a measured serum cotinine level of 56.8 nmol/L or less (18). We also constructed binary indicators for having at least 1 risk factor (0 vs. ≥1 of the 5 risk factors) and at least 1 metabolic risk factor (0 vs. ≥1 of elevated cholesterol level, diabetes, hypertension, or obesity).

Risk Factor Targets

We considered 2 target risk levels. The first was complete elimination (the theoretical minimum exposure) (19). This target provided an estimate of the total hypothetical fraction of cardiovascular mortality associated with each risk factor individually and all risk factors combined. The second target was individual risk factor reduction to the best achieved levels to provide a more realistic assessment of the fraction of cardiovascular mortality that could be prevented by reducing specific risk factors. The best achieved levels were defined as the mean prevalence in the 5 states with the lowest levels of each risk factor in 2010 by age and sex. For smoking history (current, former, and never), the mean distribution of smoking history for the 5 states with the lowest prevalence of current smoking was used as the risk reduction target.

Statistical Analysis

State-Level Prevalence of Clinically Defined Risk Factors

The detailed method for estimating state-level prevalence of clinically defined risk factors from self-reported risk factor status is outlined in the Supplement (available at www.annals.org). Briefly, we corrected for potential bias in self-reported risk factor data in the BRFSS 2009–2010 by developing regression-based correction equations using data from NHANES 2009–2010, which contains both self-reported and clinically defined risk factor status. Similar to prior studies (11, 20, 21), we developed separate correction equations specific to each risk factor by estimating a logistic regression model of meeting the clinical definition for a risk factor given participants' self-reported risk factor status, age, sex, race, marital status, education, and access to a routine medical provider. The model coefficients from the NHANES correction equations were then applied to the BRFSS respondents to estimate a predicted probability (that is, a corrected likelihood) of the clinically defined risk factor in the BRFSS. The prevalence of the clinically defined risk factor was the survey-weighted mean of the predicted probability of meeting the clinical definition among BRFSS respondents. Prevalence was estimated nationally, by state, and by age, as needed.

To avoid overfitting the correction equations to the NHANES sample, we randomly drew two thirds of the NHANES sample 10 times to generate 10 sets of correction equations that, in turn, generated 10 sets of clinically defined prevalence estimates from the BRFSS respondents. The final corrected, clinically defined prevalence for each risk factor was the mean across the 10 corrected prevalence estimates; SEs incorporated sampling variability in the BRFSS and variability across the multiple corrections (22). For height and weight, we used linear regression to develop correction equations relating continuous self-reported height and weight to measured height and weight; corrected obesity status was based on the corrected height and weight.

Hazard Ratios for Cardiovascular Mortality

The HR for cardiovascular mortality associated with each clinically defined risk factor was obtained from an analysis of public-use data from NHANES III (1988–1994) and NHANES 1999–2004, with linkage to the National Death Index through 31 December 2006. Cox proportional hazards models were estimated for each clinically defined risk factor separately by sex among adults who were aged 45 to 79 years at death or censoring (Appendix Table 1, available at www.annals.org). Attained age in single years over follow-up was used as the time scale. Persons surviving through 2004 or dying of a cause other than cardiovascular disease were treated as censored participants. We excluded participants who were underweight (body mass index <18.5 kg/m^2) and those who died within the first year to reduce potential biases from reverse causality. All models were adjusted for education (less than grade 12 completed, grade 12 completed, <4 years of college completed, college graduate, or graduate education), race (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other), and calendar year. We also adjusted for other risk factor statuses (aside from the one under consideration) to reduce confounding due to the correlation among risk factors. However, we did not adjust for risk factors conceptualized to be on the causal pathway between the risk factor under consideration and cardiovascular death. Specifically, the HR estimates for obesity and smoking were adjusted for one another but not for the other risk factors; the estimates for hypertension and diabetes were adjusted for one another, smoking, and obesity; and the estimate for elevated cholesterol level was adjusted for the 4 other risk factors. For each model, we found no evidence that the proportional hazards assumption was violated. Interactions between risk factors and age were generally statistically insignificant ($P > 0.05$); therefore, a single HR estimate for each risk factor was used for all age groups.

Preventable Fractions of Cardiovascular Mortality

We defined the preventable fraction of cardiovascular mortality associated with each risk factor as:

$$PF = \frac{\sum_k P_k HR_k - \sum_k P_k^{\ddagger} HR_k}{\sum_k P_k HR_k}$$

where P_k was the observed prevalence of exposure level k, P_k* was the "counterfactual" target prevalence (that is, elimination or best achieved level) of exposure level k, and HR_k was the relative hazard of cardiovascular death associated with exposure level k relative to the referent level of exposure. For an individual risk factor, the preventable fraction may be interpreted as the proportion of cardiovascular deaths that could hypothetically be prevented if that risk factor were brought to target levels while other risk factors were held constant; the preventable fractions for the individual risk factors were not additive. The preventable fraction for the indicator of 1 or more risk factors may be interpreted as the fraction of cardiovascular deaths that could be prevented if all risk factors were eliminated. A Monte Carlo approach was used to derive simulated CIs for the preventable fraction based on 10 000 simulated data sets; uncertainty in the prevalence and HR was taken into account (23).

Estimation of prevalence and HRs was stratified by sex. Survey weights were used to ensure representation of the U.S. and state populations, and the complex survey design was taken into account in variance estimation. Analyses were performed using Stata 11.2 (StataCorp) and SAS, version 9.3 (SAS Institute).

Role of the Funding Source

This study was funded by a grant from the Robert Wood Johnson Foundation. The funder had no role in the design, conduct, or analysis of the study; the collection, management, analysis, or interpretation of the data; the preparation, review, or approval of the man-

Table 1. Prevalence of Cardiovascular Risk Factors for U.S. Men and Women Aged 45–79 y, 2009–2010*

Variable	Men		Women	
	Prevalence (95% CI), %	Best Achieved Level, %†	Prevalence (95% CI), %	Best Achieved Level, %†
Any risk factor	81.7 (80.5–82.9)	77.5	80.0 (78.4–81.6)	74.5
Any metabolic risk factor‡	74.9 (73.3–76.5)	69.6	74.8 (73.2–76.4)	69.4
Elevated cholesterol level	46.7 (20.6–72.8)	40.8	46.2 (30.9–61.5)	44.1
Diabetes	17.9 (16.5–19.3)	13.6	14.5 (13.1–15.9)	9.9
Hypertension	46.6 (45.4–47.8)	40.7	45.1 (43.9–46.3)	36.5
Obesity	37.1 (36.5–37.7)	29.1	38.4 (38.0–38.8)	29.5
Current smoking§	24.8 (23.0–26.6)	20.3	17.6 (17.0–18.2)	12.8

* Corrected estimates from the BRFSS (Behavioral Risk Factor Surveillance System) 2009–2010.
† Mean prevalence among the 5 states with the lowest levels of the risk factor.
‡ Elevated cholesterol level, diabetes, hypertension, or obesity.
§ In subsequent analysis, smoking history was classified as current, former, or never.

uscript; or the decision to submit the manuscript for publication.

RESULTS

Table 1 shows the national distribution of clinically defined risk factors for U.S. men and women aged 45 to 79 years in 2009 to 2010 and the prevalence of risk factors in the best-performing states. Most of the population (81.7% [95% CI, 80.5% to 82.9%] of men and 80.0% [CI, 78.4% to 81.6%] of women) was exposed to at least 1 cardiovascular risk factor. Hypertension and elevated cholesterol level were the most prevalent risk factors among both men and women. Current smoking was higher among men, and between-sex differences in other risk factors were within 3 percentage points.

Table 2 shows the total fraction of national cardiovascular mortality associated with the leading risk factors, which was estimated by using complete elimination of risk factors as the target. Among men, 54.0% of cardiovascular deaths could be prevented through elimination of all risk factors collectively, and 39.6% could be prevented through elimination of the components of the metabolic syndrome. Among women, the corresponding figures were 49.6% and 56.5%, respectively. Individually, hypertension (30.4% and 38.0%) and smoking (36.4% and 17.4%) were associated with the largest preventable fractions for men and women, respectively.

Table 3 shows the fraction of national cardiovascular mortality that could be prevented if the risk factor levels for each state were reduced to the best achieved levels in 2009 to 2010. For individual risk factors, preventable fractions among men were 2.0% for cholesterol level, 1.7% for diabetes, 3.8% for hypertension, 2.6% for obesity, and 5.1% for smoking; among women, the preventable fractions were −0.1%, 4.1%, 7.3%, 1.7%, and 4.4%, respectively. For both men and women, hypertension and smoking were associated with the largest preventable fractions.

The Figure maps the ranking of state-level estimated prevalence of clinically defined cardiovascular risk factors for U.S. adults aged 45 to 79 years; clinically defined and self-reported cardiovascular risk factors by state are reported in Appendix Table 2 and Appendix Table 3 (available at www.annals.org), respectively. States in the West most often contributed to the esti-

Table 2. National Preventable Fractions of Cardiovascular Mortality Associated With Complete Elimination of Leading Risk Factors in the United States, 2009–2010

Age Group, by Sex	Preventable Fraction (95% CI), %*						
	All Risk Factors Collectively	All Metabolic Risk Factors Collectively†	Elevated Cholesterol Level	Diabetes	Hypertension	Obesity	Current Smoking
Men							
45–79 y	54.0 (5.5 to 78.8)	39.6 (18.5 to 55.8)	15.9 (2.0 to 32.0)	7.2 (0.8 to 14.9)	30.4 (16.2 to 43.4)	12.0 (1.2 to 23.1)	36.4 (23.9 to 48.3)
45–54 y	53.0 (4.9 to 78.2)	37.4 (17.3 to 53.5)	14.3 (1.7 to 29.3)	4.1 (0.4 to 8.9)	23.7 (12.1 to 35.5)	12.3 (1.1 to 23.6)	36.4 (24.5 to 48.1)
55–64 y	54.0 (5.0 to 78.9)	40.0 (18.9 to 56.4)	17.4 (2.5 to 34.0)	8.5 (0.9 to 17.3)	31.5 (17.1 to 44.8)	12.6 (1.4 to 24.1)	38.8 (25.5 to 51.0)
65–79 y	55.7 (5.1 to 80.1)	42.4 (20.6 to 58.8)	16.7 (1.8 to 34.1)	10.6 (1.2 to 20.9)	38.1 (21.5 to 52.0)	10.7 (1.1 to 20.8)	33.0 (18.0 to 46.6)
Women							
45–79 y	49.6 (3.6 to 75.1)	56.5 (21.8 to 77.0)	−1.2 (−18.9 to 16.6)	13.0 (6.1 to 21.3)	38.0 (18.5 to 55.2)	7.4 (−9.2 to 25.1)	17.4 (7.1 to 28.3)
45–54 y	45.5 (3.3 to 71.8)	50.3 (17.8 to 72.2)	−0.8 (−13.4 to 12.3)	7.8 (3.4 to 13.5)	25.7 (11.3 to 40.9)	6.7 (−8.2 to 23.1)	19.6 (9.2 to 30.4)
55–64 y	51.4 (3.8 to 76.3)	59.0 (23.4 to 78.7)	−1.8 (−31.1 to 22.7)	14.8 (7.0 to 23.9)	38.7 (18.9 to 55.8)	8.1 (−10.2 to 26.9)	18.4 (7.6 to 29.5)
65–79 y	52.6 (3.9 to 77.3)	60.8 (24.7 to 80.0)	−1.2 (−18.9 to 16.5)	17.7 (8.4 to 28.0)	48.8 (26.1 to 65.5)	7.6 (−9.5 to 25.4)	13.2 (1.7 to 25.4)

* Negative preventable fractions indicate that excess mortality would be expected with elimination of the risk factor and were observed for elevated cholesterol level among women because the hazard ratio for mortality was <1.
† Elevated cholesterol level, diabetes, hypertension, and obesity.

Table 3. National Preventable Fractions of Cardiovascular Mortality Associated With Reduction of Leading Risk Factors to Best Achieved Levels in the United States, 2009–2010*

Age Group, by Sex	Preventable Fraction (95% CI), %†				
	Elevated Cholesterol Level	Diabetes	Hypertension	Obesity	Current Smoking
Men					
45–79 y	2.0 (−8.4 to 11.8)	1.7 (0.2 to 3.8)	3.8 (1.9 to 5.7)	2.6 (0.3 to 5.0)	5.1 (1.3 to 9.0)
45–54 y	2.1 (−7.8 to 11.7)	1.3 (0 to 3.4)	4.8 (2.2 to 7.9)	2.7 (0.2 to 5.3)	6.7 (2.7 to 10.7)
55–64 y	2.1 (−8.9 to 12.2)	2.8 (0.3 to 5.8)	5.1 (2.4 to 8.1)	2.7 (0.3 to 5.2)	3.2 (−3.8 to 9.4)
65–79 y	2.0 (−11.5 to 13.6)	2.1 (0.2 to 4.3)	2.4 (1.0 to 4.1)	2.4 (0.2 to 4.7)	3.6 (−1.7 to 8.8)
Women					
45–79 y	−0.1 (−3.6 to 3.2)	4.1 (1.8 to 7.2)	7.3 (3.5 to 10.8)	1.7 (−2.1 to 5.8)	4.4 (2.0 to 7.1)
45–54 y	0.0 (−4.6 to 4.1)	3.4 (1.3 to 6.5)	8.1 (3.4 to 13.5)	1.8 (−2.2 to 6.1)	5.4 (2.1 to 8.9)
55–64 y	−0.1 (−7.3 to 5.9)	5.1 (2.3 to 8.5)	8.1 (3.7 to 12.5)	1.9 (−2.4 to 6.4)	4.5 (1.5 to 7.8)
65–79 y	−0.1 (−4.9 to 4.2)	4.9 (2.1 to 8.4)	4.6 (2.3 to 6.9)	1.7 (−2.1 to 5.6)	3.4 (0.9 to 6.3)

* Best achieved level is the mean prevalence among the 5 states with the lowest levels of the risk factor.
† Negative preventable fractions indicate that excess mortality would be expected with reduction of the risk factor and were observed for elevated cholesterol level among women because the hazard ratio for mortality was <1.

mates of best achieved levels across risk factors. States in the South and Midwest tended to have the highest prevalence of at least 1 cardiovascular risk factor. Although elevated cholesterol levels showed little regional patterning, diabetes and hypertension were highest in southern states, and obesity and smoking were highest in southern and midwestern states.

Table 4 shows the state-level fractions of cardiovascular mortality preventable through reduction of individual risk factors to the best achieved levels. The best-performing states tended to be in the West, with Colorado in the best-performing quintile across all risk factors (preventable fractions ranged from 2.4% for smoking to −1.1% for hypertension; quintiles of preventable fractions are shown in the Appendix Figure, available at www.annals.org). Kentucky and West Virginia ranked in the worst-performing quintile for all 5 cardiovascular risk factors. Mississippi, Alabama, and Louisiana ranked in the worst-performing quintile for 4 cardiovascular risk factors.

In a sensitivity analysis, we compared the national preventable fractions reported in Table 2, which were based on corrected self-reported risk factor status in the BRFSS 2009–2010, with preventable fractions based on objectively measured, clinically defined risk factor prevalence in NHANES 2009–2010. Results were similar (Appendix Table 4, available at www.annals.org).

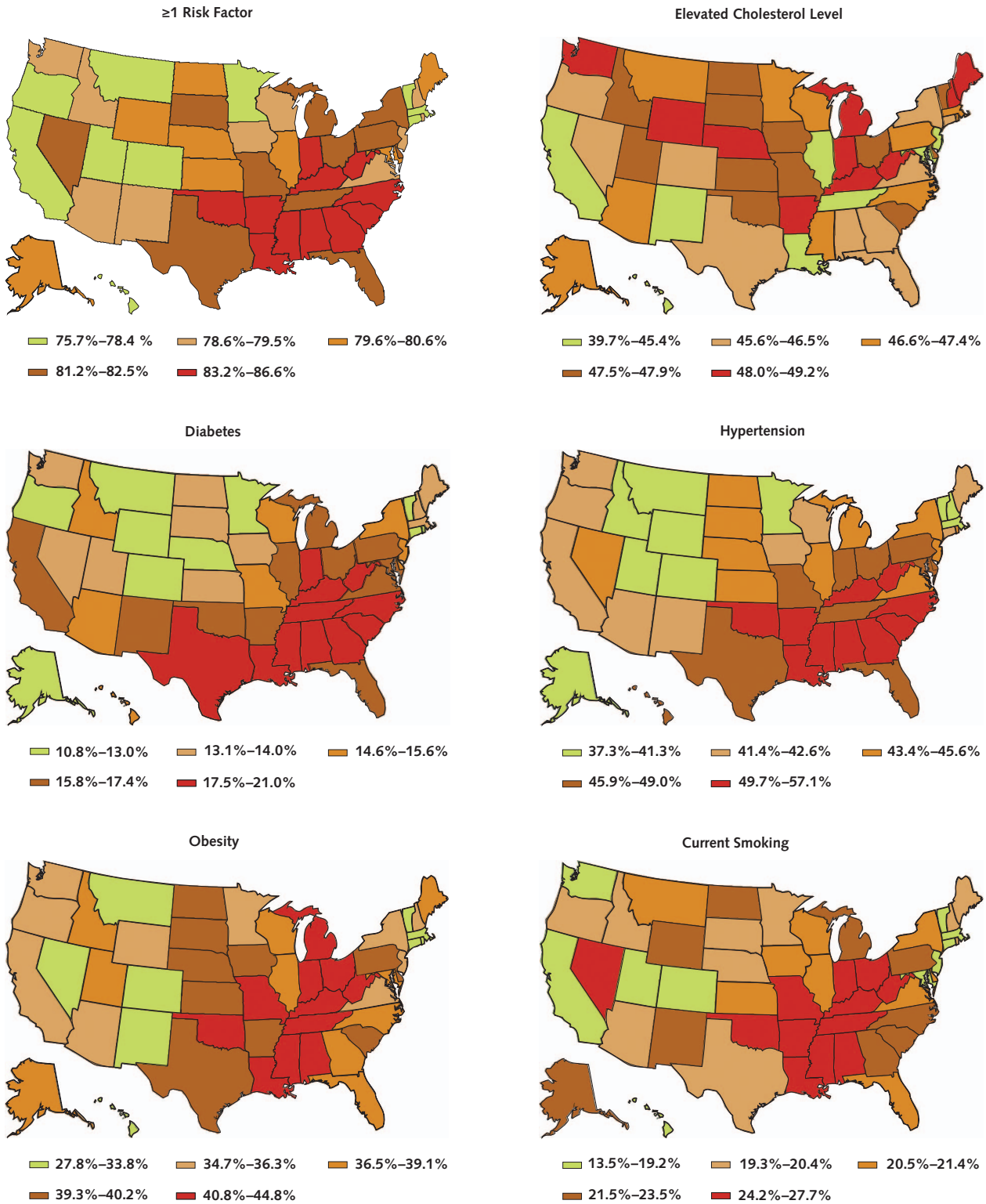
Discussion

We comparatively assessed the contribution of 5 leading cardiovascular risk factors to preventable cardiovascular mortality at the national and state levels by defining 2 targets: complete elimination, and reduction to a level achieved by the states with the lowest prevalence. The risk factor elimination target provided the upper bound of the total preventable fraction of cardiovascular mortality. We found that roughly half of national cardiovascular deaths in 2009 to 2010 could be attributed to the combination of the 5 risk factors. In contrast, the risk factor reduction target provided a more realistic estimate of preventable cardiovascular mortality. Under this target, the national preventable fractions for cardiovascular mortality associated with individual risk factors ranged from 2% to 5% among men and from 0% to 7% among women. Smoking and hypertension were the 2 leading risk factors for cardiovascular death nationally for both sexes; obesity ranked third among men, and diabetes ranked third among women.

A key contribution of this study was our examination of a risk target defined as the levels achieved by the best-performing states. This analysis was ostensibly a more plausible alternative to conventional attributable-risk assessments that quantify preventable fractions under the assumption of complete elimination of a risk factor. Another contribution of this study was the estimation and comparison of contemporary state-level burdens of multiple modifiable cardiovascular risk factors and associated cardiovascular mortality. We found that most U.S. adults aged 45 to 79 years were exposed to at least 1 of the 5 risk factors regardless of their state of residence (state-level prevalence of ≥1 risk factor ranged from 76% to 87%), suggesting less variation in risk factors than in cardiovascular mortality. The findings imply that risk factors are not the primary drivers of disparities in cardiovascular mortality among states, although they contribute substantially to the absolute levels of cardiovascular mortality in all states and the nation.

Within states and nationally, comparative assessment of the contribution of multiple risk factors to state-level preventable cardiovascular mortality is of prime importance to the prioritization and evaluation of investments in preventive health policy. The publicly available, nationally representative prevalence data reported here provide benchmarks to monitor state-level progress in reducing modifiable risk factors and their disparities. We found that states with high prevalence of one risk factor tended to have high prevalence of

Figure. Distribution of 5 leading modifiable cardiovascular risk factors in the United States, 2009–2010.



Prevalence of clinically defined cardiovascular risk factors, based on a correction of self-reported data in the Behavioral Risk Factor Surveillance System 2009–2010 and shaded by quintile of national ranking, are shown.

Table 4. State-Level Preventable Fractions of Cardiovascular Mortality Associated With Reduction of Leading Risk Factors to Best Achieved Levels in the United States, 2009–2010

State	Cardiovascular Mortality Rate per 100 000 Persons*	Preventable Fraction (95% CI), %†				
		Elevated Cholesterol Level	Diabetes	Hypertension	Obesity	Current Smoking
Mississippi	477.0	0.9 (−3.0 to 4.7)	6.2 (3.3 to 9.5)	13.0 (8.4 to 17.0)	3.8 (−0.5 to 8.1)	8.4 (4.8 to 12.0)
District of Columbia	440.9	−0.9 (−5.6 to 2.7)	3.0 (1.4 to 5.1)	7.2 (3.9 to 10.5)	0.2 (−2.2 to 2.6)	5.2 (1.3 to 9.0)
Alabama	434.5	0.8 (−3.8 to 5.3)	5.9 (3.2 to 9.2)	11.0 (6.9 to 14.6)	3.3 (−0.5 to 7.3)	8.2 (4.3 to 12.0)
Louisiana	424.0	0.5 (−3.9 to 4.5)	5.5 (3.0 to 8.5)	10.8 (6.9 to 14.3)	3.6 (−0.2 to 7.4)	7.9 (4.4 to 11.4)
Oklahoma	414.9	1.1 (−3.3 to 5.6)	3.9 (1.9 to 6.4)	9.6 (6.1 to 12.8)	3.1 (−0.3 to 6.7)	10.6 (6.7 to 14.4)
Arkansas	405.4	1.4 (−3.7 to 6.5)	3.0 (1.4 to 5.1)	9.7 (6.1 to 13.1)	2.6 (0 to 5.4)	8.1 (4.1 to 12.0)
Tennessee	393.0	0.7 (−4.4 to 5.4)	4.4 (2.3 to 7.0)	6.6 (3.7 to 9.4)	2.8 (−0.8 to 6.4)	7.4 (3.5 to 11.2)
Kentucky	385.5	1.5 (−3.7 to 6.5)	4.4 (2.2 to 7.0)	11.3 (7.3 to 14.8)	3.3 (0.1 to 6.6)	9.9 (5.8 to 13.9)
West Virginia	371.3	1.6 (−3.6 to 6.7)	5.4 (2.8 to 8.5)	10.3 (6.6 to 13.7)	3.1 (−0.5 to 6.6)	10.3 (6.0 to 14.5)
South Carolina	370.0	1.1 (−3.3 to 5.4)	4.0 (2.1 to 6.4)	8.4 (5.0 to 11.4)	2.6 (−0.4 to 5.7)	7.1 (3.7 to 10.4)
Georgia	368.6	1.0 (−3.8 to 5.7)	4.1 (2.1 to 6.5)	8.4 (5.1 to 11.5)	2.2 (−0.4 to 4.9)	5.6 (2.2 to 8.8)
Nevada	358.5	1.2 (−3.9 to 6.1)	0.4 (−0.8 to 1.7)	3.7 (1.4 to 6.4)	1.1 (0.1 to 2.4)	9.4 (4.6 to 14.0)
Missouri	346.7	1.2 (−3.8 to 6.2)	2.6 (1.2 to 4.5)	6.2 (3.5 to 8.9)	3.2 (0.1 to 6.5)	9.1 (4.8 to 13.3)
Indiana	337.3	1.4 (−3.6 to 6.4)	3.6 (1.8 to 5.8)	7.4 (4.6 to 10.1)	3.0 (−0.3 to 6.4)	7.7 (4.2 to 11.1)
Michigan	333.1	1.4 (−3.8 to 6.5)	2.7 (1.4 to 4.5)	5.0 (2.9 to 7.1)	3.1 (−0.4 to 6.7)	6.3 (3.2 to 9.4)
Ohio	325.3	1.4 (−3.8 to 6.6)	3.5 (1.8 to 5.6)	6.1 (3.7 to 8.5)	2.9 (−0.2 to 6.1)	7.6 (4.1 to 11.1)
North Carolina	323.9	0.9 (−3.9 to 5.6)	4.4 (2.3 to 7.0)	8.9 (5.5 to 12.0)	2.3 (−0.5 to 5.3)	6.9 (3.8 to 10.1)
Texas	323.5	0.8 (−4.1 to 5.4)	4.2 (2.1 to 6.7)	7.9 (4.8 to 10.7)	2.7 (−0.2 to 5.7)	3.8 (1.0 to 6.6)
Maryland	315.2	0.4 (−4.2 to 4.5)	3.1 (1.5 to 5.1)	6.6 (3.8 to 9.3)	1.9 (−0.3 to 4.4)	2.7 (0 to 5.3)
Illinois	309.7	0.6 (−4.5 to 5.3)	3.0 (1.5 to 4.9)	4.9 (2.6 to 7.2)	2.4 (−0.4 to 5.3)	4.6 (1.4 to 7.8)
Pennsylvania	304.6	1.1 (−4.1 to 6.1)	3.4 (1.7 to 5.4)	5.7 (3.3 to 8.1)	2.6 (−0.3 to 5.6)	6.2 (2.9 to 9.4)
New York	297.7	0.8 (−4.4 to 5.6)	2.5 (1.2 to 4.4)	5.6 (3.1 to 8.1)	1.7 (−0.3 to 3.8)	4.2 (1.3 to 7.2)
Delaware	296.6	1.2 (−4.1 to 6.2)	2.1 (0.9 to 3.8)	6.8 (4.1 to 9.7)	2.6 (0 to 5.4)	4.4 (0.8 to 8.0)
Virginia	291.1	1.0 (−4.4 to 6.0)	2.9 (1.4 to 4.9)	5.1 (2.9 to 7.6)	1.7 (−0.2 to 3.7)	5.0 (1.4 to 8.5)
Wyoming	290.9	1.5 (−4.8 to 7.4)	1.0 (0.1 to 2.2)	1.6 (0.1 to 3.3)	1.6 (0 to 3.4)	6.1 (2.4 to 9.6)
Iowa	284.1	1.3 (−4.9 to 6.9)	1.3 (0.4 to 2.4)	2.7 (1.0 to 4.6)	2.9 (0.1 to 5.7)	4.5 (1.2 to 7.8)
Kansas	280.8	1.2 (−4.8 to 6.7)	1.6 (0.7 to 3.0)	4.9 (2.8 to 6.9)	2.7 (−0.1 to 5.7)	4.7 (1.7 to 7.6)
Alaska	271.4	0.9 (−4.8 to 6.2)	0.8 (−0.7 to 2.5)	2.2 (−0.6 to 5.1)	1.9 (−0.1 to 4.3)	6.6 (1.3 to 11.5)
Florida	267.3	1.0 (−4.6 to 6.1)	3.3 (1.6 to 5.4)	7.5 (4.7 to 10.3)	1.9 (0.1 to 3.9)	5.2 (2.2 to 8.1)
North Dakota	266.4	1.3 (−5.0 to 7.1)	0.7 (−0.1 to 1.8)	4.2 (2.2 to 6.4)	2.8 (0.2 to 5.5)	4.9 (1.3 to 8.3)
California	265.5	0.3 (−4.8 to 4.7)	3.2 (1.5 to 5.4)	2.8 (1.2 to 4.4)	1.3 (−0.4 to 3.2)	0.1 (−2.2 to 2.0)
New Jersey	263.9	0.6 (−4.5 to 5.2)	2.2 (1.0 to 3.8)	4.8 (2.7 to 6.9)	1.5 (0 to 3.2)	2.8 (0.2 to 5.4)
Wisconsin	262.4	1.2 (−4.9 to 6.8)	2.0 (0.8 to 3.6)	3.2 (0.9 to 5.7)	2.5 (0 to 5.2)	4.2 (0.3 to 7.9)
South Dakota	258.1	1.3 (−5.2 to 7.2)	1.0 (0.1 to 2.1)	4.6 (2.6 to 6.8)	2.8 (0.1 to 5.7)	3.3 (−0.1 to 6.5)
Hawaii	257.3	−0.3 (−5.3 to 3.7)	2.5 (0.9 to 4.6)	6.6 (3.4 to 9.9)	−0.3 (−1.3 to 0.5)	1.5 (−1.4 to 4.2)
Montana	256.0	1.1 (−5.0 to 6.6)	0.3 (−0.5 to 1.1)	1.2 (−0.3 to 2.8)	1.2 (0 to 2.6)	4.6 (1.2 to 7.8)
Rhode Island	252.6	1.2 (−4.6 to 6.7)	0.8 (0 to 1.9)	5.0 (2.9 to 7.3)	1.2 (0.1 to 2.5)	3.7 (0.2 to 7.1)
Idaho	251.5	1.3 (−5.2 to 7.1)	1.8 (0.6 to 3.4)	1.4 (−0.4 to 3.2)	2.0 (0 to 4.3)	3.3 (−0.1 to 6.5)
Arizona	249.9	1.1 (−6.3 to 7.6)	2.4 (1.0 to 4.3)	2.8 (0.7 to 5.0)	1.6 (−0.1 to 3.5)	3.8 (−0.3 to 7.7)
New Mexico	249.4	0.5 (−4.7 to 5.2)	3.4 (1.7 to 5.6)	3.1 (1.6 to 4.8)	0.8 (−0.5 to 2.3)	5.3 (2.4 to 8.1)
Washington	243.9	1.3 (−5.2 to 7.2)	1.0 (0.2 to 2.0)	2.2 (0.9 to 3.6)	1.9 (0.1 to 3.8)	2.5 (−0.2 to 5.0)
Nebraska	243.4	1.3 (−4.8 to 6.9)	0.9 (0.1 to 1.9)	3.8 (2.0 to 5.8)	2.6 (0.1 to 5.3)	3.5 (0.4 to 6.6)
Maine	235.7	1.7 (−4.3 to 7.5)	1.2 (0.3 to 2.4)	2.7 (1.2 to 4.5)	1.8 (−0.1 to 3.9)	4.5 (0.9 to 8.0)
Connecticut	232.5	1.0 (−5.7 to 6.7)	0.5 (−0.4 to 1.5)	2.6 (0.9 to 4.5)	0.9 (0.1 to 1.9)	1.5 (−2.1 to 4.8)
Vermont	231.9	1.3 (−5.2 to 7.2)	0.2 (−0.5 to 1.0)	0.3 (−1.2 to 1.9)	0.8 (−0.1 to 1.8)	1.8 (−1.8 to 5.2)
Oregon	231.5	0.9 (−5.1 to 6.3)	0.4 (−0.4 to 1.4)	3.0 (1.1 to 5.0)	1.6 (0 to 3.4)	3.6 (0.2 to 6.8)
Massachusetts	228.0	1.1 (−5.0 to 6.6)	1.2 (0.4 to 2.3)	2.0 (0.7 to 3.5)	0.6 (0.1 to 1.3)	2.4 (−0.6 to 5.3)
New Hampshire	226.6	1.5 (−5.2 to 7.5)	0.7 (−0.2 to 1.7)	1.9 (0.3 to 3.7)	1.6 (0.2 to 3.2)	3.3 (−0.4 to 6.9)
Colorado	219.3	0.8 (−5.8 to 6.5)	−0.6 (−1.5 to 0.1)	−1.1 (−2.6 to 0.2)	0.1 (−0.3 to 0.5)	2.4 (−0.2 to 5.0)
Utah	217.8	1.1 (−6.1 to 7.4)	1.2 (0.3 to 2.3)	1.1 (−0.4 to 2.6)	2.1 (0 to 4.3)	−5.1 (−9.3 to −1.5)
Minnesota	195.2	1.0 (−5.5 to 6.8)	0.3 (−0.5 to 1.2)	−0.7 (−2.4 to 0.8)	1.9 (0.1 to 3.8)	3.5 (0.1 to 6.7)

* Age-standardized to the national population in 2009–2010. The table is ordered by decreasing cardiovascular mortality.
† Negative preventable fractions indicate that excess mortality would be expected with reduction of the risk factor and were observed when the hazard ratio for mortality was <1 and/or when the state mean risk factor level was less than the best achieved level (mean prevalence among the 5 states with the lowest levels of the risk factor).

others such that the worst-performing states experienced relatively high burdens of multiple risk factors simultaneously. Most of the worst-performing states were located in the South and Midwest, and the best-performing states were located in the West. Our results indicate that the South and Midwest stand to gain the most from reductions in risk factor levels; these regions also have the highest cardiovascular mortality rates.

The high cardiovascular mortality burden associated with hypertension, smoking, and diabetes is consistent with past estimates (7, 9). If prevalence of diabetes increases, per recent trends (24), while prevalence

of smoking and hypertension decreases (25) in the U.S. population, the preventable fraction associated with diabetes may surpass that of hypertension and smoking in the future. We caution, however, that changes in clinical definitions of these risk factors must be considered when comparisons are made with past or future data. Preventable fractions for obesity ranged from 7% to 12% in 2010, and although this is consistent with levels reported in prior studies (10, 26), these may be lower-bound estimates. Given data limitations, our results were based on obesity status at the time of the initial survey, with no information on weight histories available. Recent work suggests that the relative and attributable risks for obesity are larger if more complete information on body weight over the person's life span is incorporated (27–29). Our analysis also estimated no excess cardiovascular mortality associated with elevated cholesterol levels in either scenario among women aged 45 to 79 years, a finding that is statistically driven by an HR of around 1.0 for mortality and that warrants further investigation.

We limited our reporting to the leading biomedical risk factors for cardiovascular death that have traditionally been within the purview of clinical intervention and prevention-oriented policy. Many other modifiable factors, such as income, education, discrimination, economic opportunities, welfare policies, and quality of primary health care access, may affect risk for cardiovascular disease and death. These background characteristics may contribute to differences among states in cardiovascular mortality independently of the traditional cardiovascular risk factors examined here.

A primary limitation of our study was the lack of objectively measured data on risk factors at the state level. To address systematic reporting error in self-reported data, we corrected self-reported risk factor status in the BRFSS. Our correction approach could not account for state-related differences in reporting bias. With respect to HR estimation, limitations were the application of a single HR estimate to all states in the estimation of preventable fractions, reliance on a single baseline risk status (status at the NHANES interview), potential secular changes in mortality associated with some risk factors (26, 30), and a lack of precision. Yet, only the combination of NHANES and the BRFSS allowed us to estimate nationally representative HRs for each risk factor that could be applied to nationally representative and state-representative prevalence of risk factors, which is critical to the validity of population-attributable risk estimates (31).

In summary, despite progress in the reduction of cardiovascular mortality over the past 6 decades, modifiable cardiovascular risk factors continue to be associated with half of the burden of cardiovascular mortality at the national and state levels, and the best achieved levels are far from the theoretical minimum. All states can benefit from further risk reduction. These risk factors are highly correlated across states and are modifiable through policies that can influence multiple risk factors simultaneously (for example, tobacco taxation, smoke-free places, and construction of built environments that promote physical activity). Although reduction of smoking, hypertension, and diabetes to the best observed levels could translate into thousands of cardiovascular deaths averted, large-scale decreases in cardiovascular mortality may be infeasible without adoption and achievement of more aggressive risk reduction targets for primordial prevention.

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Note: Drs. Patel and Mehta had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Reproducible Research Statement: *Study protocol:* Not applicable. *Statistical code:* The full code is available from Dr. Patel (e-mail, s.a.patel@emory.edu). Sample code is provided in the Supplement. *Data set:* BRFSS data are available at www.cdc.gov/brfss. NHANES data are available at www.cdc.gov/nchs/nhanes.htm.

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Appendix Table 1. Adjusted HR of Cardiovascular Mortality Associated With Each Risk Factor

Risk Factor, by Sex	HR (95% CI)*
Women	
≥1 risk factor (vs. no risk factor)	2.232 (1.046–4.761)
≥1 metabolic risk factor (vs. no metabolic risk factor)†	2.740 (1.371–5.480)
Elevated cholesterol level (total blood cholesterol level ≥6.21 mmol/L [≥240 mg/dL] or taking medication)	0.974 (0.667–1.422)
Diabetes (HbA_{1c} level ≥6.5% or taking insulin or oral medication)	2.032 (1.446–2.856)
Hypertension (mean systolic BP ≥140 mm Hg, mean diastolic BP ≥90 mm Hg, or taking medication)	2.356 (1.500–3.701)
Obesity (BMI ≥30 kg/m^2)	1.208 (0.781–1.868)
Smoking	
Self-reported never and serum cotinine level ≤56.8 nmol/L	1.0 (reference)
Self-reported former and serum cotinine level ≤56.8 nmol/L	1.054 (0.725–1.532)
Self-reported current or serum cotinine level >56.8 nmol/L	2.115 (1.552–2.882)
Men	
≥1 risk factor (vs. no risk factor)	2.438 (1.064–5.587)
≥1 metabolic risk factor (vs. no metabolic risk factor)†	1.874 (1.305–2.692)
Elevated cholesterol level (total blood cholesterol level ≥6.21 mmol/L [≥240 mg/dL] or taking medication)	1.406 (1.056–1.872)
Diabetes (HbA_{1c} level ≥6.5% or taking insulin or oral medication)	1.434 (1.044–1.971)
Hypertension (mean systolic BP ≥140 mm Hg, mean diastolic BP ≥90 mm Hg, or taking medication)	1.937 (1.416–2.648)
Obesity (BMI ≥30 kg/m^2)	1.367 (1.032–1.810)
Smoking	
Self-reported never and serum cotinine level ≤56.8 nmol/L	1.0 (reference)
Self-reported former and serum cotinine level ≤56.8 nmol/L	1.412 (0.977–2.040)
Self-reported current or serum cotinine level >56.8 nmol/L	2.736 (1.926–3.884)

BMI = body mass index; BP = blood pressure; HbA_{1c} = hemoglobin A_{1c}; HR = hazard ratio.
* Based on NHANES (National Health and Nutrition Examination Survey) 2009–2010 data using objectively measured risk factors. All models were adjusted for attained age at death or censoring (in single years centered at 45 y, treated as time-varying), education level (less than grade 12 completed, grade 12 completed, <4 y of college completed, college graduate, or graduate education), race (non-Hispanic white, non-Hispanic black, Hispanic, or non-Hispanic other), and calendar year. The HR for elevated cholesterol level was adjusted for all other risk factors; the HRs for hypertension and diabetes were adjusted for one another, smoking, and obesity; and the HRs for obesity and smoking were adjusted for one another.
† Elevated cholesterol level, diabetes, hypertension, or obesity.

Appendix Table 2. Self-reported Age, Sex, and Risk Factor Prevalence by State in the BRFSS 2009-2010

State	Demographic Characteristic		Risk Factor							
	Mean Age (±SE), *y*	Male (±SE), %	Any Risk Factor (±SE), %	Any Metabolic Risk Factor (±SE), %*	Elevated Cholesterol Level (±SE), %	Diabetes (±SE), %	Hypertension (±SE), %	Obesity (±SE), %	Mean BMI (±SE), kg/m^2	Current Smoking (±SE), %
Alabama	59.1 (±0.13)	46.6 (±0.74)	81.3 (±0.86)	75.8 (±0.95)	49.2 (±1.14)	18.6 (±0.54)	52.5 (±1.09)	34.5 (±0.71)	31.3 (±0.19)	20.6 (±0.61)
Alaska	57.1 (±0.23)	51.1 (±1.40)	75.7 (±1.61)	67.9 (±1.77)	47.5 (±2.01)	10.3 (±0.89)	40.3 (±1.83)	30.6 (±1.28)	30.8 (±0.44)	18.5 (±1.08)
Arizona	58.2 (±0.19)	48.7 (±1.08)	74.3 (±1.26)	69.0 (±1.32)	50.2 (±1.45)	13.6 (±0.68)	38.9 (±1.33)	27.1 (±0.97)	30.3 (±0.32)	15.2 (±0.77)
Arkansas	59.6 (±0.16)	47.5 (±0.85)	79.6 (±0.96)	73.8 (±1.06)	50.5 (±1.24)	15.7 (±0.58)	49.7 (±1.19)	32.3 (±0.81)	31.4 (±0.26)	19.1 (±0.68)
California	58.2 (±0.08)	48.1 (±0.45)	73.3 (±0.56)	70.1 (±0.59)	47.0 (±0.67)	15.7 (±0.34)	39.9 (±0.63)	28.0 (±0.42)	32.0 (±0.17)	11.6 (±0.30)
Colorado	57.9 (±0.09)	48.9 (±0.51)	70.0 (±0.66)	64.8 (±0.69)	45.1 (±0.74)	9.8 (±0.31)	34.8 (±0.68)	23.5 (±0.45)	29.9 (±0.15)	14.1 (±0.35)
Connecticut	58.3 (±0.13)	47.6 (±0.72)	71.8 (±0.94)	66.9 (±0.99)	46.0 (±1.05)	10.7 (±0.42)	38.7 (±0.98)	25.6 (±0.65)	30.7 (±0.21)	12.1 (±0.48)
Delaware	59.1 (±0.16)	47.1 (±0.87)	77.7 (±1.07)	73.0 (±1.13)	48.3 (±1.29)	13.6 (±0.56)	44.9 (±1.24)	32.7 (±0.85)	31.4 (±0.25)	15.4 (±0.61)
District of Columbia	57.5 (±0.16)	45.7 (±0.94)	73.8 (±1.05)	69.4 (±1.11)	47.3 (±1.24)	12.4 (±0.59)	43.5 (±1.19)	25.5 (±0.83)	30.2 (±0.28)	17.2 (±0.77)
Florida	59.1 (±0.12)	47.6 (±0.62)	77.0 (±0.79)	72.2 (±0.84)	50.4 (±0.98)	14.7 (±0.42)	44.8 (±0.95)	29.3 (±0.59)	30.6 (±0.16)	16.3 (±0.43)
Georgia	58.1 (±0.13)	47.0 (±0.73)	78.8 (±0.86)	73.2 (±0.93)	49.9 (±1.09)	16.3 (±0.52)	46.8 (±1.04)	31.1 (±0.69)	31.2 (±0.22)	17.1 (±0.55)
Hawaii	59.3 (±0.14)	48.1 (±0.71)	73.3 (±0.85)	69.2 (±0.89)	46.5 (±1.02)	13.1 (±0.50)	44.3 (±0.99)	22.4 (±0.62)	28.1 (±0.16)	12.7 (±0.48)
Idaho	58.8 (±0.13)	49.4 (±0.70)	73.3 (±0.94)	68.4 (±0.99)	46.5 (±1.11)	13.0 (±0.46)	38.3 (±1.00)	29.5 (±0.66)	30.6 (±0.19)	14.9 (±0.51)
Illinois	58.5 (±0.14)	47.5 (±0.76)	76.5 (±0.86)	71.1 (±0.92)	46.9 (±1.02)	13.4 (±0.51)	42.8 (±0.99)	31.9 (±0.72)	29.9 (±0.17)	16.4 (±0.57)
Indiana	58.7 (±0.11)	47.9 (±0.58)	79.6 (±0.67)	73.5 (±0.73)	50.1 (±0.85)	16.0 (±0.42)	47.1 (±0.82)	34.4 (±0.56)	31.6 (±0.17)	19.3 (±0.46)
Iowa	59.0 (±0.12)	48.5 (±0.66)	74.4 (±0.83)	68.6 (±0.88)	45.3 (±0.96)	11.6 (±0.40)	39.1 (±0.91)	31.9 (±0.63)	31.7 (±0.20)	15.8 (±0.48)
Kansas	58.8 (±0.08)	48.4 (±0.46)	76.3 (±0.44)	70.9 (±0.47)	47.4 (±0.53)	13.3 (±0.30)	42.1 (±0.50)	32.6 (±0.44)	31.2 (±0.14)	16.3 (±0.35)
Kentucky	58.9 (±0.13)	47.2 (±0.71)	83.5 (±0.70)	78.4 (±0.77)	52.5 (±1.03)	16.9 (±0.51)	53.1 (±0.99)	34.9 (±0.69)	31.3 (±0.18)	21.6 (±0.58)
Louisiana	58.7 (±0.11)	46.8 (±0.61)	82.1 (±0.64)	75.9 (±0.72)	47.9 (±0.86)	17.6 (±0.44)	51.0 (±0.82)	36.1 (±0.59)	31.5 (±0.16)	20.2 (±0.50)
Maine	59.0 (±0.11)	48.0 (±0.56)	75.1 (±0.68)	70.6 (±0.72)	48.9 (±0.79)	12.7 (±0.35)	40.4 (±0.75)	29.6 (±0.51)	30.5 (±0.15)	14.9 (±0.44)
Maryland	58.3 (±0.11)	47.2 (±0.63)	75.2 (±0.78)	70.8 (±0.83)	46.8 (±0.92)	15.1 (±0.45)	43.4 (±0.90)	29.9 (±0.59)	31.1 (±0.17)	14.3 (±0.45)
Massachusetts	58.5 (±0.09)	47.3 (±0.51)	70.8 (±0.65)	66.4 (±0.67)	45.1 (±0.72)	12.1 (±0.32)	38.0 (±0.68)	25.1 (±0.45)	31.4 (±0.16)	13.1 (±0.33)
Michigan	58.6 (±0.10)	48.3 (±0.56)	78.7 (±0.66)	73.5 (±0.70)	50.3 (±0.79)	15.2 (±0.38)	42.9 (±0.76)	34.2 (±0.54)	31.1 (±0.14)	17.7 (±0.43)
Minnesota	58.2 (±0.12)	49.3 (±0.67)	69.1 (±0.86)	62.6 (±0.91)	42.6 (±0.93)	10.2 (±0.39)	31.6 (±0.84)	28.0 (±0.61)	30.3 (±0.18)	14.7 (±0.47)
Mississippi	59.0 (±0.11)	46.7 (±0.59)	83.7 (±0.57)	78.0 (±0.63)	52.3 (±0.78)	19.6 (±0.45)	54.3 (±0.75)	36.8 (±0.58)	31.5 (±0.16)	20.5 (±0.49)
Missouri	58.9 (±0.16)	47.3 (±0.87)	78.5 (±1.04)	71.9 (±1.13)	48.0 (±1.27)	14.1 (±0.57)	44.7 (±1.21)	34.1 (±0.84)	30.7 (±0.23)	21.1 (±0.71)
Montana	58.9 (±0.12)	49.5 (±0.64)	71.6 (±0.80)	65.7 (±0.84)	44.5 (±0.91)	10.3 (±0.39)	38.8 (±0.84)	26.9 (±0.58)	29.6 (±0.16)	15.6 (±0.47)
Nebraska	58.8 (±0.11)	48.2 (±0.60)	74.8 (±0.77)	69.6 (±0.81)	47.5 (±0.87)	12.1 (±0.36)	40.6 (±0.81)	31.5 (±0.55)	30.5 (±0.15)	15.1 (±0.44)
Nevada	58.7 (±0.20)	50.1 (±1.08)	76.9 (±1.25)	69.5 (±1.39)	48.3 (±1.59)	12.3 (±0.71)	41.7 (±1.50)	26.6 (±0.98)	29.9 (±0.29)	21.5 (±0.91)
New Hampshire	58.2 (±0.13)	48.7 (±0.70)	73.5 (±0.92)	69.1 (±0.95)	47.8 (±1.05)	11.2 (±0.41)	39.8 (±0.99)	28.2 (±0.65)	30.4 (±0.18)	13.7 (±0.47)
New Jersey	58.5 (±0.10)	47.7 (±0.55)	74.5 (±0.68)	70.0 (±0.71)	46.7 (±0.80)	14.3 (±0.39)	40.5 (±0.75)	28.3 (±0.51)	31.9 (±0.18)	14.1 (±0.37)
New Mexico	59.0 (±0.12)	47.7 (±0.63)	73.8 (±0.73)	67.4 (±0.79)	43.2 (±0.86)	13.6 (±0.41)	40.1 (±0.81)	26.0 (±0.55)	29.6 (±0.16)	16.7 (±0.47)
New York	58.7 (±0.12)	46.9 (±0.64)	76.6 (±0.85)	71.7 (±0.90)	50.3 (±1.01)	14.6 (±0.46)	42.1 (±0.97)	28.9 (±0.59)	30.6 (±0.19)	15.4 (±0.47)
North Carolina	58.8 (±0.11)	47.4 (±0.58)	79.5 (±0.65)	73.9 (±0.72)	50.7 (±0.85)	16.2 (±0.42)	47.4 (±0.83)	31.5 (±0.56)	31.3 (±0.18)	18.3 (±0.48)
North Dakota	59.1 (±0.14)	49.0 (±0.71)	75.9 (±0.85)	69.2 (±0.92)	45.8 (±1.02)	12.2 (±0.46)	40.4 (±0.97)	32.0 (±0.68)	31.7 (±0.21)	16.2 (±0.53)
Ohio	58.9 (±0.10)	47.3 (±0.56)	77.6 (±0.66)	71.7 (±0.71)	48.6 (±0.81)	15.4 (±0.39)	45.0 (±0.78)	33.3 (±0.54)	31.9 (±0.17)	19.4 (±0.45)
Oklahoma	59.2 (±0.11)	47.4 (±0.59)	82.9 (±0.64)	76.2 (±0.72)	52.0 (±0.86)	17.1 (±0.43)	50.5 (±0.83)	34.2 (±0.57)	30.6 (±0.15)	23.1 (±0.51)
Oregon	58.9 (±0.13)	48.6 (±0.73)	72.1 (±0.98)	66.2 (±1.04)	43.2 (±1.10)	11.7 (±0.44)	40.0 (±1.04)	28.7 (±0.68)	30.7 (±0.20)	14.9 (±0.53)
Pennsylvania	59.2 (±0.11)	47.6 (±0.58)	76.3 (±0.76)	70.5 (±0.81)	47.7 (±0.89)	14.6 (±0.41)	42.7 (±0.84)	32.4 (±0.55)	31.5 (±0.17)	17.4 (±0.44)
Rhode Island	58.6 (±0.12)	47.1 (±0.67)	74.3 (±0.86)	70.5 (±0.89)	47.2 (±0.98)	12.0 (±0.42)	43.6 (±0.95)	27.6 (±0.61)	29.9 (±0.16)	14.1 (±0.46)
South Carolina	59.0 (±0.12)	46.8 (±0.68)	79.6 (±0.81)	74.2 (±0.85)	52.0 (±0.96)	16.3 (±0.48)	45.9 (±0.93)	32.0 (±0.64)	31.3 (±0.20)	18.5 (±0.55)
South Dakota	59.0 (±0.13)	48.8 (±0.69)	76.8 (±0.81)	71.0 (±0.89)	46.0 (±1.00)	11.1 (±0.40)	43.3 (±0.95)	32.1 (±0.66)	31.6 (±0.21)	14.3 (±0.48)
Tennessee	58.9 (±0.14)	47.1 (±0.80)	76.2 (±0.95)	70.5 (±1.04)	39.3 (±1.12)	16.7 (±0.58)	43.8 (±1.09)	33.1 (±0.75)	32.0 (±0.23)	19.5 (±0.65)
Texas	58.4 (±0.11)	47.9 (±0.64)	77.5 (±0.81)	73.0 (±0.85)	52.1 (±0.96)	16.3 (±0.44)	46.2 (±0.93)	33.1 (±0.64)	32.0 (±0.21)	15.5 (±0.44)
Utah	58.4 (±0.10)	49.0 (±0.57)	70.7 (±0.75)	67.4 (±0.77)	45.2 (±0.85)	12.1 (±0.36)	38.6 (±0.78)	29.7 (±0.54)	31.1 (±0.17)	8.7 (±0.32)
Vermont	58.6 (±0.10)	48.7 (±0.59)	69.4 (±0.78)	65.0 (±0.80)	43.6 (±0.85)	10.3 (±0.35)	37.5 (±0.80)	26.3 (±0.53)	29.7 (±0.15)	12.3 (±0.39)
Virginia	58.6 (±0.15)	47.4 (±0.84)	73.6 (±1.10)	67.7 (±1.14)	44.4 (±1.18)	14.0 (±0.56)	41.8 (±1.12)	29.5 (±0.77)	31.8 (±0.27)	16.4 (±0.58)
Washington	58.4 (±0.07)	48.7 (±0.39)	74.2 (±0.48)	69.9 (±0.51)	47.8 (±0.56)	12.0 (±0.24)	40.7 (±0.52)	29.4 (±0.36)	31.1 (±0.12)	13.7 (±0.27)
West Virginia	59.5 (±0.14)	47.9 (±0.74)	81.6 (±0.79)	75.4 (±0.88)	47.5 (±1.05)	18.1 (±0.55)	51.4 (±1.01)	34.2 (±0.71)	31.6 (±0.21)	22.4 (±0.63)
Wisconsin	58.7 (±0.16)	48.7 (±0.87)	73.0 (±1.21)	68.2 (±1.25)	44.6 (±1.35)	12.6 (±0.57)	39.8 (±1.28)	31.2 (±0.82)	32.0 (±0.27)	14.9 (±0.60)
Wyoming	58.6 (±0.11)	49.9 (±0.63)	74.4 (±0.78)	67.9 (±0.83)	47.9 (±0.92)	11.5 (±0.40)	38.6 (±0.86)	27.6 (±0.58)	30.2 (±0.17)	17.7 (±0.50)

BMI = body mass index; BRFSS = Behavioral Risk Factor Surveillance System.
* Elevated cholesterol level, diabetes, hypertension, or obesity.

Appendix Table 3. Prevalence of Clinically Defined Risk Factors, by State*

State	≥1 Risk Factor	Metabolic Syndrome Components					Current Smoking
		Any Metabolic Risk Factor	Elevated Cholesterol Level	Diabetes	Hypertension	Obesity	
Alabama	84.9 (83.5–86.4)	78.5 (76.9–80.2)	45.9 (31.7–60.1)	20.7 (19.0–22.5)	53.8 (51.7–55.9)	43.0 (41.5–44.6)	25.0 (23.6–26.3)
Alaska	79.8 (77.2–82.5)	71.0 (67.6–74.3)	47.0 (28.6–65.4)	12.9 (10.6–15.2)	41.3 (37.6–45.0)	36.7 (34.0–39.5)	23.5 (21.2–25.8)
Arizona	79.4 (77.5–81.4)	73.3 (71.1–75.4)	46.7 (25.0–68.4)	15.1 (13.4–16.8)	42.1 (39.6–44.6)	35.3 (33.1–37.5)	20.4 (18.7–22.2)
Arkansas	83.3 (81.8–84.8)	77.0 (75.0–79.0)	48.5 (32.4–64.7)	16.1 (14.3–18.0)	52.2 (49.9–54.5)	39.5 (37.7–41.2)	24.2 (22.5–25.8)
California	78.4 (77.3–79.5)	73.6 (71.9–75.2)	43.2 (28.0–58.4)	16.5 (14.6–18.3)	41.8 (40.5–43.2)	34.7 (33.7–35.7)	16.4 (15.5–17.3)
Colorado	75.9 (74.6–77.2)	70.1 (68.7–71.5)	45.6 (26.1–65.1)	10.8 (9.7–12.0)	37.3 (35.7–38.8)	29.5 (28.5–30.5)	19.0 (17.9–20.1)
Connecticut	77.3 (75.6–78.9)	72.2 (70.5–73.8)	46.5 (27.0–66.0)	12.8 (11.6–13.9)	41.8 (39.7–43.8)	32.3 (30.9–33.8)	17.6 (16.1–19.0)
Delaware	82.1 (80.4–83.9)	76.7 (74.9–78.6)	47.5 (31.6–63.4)	15.3 (13.8–16.8)	47.8 (45.4–50.2)	39.3 (37.5–41.1)	20.5 (18.9–22.0)
District of Columbia	80.6 (78.2–83.0)	75.0 (72.9–77.2)	39.7 (27.1–52.3)	15.5 (14.2–16.9)	47.8 (45.3–50.2)	31.9 (29.9–33.9)	21.9 (20.3–23.6)
Florida	82.1 (80.7–83.5)	76.3 (74.9–77.8)	45.6 (29.3–61.8)	17.0 (15.6–18.5)	48.7 (46.8–50.6)	36.5 (35.2–37.8)	21.3 (20.2–22.5)
Georgia	83.5 (82.0–84.9)	76.9 (75.4–78.4)	46.5 (31.7–61.3)	17.8 (16.5–19.2)	49.7 (47.7–51.8)	38.1 (36.6–39.6)	22.0 (20.7–23.4)
Hawaii	76.0 (72.5–79.4)	69.6 (64.8–74.4)	42.1 (27.1–57.0)	15.3 (12.7–17.9)	47.2 (44.5–49.8)	27.8 (26.3–29.3)	17.5 (16.3–18.7)
Idaho	79.0 (77.5–80.5)	72.7 (70.8–74.5)	47.9 (27.7–68.1)	14.6 (13.0–16.1)	40.2 (38.0–42.5)	37.2 (35.8–38.7)	20.2 (18.8–21.5)
Illinois	80.5 (79.1–81.8)	74.4 (72.9–75.9)	45.4 (29.9–60.9)	15.8 (14.5–17.1)	44.6 (42.7–46.6)	39.1 (37.6–40.6)	21.1 (19.8–22.4)
Indiana	83.3 (82.1–84.4)	76.5 (75.0–78.0)	48.7 (32.1–65.3)	17.5 (16.2–18.8)	48.5 (46.8–50.3)	41.3 (40.2–42.5)	24.2 (22.9–25.6)
Iowa	79.5 (78.2–80.9)	73.1 (71.4–74.7)	47.7 (28.3–67.2)	13.6 (12.4–14.7)	41.9 (39.9–43.8)	40.2 (38.8–41.6)	21.1 (19.6–22.5)
Kansas	80.6 (79.7–81.5)	74.5 (73.3–75.6)	47.6 (29.3–65.9)	14.0 (12.6–15.3)	44.8 (43.5–46.1)	40.1 (39.1–41.0)	21.4 (20.2–22.6)
Kentucky	85.4 (84.2–86.5)	79.1 (77.5–80.6)	49.2 (33.5–64.9)	18.7 (17.1–20.2)	54.6 (52.6–56.6)	41.9 (40.4–43.4)	26.5 (24.9–28.0)
Louisiana	85.7 (84.6–86.9)	78.8 (77.5–80.1)	45.0 (32.0–58.0)	20.0 (18.6–21.4)	53.5 (51.8–55.3)	43.6 (42.3–44.9)	24.6 (23.4–25.8)
Maine	80.0 (78.7–81.4)	74.5 (73.1–75.9)	49.1 (30.5–67.7)	13.2 (11.9–14.6)	41.9 (40.2–43.6)	36.5 (35.3–37.6)	20.4 (18.8–21.9)
Maryland	80.6 (79.2–82.0)	75.0 (73.6–76.4)	44.3 (30.4–58.1)	16.1 (14.7–17.5)	47.0 (45.2–48.9)	37.2 (35.9–38.5)	19.2 (18.1–20.3)
Massachusetts	76.7 (75.3–78.1)	71.6 (70.2–72.9)	46.6 (27.9–65.4)	13.7 (12.7–14.6)	41.0 (39.4–42.6)	31.3 (30.3–32.3)	18.6 (17.4–19.7)
Michigan	82.3 (81.2–83.5)	76.2 (74.9–77.5)	48.3 (32.3–64.2)	15.8 (14.4–17.3)	45.0 (43.4–46.7)	41.9 (40.7–43.0)	22.6 (21.4–23.9)
Minnesota	76.0 (74.4–77.5)	69.2 (67.6–70.8)	46.6 (26.8–66.5)	12.3 (11.1–13.4)	37.7 (35.7–39.6)	36.3 (35.0–37.7)	19.8 (18.3–21.3)
Mississippi	86.6 (85.5–87.7)	80.0 (78.7–81.3)	46.6 (34.8–58.4)	21.0 (19.5–22.5)	57.1 (55.6–58.7)	44.8 (43.6–46.1)	25.1 (23.9–26.3)
Missouri	82.5 (81.0–84.1)	75.0 (73.1–77.0)	47.8 (32.0–63.5)	15.4 (13.8–17.1)	46.6 (44.2–49.0)	41.6 (39.8–43.4)	26.0 (24.4–27.7)
Montana	77.8 (76.3–79.2)	70.8 (69.0–72.7)	47.0 (27.9–66.1)	12.2 (11.0–13.4)	40.3 (38.4–42.3)	33.8 (32.5–35.2)	21.0 (19.6–22.4)
Nebraska	79.8 (78.5–81.1)	73.9 (72.5–75.3)	48.0 (29.2–66.8)	13.0 (11.8–14.1)	43.4 (41.6–45.2)	39.3 (38.1–40.5)	20.1 (18.7–21.4)
Nevada	81.5 (79.6–83.4)	73.4 (71.2–75.7)	46.5 (30.3–62.7)	13.1 (11.4–14.8)	43.4 (40.5–46.4)	32.7 (30.6–34.8)	26.5 (24.6–28.5)
New Hampshire	78.6 (77.1–80.2)	73.2 (71.5–74.8)	48.1 (28.3–67.8)	13.2 (12.0–14.4)	41.1 (39.1–43.2)	35.0 (33.6–36.4)	19.3 (17.7–20.8)
New Jersey	79.5 (78.3–80.7)	74.0 (72.6–75.3)	44.3 (28.9–59.6)	15.1 (13.8–16.4)	44.6 (42.9–46.2)	35.2 (34.0–36.3)	19.2 (18.1–20.2)
New Mexico	78.9 (77.5–80.3)	72.5 (70.7–74.3)	43.4 (27.9–58.8)	16.7 (15.1–18.2)	42.6 (40.9–44.2)	32.8 (31.5–34.2)	21.5 (20.4–22.7)
New York	81.6 (80.2–83.0)	75.6 (74.1–77.2)	46.3 (30.8–61.7)	15.6 (14.0–17.1)	45.6 (43.6–47.5)	36.2 (34.9–37.4)	20.5 (19.3–21.8)
North Carolina	83.2 (82.1–84.3)	76.7 (75.4–78.0)	47.2 (32.2–62.1)	18.2 (17.0–19.5)	50.5 (48.8–52.2)	38.9 (37.6–40.1)	23.3 (22.0–24.5)
North Dakota	80.5 (79.1–82.0)	73.4 (71.7–75.1)	47.9 (28.2–67.6)	13.1 (11.9–14.3)	44.1 (42.1–46.2)	39.7 (38.2–41.1)	21.5 (20.0–23.1)
Ohio	81.9 (80.7–83.2)	75.3 (73.9–76.8)	47.8 (31.2–64.3)	16.9 (15.7–18.1)	46.7 (44.9–48.5)	40.8 (39.6–42.0)	24.5 (23.2–25.7)
Oklahoma	84.9 (83.7–86.2)	77.3 (75.4–79.2)	47.7 (33.5–61.9)	17.4 (15.3–19.5)	51.8 (50.0–53.6)	41.9 (40.6–43.2)	27.7 (26.5–28.9)
Oregon	77.8 (76.0–79.6)	71.1 (69.0–73.2)	46.0 (27.4–64.5)	12.4 (11.0–13.8)	42.4 (40.2–44.6)	35.3 (33.8–36.8)	19.9 (18.5–21.3)
Pennsylvania	81.2 (79.8–82.6)	75.0 (73.4–76.5)	47.4 (30.9–63.8)	17.0 (15.9–18.1)	45.9 (44.1–47.7)	39.7 (38.5–40.8)	22.6 (21.3–23.9)
Rhode Island	78.7 (77.2–80.1)	73.9 (72.4–75.3)	47.0 (28.8–65.1)	12.8 (11.5–14.1)	45.3 (43.3–47.3)	33.7 (32.4–35.0)	19.4 (18.0–20.9)
South Carolina	84.0 (82.7–85.4)	77.8 (76.3–79.3)	47.6 (33.8–61.3)	17.7 (16.4–19.0)	49.7 (47.8–51.5)	39.7 (38.2–41.1)	23.3 (22.0–24.7)
South Dakota	81.2 (79.9–82.6)	74.3 (72.5–76.1)	47.9 (27.5–68.2)	13.3 (12.0–14.5)	44.6 (42.6–46.7)	40.0 (38.6–41.5)	19.6 (18.2–21.1)
Tennessee	82.0 (80.5–83.6)	75.4 (73.5–77.3)	44.7 (28.6–60.9)	18.5 (16.9–20.0)	47.1 (44.9–49.3)	41.0 (39.4–42.6)	24.3 (22.8–25.8)
Texas	81.4 (80.2–82.7)	75.9 (74.3–77.4)	45.8 (30.9–60.8)	18.1 (16.3–19.8)	49.0 (47.2–50.7)	39.9 (38.5–41.3)	20.3 (19.3–21.4)
Utah	76.9 (75.5–78.2)	71.7 (70.2–73.1)	47.8 (24.5–71.1)	13.4 (12.3–14.6)	40.0 (38.2–41.8)	37.2 (35.9–38.5)	13.5 (12.5–14.6)
Vermont	75.7 (74.1–77.4)	70.5 (68.9–72.0)	47.5 (27.7–67.3)	11.9 (11.0–12.8)	39.1 (37.2–41.0)	32.3 (31.1–33.4)	17.8 (16.3–19.2)
Virginia	78.8 (77.0–80.6)	72.4 (70.5–74.3)	45.7 (29.3–62.2)	15.8 (14.4–17.2)	45.5 (43.3–47.8)	35.8 (34.1–37.5)	21.4 (19.9–23.0)
Washington	78.8 (77.7–79.9)	73.2 (71.9–74.5)	48.1 (28.2–67.9)	13.1 (11.9–14.3)	41.4 (39.9–42.9)	36.3 (35.5–37.2)	19.0 (17.8–20.1)
West Virginia	84.9 (83.7–86.1)	78.2 (76.3–80.1)	49.0 (32.2–65.9)	19.9 (18.2–21.6)	53.0 (51.0–55.1)	41.7 (40.2–43.2)	27.3 (25.7–28.9)
Wisconsin	78.6 (76.7–80.5)	72.6 (70.6–74.7)	47.3 (28.7–66.0)	15.0 (13.6–16.3)	42.4 (39.9–45.0)	39.0 (37.2–40.8)	20.6 (18.9–22.2)
Wyoming	79.6 (78.2–81.0)	72.4 (70.8–74.0)	48.7 (28.9–68.4)	13.0 (11.7–14.3)	40.8 (38.9–42.7)	35.5 (34.2–36.8)	22.9 (21.4–24.4)

* Corrected estimates from the BRFSS (Behavioral Risk Factor Surveillance System) 2009–2010. Values are prevalence (95% CIs) in percentages.

Appendix Figure. **State level preventable fractions of cardiovascular mortality for men and women, based on a target of the best achieved levels of risk factors.**

State	Mortality Rate per 100 000 Persons	Hypertension	Smoking	Diabetes	Obesity	High Cholesterol
Mississippi	477.0	13.0	8.4	6.2	3.8	0.9
District of Columbia	440.9	7.2	5.2	3.0	0.2	−0.9
Alabama	434.5	11.0	8.2	5.9	3.3	0.8
Louisiana	424.0	10.8	7.9	5.5	3.6	0.5
Oklahoma	414.9	9.6	10.6	3.9	3.1	1.1
Arkansas	405.4	9.7	8.1	3.0	2.6	1.4
Tennessee	393.0	6.6	7.4	4.4	2.8	0.7
Kentucky	385.5	11.3	9.9	4.4	3.3	1.5
West Virginia	371.3	10.3	10.3	5.4	3.1	1.6
South Carolina	370.0	8.4	7.1	4.0	2.6	1.1
Georgia	368.6	8.4	5.6	4.1	2.2	1.0
Nevada	358.5	3.7	9.4	0.4	1.1	1.2
Missouri	346.7	6.2	9.1	2.6	3.2	1.2
Indiana	337.3	7.4	7.7	3.6	3.0	1.4
Michigan	333.1	5.0	6.3	2.7	3.1	1.4
Ohio	325.3	6.1	7.6	3.5	2.9	1.4
North Carolina	323.9	8.9	6.9	4.4	2.3	0.9
Texas	323.5	7.9	3.8	4.2	2.7	0.8
Maryland	315.2	6.6	2.7	3.1	1.9	0.4
Illinois	309.7	4.9	4.6	3.0	2.4	0.6
Pennsylvania	304.6	5.7	6.2	3.4	2.6	1.1
New York	297.7	5.6	4.2	2.5	1.7	0.8
Delaware	296.6	6.8	4.4	2.1	2.6	1.2
Virginia	291.1	5.1	5.0	2.9	1.7	1.0
Wyoming	290.9	1.6	6.1	1.0	1.6	1.5
Iowa	284.1	2.7	4.5	1.3	2.9	1.3
Kansas	280.8	4.9	4.7	1.6	2.7	1.2
Alaska	271.4	2.2	6.6	0.8	1.9	0.9
Florida	267.3	7.5	5.2	3.3	1.9	1.0
North Dakota	266.4	4.2	4.9	0.7	2.8	1.3
California	265.5	2.8	0.1	3.2	1.3	0.3
New Jersey	263.9	4.8	2.8	2.2	1.5	0.6
Wisconsin	262.4	3.2	4.2	2.0	2.5	1.2
South Dakota	258.1	4.6	3.3	1.0	2.8	1.3
Hawaii	257.3	6.6	1.5	2.5	−0.3	−0.3
Montana	256.0	1.2	4.6	0.3	1.2	1.1
Rhode Island	252.6	5.0	3.7	0.8	1.2	1.2
Idaho	251.5	1.4	3.3	1.8	2.0	1.3
Arizona	249.9	2.8	3.8	2.4	1.6	1.1
New Mexico	249.4	3.1	5.3	3.4	0.8	0.5
Washington	243.9	2.2	2.5	1.0	1.9	1.3
Nebraska	243.4	3.8	3.5	0.9	2.6	1.3
Maine	235.7	2.7	4.5	1.2	1.8	1.7
Connecticut	232.5	2.6	1.5	0.5	0.9	1.0
Vermont	231.9	0.3	1.8	0.2	0.8	1.3
Oregon	231.5	3.0	3.6	0.4	1.6	0.9
Massachusetts	228.0	2.0	2.4	1.2	0.6	1.1
New Hampshire	226.6	1.9	3.3	0.7	1.6	1.5
Colorado	219.3	−1.1	2.4	−0.6	0.1	0.8
Utah	217.8	1.1	0.0	1.2	2.1	1.1
Minnesota	195.2	−0.7	3.5	0.3	1.9	1.0

Quintile of Preventable Fraction

anyrisk 0 1 2 3 4

States are displayed in descending order of cardiovascular mortality, age-standardized to the national population in 2009–2010.

Appendix Table 4. National Preventable Fraction of Cardiovascular Mortality Associated with Complete Elimination of Clinically Defined Risk Factors, Based on NHANES 2009-2010*

Variable	Preventable Fraction, %						
	All Risk Factors	All Metabolic Risk Factors†	Elevated Cholesterol Level	Diabetes	Hypertension	Obesity	Current Smoking
Women							
45–79 y	50.2	57.0	−1.2	13.4	39.1	7.9	17.6
45–54 y	46.3	50.8	−0.8	6.8	28.6	6.9	21.8
55–64 y	52.0	59.6	−1.4	15.8	39.7	8.8	16.8
65–79 y	53.0	61.1	−1.5	18.9	49.1	8.4	11.9
Men							
45–79 y	54.4	39.4	14.4	7.2	29.9	12.2	37.2
45–54 y	53.1	36.3	12.2	4.7	23.3	12.2	37.4
55–64 y	54.5	40.1	15.6	7.3	30.1	11.9	40.1
65–79 y	56.1	43.1	16.2	10.6	38.1	12.5	32.9

NHANES = National Health and Nutrition Examination Survey.
* Prevalence and hazard ratios were estimated using objectively measured risk factor data in NHANES.
† Elevated cholesterol level, diabetes, hypertension, and obesity.