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Comparative Analysis of the National Health Interview Survey Public-use and Restricted-use Linked Mortality Files

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Abstract

Linking national survey data with administrative data sources enables researchers to conduct analyses that would not be possible with each data source alone. Recently, the Data Linkage Program at the National Center for Health Statistics (NCHS) released updated linked mortality files, including the National Health Interview Survey data linked to the National Death Index mortality files. Two versions of the files were released: restricted-use files available through NCHS and Federal Statistical Research Data Centers and public-use files. To reduce the reidentification risk, statistical disclosure limitation methods were applied to the public-use files before they were released. This included limiting the amount of mortality information available and perturbing cause of death and follow-up time for select records. To assess the comparability of the restricted-use and public-use files, relative hazard ratios for all-cause and cause-specific mortality using Cox proportional hazards models were estimated and compared. The comparative analysis found that the two data files yielded very similar descriptive and model results.

Keywords: survival analysis • hazard rate • data integration • data quality • National Death Index

Introduction

As the nation's principal health statistics agency, the mission of the National Center for Health Statistics (NCHS) is to provide statistical information that can be used to guide actions and policy to improve the health of the American people. In addition to collecting and disseminating the nation's official vital statistics, NCHS conducts several population-based health surveys. Through the NCHS Data Linkage Program, data from these surveys have been linked to vital and other administrative data. The NCHS Data Linkage Program was established to maximize the scientific value of the data collected in the NCHS population-based surveys and to enable researchers to use longitudinal data from administrative databases or mortality data in combination with survey data to examine factors that influence disability, health care utilization, morbidity, and mortality among different U.S. subpopulations.

NCHS recently completed an update of data from the National Health Interview Survey (NHIS) participants linked to mortality data for the years 1986 through 2014. NHIS participants were linked to the National Death Index (NDI) to obtain information on mortality status and cause of death through December 31, 2015. To protect the confidentiality of the NHIS participants, restricted-use versions of the NHIS linked mortality files (LMFs) were made available only through the NCHS and Federal Statistical Research Data Centers (RDCs). To complement the restricted-use files and increase data access, NCHS developed public-use versions of the LMFs.

The public-use data release included the addition of perturbed data for two elements: date of death and underlying cause of death. Data perturbation is a privacy protecting technique that relies on statistical methods to add random noise to confidential data (1). Perturbed (or synthetic) data for a subset of records was added to reduce reidentification risk to survey participants, maximizing the amount of mortality data included in the public-use release and limiting the amount of synthetic data introduced to the data file. However, as described later in this report, the follow-up time used in the calculation was less granular for

the public-use file compared with the restricted-use file.

This report describes a comparative analysis of the public-use and restricted-use NHIS LMFs. Cox proportional hazards models were used to compare the relative hazard ratios for a standard set of sociodemographic covariates for all-cause and cause-specific mortality. NCHS conducted this comparative analysis to assess the comparability of the two versions of LMFs.

Methods

Description of NHIS

NCHS has administered NHIS, a nationally representative, cross-sectional population health survey, continuously since 1957. NHIS serves as the principal source of information on the health of the U.S. civilian noninstitutionalized population. Households are selected through a probability sampling frame drawn from each state and the District of Columbia, based on information from the decennial census. The NHIS sample design has been described in more detail elsewhere (2,3). Beginning in 1997, NHIS implemented a questionnaire redesign to obtain more detailed health information for selected individuals within a sampled household. Within each household, families are identified, and a family respondent completes a brief structured interview on family demographics and broad health measures. From each family in NHIS, one adult aged 18 or over (sample adult) and—if present—one child (sample child) are randomly selected, and information on each is collected with the Sample Adult Core and the Sample Child Core interviews. The content of these two interviews differs on some items, but both collect basic information on health status, health care services, and health behaviors. For the Sample Adult Core interview, the selected individual responds for himself or herself (i.e., no proxy response is allowed, except when the person is unable to respond due to a physical or mental condition) (3). For the Sample Child Core interview, an adult who is knowledgeable about the sample child is the respondent. This report

presents results based on the family respondent and includes all information on adults in the household, and a separate analysis presents results based only on the sample adults. Throughout this text, the analyses referred to as "all adults" are based on the family respondent responses for the household, and those referred to as "sample adults" are based on responses from the selected sample adult.

Description of NDI

NDI is a centralized database of death record information on file in jurisdictional vital records or statistics offices and maintained by NCHS (https://www.cdc.gov/nchs/ndi/index.htm). These data can be used to identify each person who has died in the United States and U.S. military overseas and his or her cause(s) and manner of death. Deaths are categorized using the *International Classification of Diseases, Ninth Revision* (ICD–9) and the *International Classification of Diseases, 10th Revision* (ICD–10) for underlying and multiple causes of death.

Description of NHIS linked mortality data

NCHS' Research Ethics Review Board (ERB) approved the linkage. The NCHS Research ERB, also known as an Institutional Review Board or IRB, is an administrative body of scientists and nonscientists that was established to protect the rights and welfare of human research subjects. Mortality status for eligible NHIS participants was determined primarily through probabilistic record matching with NDI. NHIS participants were considered eligible for mortality follow-up if they provided sufficient identifying information at the time of interview. Each participant's survey record was screened to determine if it contained at least one of the following combinations of identifying data elements:

- Social Security Number (SSN) (nine digits or last four digits), last name, first name
- SSN (nine digits or last four digits), sex, month of birth, day of birth, year of birth
- Last name, first name, month of birth, year of birth

Any survey participant record that did not meet the minimum data requirements was ineligible for record linkage. On average across all survey years, about 95% of survey participants were eligible for the mortality record linkage.

For a complete description of the matching methodology, see: https://www.cdc.gov/nchs/data/datalinkage/LMF2015_Methodology_Analytic_Considerations.pdf.

Restricted-use LMFs

The restricted-use files include detailed mortality information for all eligible survey participants, including children. The restricted-use files include the following variables: survey participant eligibility status, mortality status, age at death, age last known alive, date of death (month, day, and year), underlying and multiple causes of death, date of birth, NHIS interview date (month, day, and year), and adjusted sample weights for linkage eligibility. Additional information obtained from the death certificate can be accessed by researchers within an RDC.

Public-use LMFs

Due to confidentiality protections, the public-use files include only eligible survey participants aged 18 years and over at the time of the interview and a limited set of mortality variables. In addition, the public-use versions were subjected to data perturbation techniques to reduce the risk of participant reidentification. Synthetic data were substituted for the actual date and underlying cause-of-death data for selected decedent records. Vital status (e.g., whether the person was deceased by the end of the follow-up) was not perturbed. Variables provided in the public-use NHIS LMFs include survey participant eligibility status, mortality status, quarter and year of death, and adjusted sample weights for linkage eligibility. The file was also limited to include only the top nine leading underlying causes of death based on "Deaths: Leading Causes for 2015" (https://www.cdc.gov/nchs/data/nvsr/nvsr66/nvsr66_05.pdf). The top nine

causes of death included diseases of the heart; malignant neoplasms (cancer); chronic lower respiratory disease; cerebrovascular disease; accidents (unintentional injury); Alzheimer disease; diabetes mellitus; nephritis, nephrotic syndrome and nephrosis; and influenza and pneumonia. All other causes of death were grouped together and placed in a residual category. In addition, two variables were created to indicate the presence of diabetes or hypertension in the multiple cause-of-death codes, as these conditions are generally reported as contributing, rather than underlying, causes of death. No additional death certificate information is available in the public-use files. A summary of the two files is presented in Table 1.

Reidentification risk assessment and data perturbation

Similar to previous files, reidentification risk for deceased participants was assessed by combining different public-use sources. For NHIS decedent records, public-use survey data and the proposed public-use linked mortality file were matched on sociodemographic variables to existing publicly available data sources. The names of these public data sources are intentionally omitted here to reduce reidentification risk. This match identified potential records that were at increased risk of reidentification (4). For each publicly available data source, unique records were identified based on the combination of available data elements and then compared with the unique records identified from each data source. All NHIS decedent records that were correctly matched to unique records in these public data sources were considered to be at risk of reidentification. After identifying the NHIS decedent records at increased risk of reidentification, a data perturbation plan was created to reduce the risk of reidentification and allow for the release of an NHIS linked mortality public-use file. All NHIS decedent records considered at risk of reidentification were subject to data perturbation and were randomly assigned to have either the date of death or the underlying cause of death perturbed.

Vital status (e.g., whether the person was deceased by the end of follow-up) was not perturbed. Because the linkage was based on probabilistic techniques, those who linked were assumed deceased and those who did not were assumed alive.

Sample selection

To compare the restricted-use and public-use data sets, the public-use NHIS person-level files for each year 1986 through 2014 were merged with the corresponding public-use and restricted-use mortality files, respectively, to create the analytic samples. All analyses were limited to those eligible for mortality follow-up who were at least age 25 at the time of the NHIS interview; non-Hispanic white, non-Hispanic black, or Hispanic; and had no missing values for education level, marital status, or cause of death.

Outcome measurement

All-cause and cause-specific mortality in the public-use and restricted-use NHIS LMFs were examined. Follow-up time was constructed in two ways, depending on the file. For the public-use files, duration of follow-up was calculated using NHIS interview year and quarter, and mortality file death year and quarter for those categorized as deceased. For participants in the public-use files who were assumed alive, their follow-up duration was calculated as the time from the quarter of the interview year until the fourth quarter of 2015. For the restricted-use files, duration of follow-up was calculated using complete information on the month, day, and year of the NHIS interview and the month, day, and year of death or, for participants assumed alive, the end of the follow-up period, which was December 31, 2015.

In addition to all-cause mortality, nine leading causes of death in the United States in 2015 were examined (5). The ICD codes used to categorize the nine causes of death are documented elsewhere (6). The NHIS LMFs encompass both ICD–9 and ICD–10 cause-of-death coding for all U.S. deaths. To maintain the same cause-of-death codes across all years in the study period, the leading causes of death were based on the

ICD–10 underlying cause-of-death 113 group recode, which recodes all deaths occurring before 1999 into ICD–10 codes (7). Although the code numbers are the same for all years of mortality data, the coding rules for determining underlying cause of death differ for deaths that occurred before 1999 under ICD–9 codes and those that occurred in later years under ICD–10 (7). The analyses presented in this report do not control for the transition in coding rules between ICD–9 and ICD–10 because that transition does not affect the comparisons of interest in this report.

Covariates

All models included a standard set of sociodemographic characteristics as reported at the time of NHIS interview: age (in continuous years), sex, race and ethnicity (non-Hispanic white, non-Hispanic black, or Hispanic), educational attainment (less than high school, high school diploma or GED, some college, or college degree or more), marital status (widowed, divorced or separated, never married, or married), and region of the country (South, Midwest, Northeast, or West). If a survey participant responded, "don't know," refused to answer, or had missing data for any of these covariates, they were excluded from the analytic sample. This reduced the eligible sample by 6.5%.

Data analysis

Cox proportional hazards models were used to compare the estimated relative risk for the covariates for all-cause and cause-specific mortality. Cox proportional hazards models are used to assess the association of survival times and covariates (8). NHIS sample weights were adjusted for linkage eligibility (9). All relative risk estimates were calculated with the survival procedure in SAS 9.4-callable SUDAAN to account for the complex survey design of NHIS (10). The Efron method was used to handle tied failure times (11). Analyses were run on all adults aged 25 and over for 1986–2014 and on only sample adults aged 25 and over for the years 1997–2014. An analysis of only sample adults was also conducted because some

researchers limit their NHIS analyses to just sample adults. Throughout this text, the analyses referred to as "all adults" are based on the family respondent responses for the household, and those referred to as "sample adults" are based on responses from the selected sample adult.

Descriptive statistics for the analytic sample are presented in Table 2. Hazard ratios for all-cause mortality are presented overall and separately by sex and race and ethnicity for both the public-use and restricted-use files. Hazard ratios for cause-specific mortality are presented overall for the nine leading causes of death.

Results

Table 2 shows the unweighted sample counts (*n*), weighted percents or means, and standard errors for the covariates used in the analyses. The descriptive statistics for covariates in Table 2 are the same for both the public-use and restricted-use files, as these variables were not subject to data perturbation. In all subsequent analyses, the differences between the two files' values are associated with cause and date of death because those are the variables that were perturbed. The average age of this sample at baseline is 48.9 years, and less than 2% of respondents are aged 85 and over. A higher percentage of the sample is female (52.3% compared with 47.7%). Non-Hispanic white adults are 77.9% of the sample, while non-Hispanic black (11.3%) and Hispanic adults (10.8%) account for smaller proportions. A majority of the sample was married at the time of the NHIS interview (65.7%), and the modal educational category was a high school diploma or GED (32.5%).

The number and weighted percentage of persons in the analytic sample who were identified as deceased (*n* = 341,007; 18.9%) are identical in the public-use and restricted-use files because vital status of individuals was not changed in the perturbation process. The public-use files contain less detailed date information (year and quarter information only) and include perturbed information for quarter and year of death for selected decedents, which creates slight differences when comparing the duration of follow-up calculations

between the two files. Yet, for the pooled NHIS years 1986 through 2014, the mean years of follow-up (weighted) for both files are very similar (approximately 12.9 years, data not shown).

Table 3 shows the cause-specific percentage distributions for the nine leading causes of death studied. Overall, the distributions are similar when comparing the two files. For example, heart disease (about 20%) and cancer (about 25%) account for similar percentages of deaths in both files. Even for the less prevalent causes of death, such as diabetes; nephritis, nephrotic syndrome and nephrosis; accidents (unintentional injuries); and Alzheimer disease, the differences in the percentages of deaths attributed to each specific cause were about 0.1%. Similarly, the rankings of each cause of death were the same in the two files.

All-cause mortality model results

Table 4 displays results from two Cox proportional hazards models of all-cause mortality: one estimated from the public-use files and one estimated from the restricted-use files. While fact of death was not changed in the public-use files, there are differences in the duration of follow-up (survival time) between the public-use and restricted-use files due to the perturbation of quarter and year of death for selected decedents in the public-use files. Nevertheless, the results of all-cause mortality models are consistent. Age, race and ethnicity, education, and marital status are all related to the risk of mortality. For example, non-Hispanic black participants, persons with less than a high school education, never-married individuals, and those living in the South had higher risks of mortality compared with their respective comparison groups. Moreover, the relative risks and 95% confidence intervals are nearly identical for estimates from the public-use and restricted-use files.

All-cause Cox proportional hazards models of mortality were estimated separately by sex for both the public-use and restricted-use files, and results are shown in Table 5. Results from the sex-specific models are consistent across

the public-use and restricted-use files. Table 6 shows the results of separate all-cause Cox proportional hazards models for non-Hispanic white, non-Hispanic black, and Hispanic participants, respectively. Similar to the sex-specific models, results from the race and ethnicity-specific models are consistent across the public-use and restricted-use files. Males have higher mortality risk than females in each race and ethnicity-specific model. In addition, persons with less than a high school education have higher mortality risks over the follow-up period than those in the more educated groups in each race and ethnicity-specific model.

Cause-specific mortality model results

Tables 7–15 display the results of nine Cox proportional hazards models with each of the nine specific underlying causes of death as an outcome. Each cause-specific table provides a comparison of the model results from the public-use and restricted-use versions of the NHIS LMFs.

A comparison of the results for the public-use and restricted-use files for each of the nine causes of death yields similar results. In general, the conclusions are identical, and there are only minor differences when comparing the point and confidence interval estimates of the models. This is the case for both outcomes that are more common (e.g., heart disease mortality, cancer mortality) and less common (e.g., influenza and pneumonia mortality).

As an example of the consistency between cause-specific results from the public-use and restricted-use data, Table 8 provides comparative models that specify cancer mortality as the outcome variable. Cancer mortality risk increases just over 7% for each additional year of age in both the public-use and restricted-use models. Compared with females, males have an approximately 55% and 53% higher cancer mortality risk over the course of the follow-up period in the public-use and restricted-use files, respectively. In both the public-use and restricted-use models, those with less than a high school education had

approximately 50% and 51% higher, respectively, cancer mortality risk over the follow-up period compared with those with a college degree or more. Finally, regional differences in all-cancer mortality risk remain nearly identical when comparing the results of the public-use and restricted-use models.

Outcomes based on causes with fewer numbers of deaths were assessed because the perturbation process could have caused more bias with a smaller number of deaths. For example, as noted in Table 3, the percent distribution of mortality from nephritis, nephrotic syndrome and nephrosis (about 1.8% of decedents) is less common than cancer mortality (about 25% of decedents). Table 14 shows that when comparing public-use and restricted-use models, relative risks and 95% confidence intervals for standard sociodemographic covariates of nephritis, nephrotic syndrome and nephrosis mortality are consistent. For example, both the public-use and restricted-use models show that males are almost 1.6 times as likely as females to die from nephritis, nephrotic syndrome and nephrosis, and those with a high school diploma or GED have 1.3 times the nephritis, nephrotic syndrome and nephrosis mortality risk compared with those with some college.

All-cause and cause-specific mortality for sample adults from NHIS years 1997–2014 were analyzed. Overall, comparisons of the public-use and restricted-use linked mortality files produced consistent results when limiting the sample to just the sample adults. Tables 16–25 show that most estimates and confidence intervals are comparable, and estimates that were statistically significant in the restricted files remained statistically significant in the public files for the subset of sample adults, although the magnitude of the point estimate may vary to some extent.

Discussion

This report describes the results obtained from the public-use and restricted-use versions of the NHIS LMFs, with mortality follow-up through 2015. This report supports earlier findings comparing the public and restricted files (4). In the public-use version

of the data files, a limited amount of information for selected decedents was perturbed. Further, there is less detailed date of death information in the public-use files compared with the restricted-use files, where no information has been perturbed, and there is complete information on date of death.

The comparative analysis finds that the two data files yield very similar descriptive and model results. This is particularly true when examining all-cause mortality. Because the perturbation process in the public-use files did not affect the vital status of any individuals in the files, differences in results between the two files when examining overall (all-cause) mortality arise because the public-use files include perturbed information for date of death and less specific information regarding date of death for individuals compared with the restricted-use files. In the end, the differences that resulted from the comparisons of all-cause mortality between the public-use files and restricted-use files were very minor.

The comparative analysis of cause-specific mortality across the public-use and restricted-use versions of the NHIS LMFs also yielded consistent model results, even for causes of death such as nephritis, nephrotic syndrome and nephrosis; influenza and pneumonia; and Alzheimer disease (each represent 3% or less of all U.S. adult deaths). The perturbation processes used to create the public-use files resulted in changes in the frequency distributions for cause of death. Yet, overall, the percentage of deaths attributed to the leading causes of death for both files remained similar.

These findings should provide analysts with the confidence to use these most recent public-use data files providing mortality follow-up for eligible adult NHIS participants. However, potential users should note some analytic considerations. Caution in using the public-use files is urged when examining the mortality patterns of small subgroups of the population, such as numerically small racial and ethnic minority groups, very old individuals, or young adults. This is particularly true for cause-specific analyses of numerically small demographic subgroups.

In summary, the release of a public-use version of the NHIS LMFs provides the public health, social science, demographic, and medical communities with a large data set that is readily available, nationally representative, and rich in detail for both mortality covariates and specificity in outcomes. The public-use files may serve as a resource for researchers and policymakers in further understanding adult mortality trends and patterns.

References

1. Wilson RL, Rosen PA. Protecting data through 'perturbation' techniques: The impact on knowledge discovery in databases. J Database Manag 14(2):14–26. 2003.

2. Botman SL, Moore TF, Moriarity CL, Parsons VL. Design and estimation for the National Health Interview Survey, 1995–2004. National Center for Health Statistics. Vital Health Stat 2(130). 2000.

3. Parsons VL, Moriarity C, Jonas K, Moore TF, Davis KE, Tompkins L. Design and estimation for the National Health Interview Survey, 2006–2015. National Center for Health Statistics. Vital Health Stat 2(165). 2014.

4. Lochner K, Hummer RA, Bartee S, Wheatcroft G, Cox C. The public-use National Health Interview Survey linked mortality files: Methods of reidentification risk avoidance and comparative analysis. Am J Epidemiol 168(3):336–44. 2008.

5. Murphy SL, Xu JQ, Kochanek KD, Curtin SC, Arias E. Deaths: Final data for 2015. National Vital Statistics Reports; vol 66 no 6. Hyattsville, MD: National Center for Health Statistics. 2017.

6. National Center for Health Statistics. Public-use 2015 LMF data dictionary. Hyattsville, MD. 2019. Available from: https://www.cdc.gov/nchs/data/datalinkage/public-use-2015-linked-mortality-files-data-dictionary.pdf.

7. Anderson RN, Minino AM, Hoyert DL, Rosenberg HM. Comparability of cause of death between ICD–9 and ICD–10: Preliminary estimates. National Vital Statistics Reports; vol

49 no 2. Hyattsville, MD: National Center for Health Statistics. 2001.

8. Cox DR. Regression models and life-tables (with discussion). J R Stat Soc Series B Stat Methodol 34(2):187–202. 1972.

9. National Center for Health Statistics. The linkage of National Center for Health Statistics survey data to the National Death Index—2015 linked mortality file (LMF): Methodology overview and analytic considerations. Hyattsville, MD. 2019. Available from: https://www.cdc.gov/nchs/data/datalinkage/LMF2015_Methodology_Analytic_Considerations.pdf.

10. RTI International. SUDAAN (Release 11.0) [computer software]. 2012.

11. Hertz-Picciotto I, Rockhill B. Validity and efficiency of approximation methods for tied survival times in Cox regression. Biometrics 53(3):1151–6. 1997.

Table 1. List of key differences between public-use and restricted-use linked mortality files

File detail	Restricted-use	Public-use
Dates	Exact date of death, birth date, and interview date	Date of death represented by quarter or year
Cause of death	Detailed UCOD and MCOD information	Nine UCOD grouped and recoded. Two MCOD indicators: diabetes and hypertension
Participants	Both adults and children	Adults aged 18 and over
Perturbed data on death	No perturbation	Perturbed information: Cause of death for select decedents and follow-up time (vital status is not perturbed)

NOTES: UCOD is underlying cause of death. MCOD is multiple cause of death.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 2. Descriptive statistics for adults aged 25 and over: National Health Interview Survey linked mortality files, 1986–2014

Characteristic	Unweighted *n*	Weighted percent or mean	Standard error
Vital status: Assumed deceased.	341,007	18.9	0.11
Age (mean).	1,611,382	48.9	0.05
Age group			
25–44	744,927	45.4	0.12
45–64	557,113	35.3	0.08
65–84	280,083	17.4	0.09
85 and over.	29,259	1.9	0.03
Sex			
Male	748,419	47.7	0.04
Female	862,963	52.3	0.04
Race and ethnicity			
Non-Hispanic white.	1,149,720	77.9	0.20
Non-Hispanic black.	218,346	11.3	0.16
Hispanic	243,316	10.8	0.14
Marital status			
Married	1,056,580	65.7	0.11
Widowed.	127,219	7.7	0.05
Divorced or separated	211,674	13.1	0.05
Never married.	215,909	13.5	0.07
Education level			
Less than high school.	334,190	17.7	0.12
High school diploma or GED	531,902	32.5	0.11
Some college	379,638	24.8	0.08
College and above	365,652	25.0	0.15
Region			
Northeast	308,872	19.6	0.24
Midwest	373,496	24.3	0.24
South	581,234	36.5	0.27
West	347,780	19.6	0.25

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 3. Distribution of cause of death for the 341,007 adults aged 25 and over: National Health Interview Survey linked mortality files, 1986–2014

	Public-use		Restricted-use	
Cause-specific deaths[1]	Weighted percent	Standard error	Weighted percent	Standard error
Diseases of the heart	19.8	0.12	20.1	0.12
Cancer, all sites	25.0	0.09	24.6	0.09
Chronic lower respiratory disease	5.4	0.05	5.8	0.05
Accidents (unintentional injuries)	3.4	0.04	3.5	0.04
Cerebrovascular disease	5.7	0.05	6.0	0.05
Alzheimer disease	2.5	0.03	2.6	0.03
Diabetes mellitus	2.9	0.04	3.0	0.04
Nephritis, nephrotic syndrome and nephrosis	1.7	0.03	1.8	0.03
Influenza and pneumonia	2.3	0.03	2.4	0.03

[1]Underlying cause-of-death codes are based on the *International Classification of Diseases, 10th Revision*, recoded into 113 selected causes. Weighted percentages for cause-specific deaths are based on the sample of decedents.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 4. Hazard ratios for all-cause mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.09	1.09	1.09	1.09	1.09	1.09
Sex (female):						
Male	1.57	1.56	1.59	1.57	1.56	1.59
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.05	1.04	1.07	1.05	1.04	1.07
Hispanic	0.83	0.82	0.85	0.83	0.82	0.85
Education (college and above):						
Less than high school.	1.90	1.87	1.93	1.90	1.87	1.93
High school diploma or GED.	1.54	1.52	1.56	1.54	1.52	1.56
Some college	1.37	1.35	1.39	1.37	1.35	1.39
Marital status (married):						
Widowed	1.23	1.21	1.24	1.23	1.21	1.24
Divorced or separated.	1.36	1.34	1.38	1.36	1.34	1.38
Never married	1.52	1.49	1.55	1.52	1.49	1.55
Region (West):						
Northeast	0.93	0.92	0.95	0.93	0.92	0.95
Midwest.	0.99	0.98	1.01	0.99	0.98	1.01
South.	1.07	1.06	1.09	1.07	1.06	1.09

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 5. Hazard ratios for all-cause mortality, by sex: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Men Public-use Hazard ratio	Men Public-use Lower bound (95% CI)	Men Public-use Upper bound (95% CI)	Men Restricted-use Hazard ratio	Men Restricted-use Lower bound (95% CI)	Men Restricted-use Upper bound (95% CI)	Women Public-use Hazard ratio	Women Public-use Lower bound (95% CI)	Women Public-use Upper bound (95% CI)	Women Restricted-use Hazard ratio	Women Restricted-use Lower bound (95% CI)	Women Restricted-use Upper bound (95% CI)
Age, years	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Race and ethnicity (non-Hispanic white):												
Non-Hispanic black	1.08	1.06	1.10	1.08	1.06	1.10	1.03	1.01	1.06	1.03	1.01	1.06
Hispanic	0.88	0.86	0.90	0.88	0.86	0.90	0.78	0.76	0.81	0.78	0.76	0.80
Education (college and above):												
Less than high school	1.95	1.91	1.98	1.95	1.91	1.98	1.81	1.77	1.85	1.81	1.77	1.85
High school diploma or GED	1.58	1.55	1.61	1.58	1.55	1.61	1.47	1.44	1.50	1.47	1.44	1.50
Some college	1.41	1.38	1.43	1.41	1.38	1.43	1.30	1.28	1.33	1.30	1.28	1.33
Marital status (married):												
Widowed	1.17	1.14	1.20	1.17	1.14	1.20	1.24	1.23	1.26	1.25	1.23	1.26
Divorced or separated	1.39	1.37	1.42	1.39	1.37	1.42	1.33	1.31	1.35	1.33	1.31	1.35
Never married	1.55	1.52	1.58	1.55	1.52	1.58	1.47	1.43	1.52	1.48	1.43	1.52
Region (West):												
Northeast	0.95	0.93	0.97	0.95	0.93	0.97	0.91	0.89	0.93	0.91	0.89	0.93
Midwest	1.00	0.98	1.02	1.00	0.98	1.02	0.99	0.97	1.01	0.99	0.97	1.01
South	1.11	1.09	1.13	1.11	1.09	1.13	1.03	1.01	1.05	1.03	1.01	1.05

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 6. Hazard ratios for all-cause mortality, by race and ethnicity: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Non-Hispanic white Public-use Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Restricted-use Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Non-Hispanic black Public-use Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Restricted-use Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hispanic Public-use Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Restricted-use Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.09	1.09	1.09	1.09	1.09	1.09	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Sex (female):																		
Male	1.57	1.56	1.59	1.57	1.56	1.59	1.56	1.53	1.60	1.56	1.53	1.60	1.61	1.56	1.65	1.61	1.56	1.65
Education (college and above):																		
Less than high school	1.90	1.87	1.93	1.90	1.87	1.93	1.87	1.79	1.97	1.87	1.79	1.97	1.77	1.67	1.88	1.77	1.67	1.88
High school diploma or GED	1.52	1.50	1.55	1.52	1.50	1.54	1.53	1.45	1.61	1.53	1.45	1.61	1.44	1.36	1.53	1.44	1.36	1.53
Some college	1.36	1.34	1.38	1.36	1.34	1.38	1.33	1.26	1.40	1.33	1.26	1.40	1.28	1.20	1.36	1.28	1.20	1.36
Marital status (married):																		
Widowed	1.22	1.21	1.24	1.22	1.21	1.24	1.21	1.17	1.25	1.21	1.17	1.25	1.25	1.19	1.31	1.25	1.19	1.31
Divorced or separated	1.43	1.41	1.45	1.43	1.41	1.45	1.24	1.21	1.28	1.24	1.21	1.28	1.08	1.03	1.13	1.08	1.03	1.13
Never married	1.52	1.48	1.55	1.52	1.49	1.55	1.43	1.38	1.48	1.43	1.38	1.48	1.26	1.20	1.33	1.26	1.20	1.33
Region (West):																		
Northeast	0.95	0.93	0.97	0.95	0.93	0.97	0.90	0.85	0.95	0.90	0.86	0.95	0.83	0.80	0.87	0.83	0.79	0.87
Midwest	1.01	0.99	1.02	1.01	0.99	1.02	1.02	0.98	1.06	1.02	0.98	1.07	0.84	0.79	0.89	0.84	0.79	0.89
South	1.08	1.07	1.10	1.08	1.07	1.10	1.08	1.03	1.12	1.08	1.04	1.12	1.03	0.99	1.08	1.03	0.99	1.08

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 7. Hazard ratios for diseases of the heart mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.10	1.10	1.10	1.10	1.10	1.10
Sex (female):						
Male	1.96	1.92	1.99	1.96	1.93	2.00
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.08	1.05	1.11	1.07	1.03	1.10
Hispanic	0.78	0.74	0.81	0.74	0.70	0.77
Education (some college and above):						
Less than high school	1.82	1.77	1.87	1.78	1.74	1.83
High school diploma or GED.	1.35	1.32	1.38	1.35	1.32	1.38
Marital status (married):						
Widowed	1.33	1.30	1.36	1.36	1.33	1.39
Divorced or separated.	1.37	1.33	1.41	1.40	1.36	1.44
Never married	1.57	1.51	1.63	1.60	1.54	1.66
Region (West):						
Northeast	0.99	0.94	1.03	0.98	0.94	1.03
Midwest.	0.98	0.94	1.02	0.98	0.94	1.02
South.	1.02	0.98	1.06	1.02	0.98	1.06

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 8. Hazard ratios for malignant neoplasms (cancer) mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.07	1.07	1.07	1.07	1.07	1.07
Sex (female):						
Male	1.55	1.52	1.57	1.53	1.50	1.55
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.06	1.04	1.09	1.09	1.07	1.12
Hispanic	0.76	0.74	0.78	0.80	0.78	0.83
Education (some college and above):						
Less than high school	1.50	1.47	1.53	1.51	1.48	1.54
High school diploma or GED.	1.29	1.27	1.32	1.29	1.26	1.31
Marital status (married):						
Widowed	0.92	0.90	0.95	0.92	0.90	0.95
Divorced or separated.	1.30	1.27	1.33	1.26	1.23	1.29
Never married	1.01	0.97	1.04	0.98	0.95	1.01
Region (West):						
Northeast	1.00	0.98	1.03	1.01	0.98	1.03
Midwest.	1.04	1.02	1.06	1.04	1.02	1.07
South.	1.08	1.06	1.11	1.08	1.05	1.10

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 9. Hazard ratios for chronic lower respiratory disease mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.10	1.09	1.10	1.10	1.09	1.10
Sex (female):						
Male	1.56	1.50	1.61	1.58	1.52	1.63
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.48	0.45	0.51	0.47	0.44	0.51
Hispanic	0.34	0.31	0.37	0.34	0.31	0.37
Education (some college and above):						
Less than high school	2.40	2.28	2.51	2.34	2.23	2.45
High school diploma or GED.	1.61	1.54	1.68	1.61	1.55	1.68
Marital status (married):						
Widowed	1.15	1.09	1.21	1.19	1.14	1.25
Divorced or separated.	1.84	1.75	1.94	1.88	1.79	1.98
Never married	1.10	1.01	1.20	1.15	1.06	1.25
Region (West):						
Northeast	0.71	0.66	0.76	0.71	0.66	0.75
Midwest.	0.85	0.80	0.90	0.87	0.82	0.92
South.	1.00	0.95	1.06	1.01	0.96	1.07

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

National Health Statistics Reports ■ Number 143 ■ June 29, 2020

Table 10. Hazard ratios for cerebrovascular disease mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.11	1.11	1.12	1.11	1.11	1.12
Sex (female):						
Male	1.12	1.08	1.15	1.15	1.11	1.19
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.20	1.14	1.26	1.19	1.14	1.25
Hispanic	0.91	0.85	0.96	0.91	0.86	0.97
Education (some college and above):						
Less than high school	1.56	1.49	1.63	1.52	1.45	1.59
High school diploma or GED.	1.26	1.21	1.32	1.27	1.21	1.32
Marital status (married):						
Widowed	1.09	1.04	1.14	1.13	1.09	1.18
Divorced or separated.	1.15	1.08	1.22	1.17	1.10	1.24
Never married	1.23	1.14	1.32	1.26	1.17	1.35
Region (West):						
Northeast	0.75	0.71	0.80	0.75	0.71	0.80
Midwest.	0.95	0.90	1.00	0.96	0.91	1.01
South.	1.01	0.96	1.07	1.02	0.97	1.07

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 11. Hazard ratios for accident (unintentional injury) mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.03	1.03	1.04	1.04	1.03	1.04
Sex (female):						
Male	1.97	1.89	2.05	1.98	1.90	2.06
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.72	0.67	0.77	0.75	0.70	0.81
Hispanic	1.12	1.05	1.20	1.12	1.05	1.20
Education (some college and above):						
Less than high school.	1.76	1.65	1.87	1.72	1.62	1.83
High school diploma or GED.	1.39	1.32	1.46	1.38	1.32	1.45
Marital status (married):						
Widowed	1.77	1.64	1.90	1.71	1.59	1.84
Divorced or separated.	1.48	1.38	1.58	1.50	1.41	1.60
Never married	1.82	1.70	1.95	1.78	1.66	1.90
Region (West):						
Northeast	0.77	0.72	0.83	0.76	0.71	0.81
Midwest.	0.91	0.85	0.98	0.92	0.85	0.98
South.	1.06	0.99	1.12	1.04	0.98	1.11

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 12. Hazard ratios for Alzheimer disease mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.17	1.17	1.17	1.17	1.17	1.17
Sex (female):						
Male	0.82	0.77	0.87	0.85	0.80	0.90
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.78	0.71	0.85	0.76	0.70	0.84
Hispanic	0.78	0.70	0.87	0.75	0.68	0.84
Education (some college and above):						
Less than high school	1.07	1.00	1.14	1.02	0.96	1.10
High school diploma or GED.	1.09	1.02	1.16	1.11	1.04	1.17
Marital status (married):						
Widowed	0.82	0.77	0.88	0.88	0.82	0.94
Divorced or separated.	0.92	0.83	1.02	0.96	0.87	1.06
Never married	0.91	0.80	1.03	0.97	0.85	1.09
Region (West):						
Northeast	0.58	0.52	0.63	0.57	0.52	0.62
Midwest.	0.80	0.74	0.86	0.80	0.74	0.86
South.	0.89	0.83	0.96	0.89	0.83	0.95

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 13. Hazard ratios for diabetes mellitus mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.08	1.07	1.08	1.08	1.07	1.08
Sex (female):						
Male	1.47	1.40	1.54	1.51	1.44	1.58
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.83	1.72	1.95	1.81	1.70	1.93
Hispanic	1.59	1.47	1.73	1.56	1.44	1.69
Education (some college and above):						
Less than high school	2.04	1.92	2.17	1.97	1.85	2.09
High school diploma or GED.	1.52	1.43	1.61	1.52	1.44	1.61
Marital status (married):						
Widowed	1.25	1.17	1.34	1.30	1.22	1.39
Divorced or separated.	1.47	1.37	1.57	1.51	1.41	1.61
Never married	1.49	1.38	1.62	1.55	1.44	1.67
Region (West):						
Northeast	0.89	0.82	0.96	0.88	0.82	0.95
Midwest.	1.07	1.00	1.15	1.08	1.01	1.16
South.	1.07	1.00	1.14	1.07	1.01	1.15

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 14. Hazard ratios for nephritis, nephrotic syndrome and nephrosis disease mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.11	1.10	1.11	1.11	1.10	1.11
Sex (female):						
Male	1.60	1.51	1.70	1.64	1.55	1.74
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.95	1.80	2.11	1.97	1.82	2.13
Hispanic	1.15	1.03	1.28	1.17	1.05	1.29
Education (some college and above):						
Less than high school	1.65	1.53	1.79	1.61	1.49	1.73
High school diploma or GED.	1.34	1.24	1.44	1.34	1.24	1.44
Marital status (married):						
Widowed	1.08	1.00	1.18	1.14	1.06	1.24
Divorced or separated.	1.24	1.13	1.36	1.27	1.16	1.39
Never married	1.39	1.23	1.56	1.43	1.27	1.60
Region (West):						
Northeast	1.52	1.36	1.71	1.48	1.32	1.65
Midwest.	1.61	1.44	1.79	1.64	1.47	1.82
South.	1.62	1.46	1.80	1.62	1.46	1.80

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 15. Hazard ratios for influenza and pneumonia mortality: National Health Interview Survey linked mortality files, 1986–2014 (follow-up through 2015)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.12	1.12	1.13	1.12	1.12	1.13
Sex (female):						
Male	1.59	1.51	1.68	1.63	1.55	1.72
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.97	0.88	1.06	0.97	0.89	1.07
Hispanic	0.76	0.68	0.85	0.75	0.68	0.84
Education (some college and above):						
Less than high school	1.79	1.67	1.92	1.74	1.62	1.86
High school diploma or GED.	1.35	1.26	1.44	1.34	1.25	1.43
Marital status (married):						
Widowed	1.24	1.16	1.33	1.27	1.19	1.36
Divorced or separated.	1.26	1.15	1.37	1.27	1.17	1.39
Never married	1.78	1.59	2.00	1.84	1.66	2.05
Region (West):						
Northeast	0.88	0.81	0.97	0.87	0.80	0.95
Midwest.	0.82	0.74	0.90	0.83	0.76	0.91
South.	0.90	0.83	0.97	0.90	0.83	0.97

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 16. Hazard ratios for all-cause mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.09	1.09	1.09	1.09	1.09	1.09
Sex (female):						
Male	1.60	1.57	1.63	1.60	1.57	1.63
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.06	1.03	1.10	1.06	1.03	1.10
Hispanic	0.87	0.83	0.90	0.87	0.83	0.90
Education (college and above):						
Less than high school	2.00	1.94	2.07	2.00	1.93	2.07
High school diploma or GED.	1.59	1.54	1.64	1.59	1.54	1.64
Some college	1.43	1.38	1.48	1.43	1.38	1.48
Marital status (married):						
Widowed	1.33	1.30	1.37	1.33	1.30	1.37
Divorced or separated.	1.39	1.36	1.43	1.39	1.36	1.43
Never married	1.64	1.58	1.70	1.64	1.58	1.71
Region (West):						
Northeast	0.95	0.92	0.98	0.95	0.92	0.98
Midwest.	1.01	0.98	1.04	1.01	0.98	1.04
South.	1.08	1.05	1.11	1.08	1.05	1.11

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 17. Hazard ratios for diseases of the heart mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.10	1.10	1.10	1.10	1.10	1.10
Sex (female):						
Male	2.11	2.02	2.22	2.10	2.01	2.20
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.16	1.09	1.24	1.15	1.09	1.23
Hispanic	0.88	0.81	0.95	0.83	0.76	0.90
Education (some college and above):						
Less than high school	1.72	1.62	1.82	1.67	1.58	1.77
High school diploma or GED.	1.26	1.19	1.33	1.26	1.20	1.33
Marital status (married):						
Widowed	1.47	1.38	1.56	1.52	1.43	1.61
Divorced or separated.	1.45	1.36	1.55	1.49	1.40	1.58
Never married	1.85	1.69	2.03	1.95	1.79	2.13
Region (West):						
Northeast	1.00	0.92	1.07	1.00	0.93	1.07
Midwest.	1.03	0.96	1.11	1.03	0.96	1.10
South.	1.06	0.99	1.14	1.06	1.00	1.13

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

National Health Statistics Reports ■ Number 143 ■ June 29, 2020

Table 18. Hazard ratios for malignant neoplasms (cancer) mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.07	1.07	1.07	1.07	1.07	1.08
Sex (female):						
Male	1.55	1.49	1.62	1.52	1.46	1.58
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.05	0.99	1.12	1.09	1.03	1.16
Hispanic	0.80	0.74	0.86	0.86	0.80	0.93
Education (some college and above):						
Less than high school	1.53	1.46	1.61	1.56	1.49	1.64
High school diploma or GED.	1.30	1.24	1.35	1.29	1.23	1.36
Marital status (married):						
Widowed	0.98	0.93	1.03	0.97	0.92	1.02
Divorced or separated.	1.31	1.25	1.38	1.26	1.20	1.33
Never married	1.07	0.98	1.16	1.03	0.94	1.11
Region (West):						
Northeast	1.07	1.01	1.14	1.06	1.00	1.12
Midwest.	1.07	1.01	1.14	1.08	1.01	1.14
South.	1.14	1.07	1.20	1.13	1.07	1.20

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 19. Hazard ratios for chronic lower respiratory disease mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.10	1.10	1.10	1.10	1.10	1.10
Sex (female):						
Male	1.51	1.39	1.64	1.52	1.40	1.64
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.42	0.36	0.49	0.41	0.35	0.48
Hispanic	0.28	0.23	0.35	0.28	0.23	0.34
Education (some college and above):						
Less than high school	2.48	2.20	2.78	2.46	2.21	2.75
High school diploma or GED.	1.44	1.30	1.60	1.51	1.37	1.67
Marital status (married):						
Widowed	1.30	1.16	1.46	1.37	1.23	1.53
Divorced or separated.	1.94	1.74	2.18	2.03	1.83	2.26
Never married	1.28	1.07	1.54	1.33	1.12	1.57
Region (West):						
Northeast	0.72	0.62	0.85	0.71	0.61	0.83
Midwest.	0.91	0.80	1.04	0.94	0.82	1.07
South.	1.02	0.90	1.16	1.02	0.90	1.16

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 20. Hazard ratios for cerebrovascular disease mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.12	1.11	1.12	1.12	1.11	1.12
Sex (female):						
Male	1.04	0.95	1.14	1.08	0.99	1.17
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.25	1.11	1.41	1.19	1.06	1.34
Hispanic	1.00	0.85	1.16	0.98	0.84	1.14
Education (some college and above):						
Less than high school	1.61	1.44	1.81	1.53	1.37	1.70
High school diploma or GED.	1.26	1.13	1.40	1.26	1.13	1.39
Marital status (married):						
Widowed	1.08	0.96	1.20	1.15	1.03	1.27
Divorced or separated.	1.15	1.01	1.31	1.16	1.02	1.32
Never married	1.20	1.01	1.43	1.25	1.06	1.47
Region (West):						
Northeast	0.70	0.61	0.81	0.72	0.62	0.82
Midwest.	0.88	0.78	1.00	0.89	0.79	1.00
South.	0.95	0.84	1.06	0.96	0.86	1.07

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 21. Hazard ratios for accident (unintentional injury) mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.03	1.02	1.03	1.03	1.03	1.04
Sex (female):						
Male	1.97	1.79	2.17	1.97	1.79	2.17
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.62	0.52	0.73	0.66	0.56	0.78
Hispanic	1.09	0.93	1.28	1.14	0.97	1.33
Education (some college and above):						
Less than high school	1.82	1.56	2.12	1.73	1.49	2.01
High school diploma or GED.	1.32	1.17	1.49	1.29	1.15	1.45
Marital status (married):						
Widowed	2.08	1.78	2.44	1.96	1.67	2.30
Divorced or separated.	1.50	1.31	1.71	1.51	1.33	1.73
Never married	2.02	1.74	2.34	1.90	1.63	2.21
Region (West):						
Northeast	0.77	0.65	0.90	0.74	0.64	0.87
Midwest.	0.90	0.77	1.06	0.90	0.76	1.05
South.	0.97	0.85	1.12	0.95	0.83	1.08

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 22. Hazard ratios for Alzheimer disease mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.20	1.19	1.21	1.20	1.19	1.21
Sex (female):						
Male	0.87	0.75	1.01	0.92	0.81	1.06
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	0.90	0.73	1.12	0.85	0.69	1.04
Hispanic	0.90	0.68	1.18	0.86	0.66	1.12
Education (some college and above):						
Less than high school	1.21	1.02	1.44	1.14	0.97	1.35
High school diploma or GED.	1.17	1.02	1.34	1.19	1.04	1.36
Marital status (married):						
Widowed	0.89	0.77	1.02	0.97	0.85	1.11
Divorced or separated.	0.92	0.74	1.16	0.96	0.78	1.19
Never married	1.08	0.80	1.45	1.18	0.90	1.54
Region (West):						
Northeast	0.57	0.46	0.70	0.56	0.46	0.68
Midwest.	0.76	0.63	0.92	0.81	0.68	0.96
South.	0.84	0.71	0.99	0.86	0.74	1.00

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 23. Hazard ratios for diabetes mellitus mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.08	1.07	1.08	1.08	1.07	1.08
Sex (female):						
Male	1.59	1.40	1.81	1.66	1.47	1.87
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.99	1.72	2.30	1.97	1.71	2.27
Hispanic	1.57	1.35	1.84	1.56	1.34	1.81
Education (some college and above):						
Less than high school	2.03	1.77	2.32	1.95	1.71	2.23
High school diploma or GED.	1.48	1.30	1.70	1.55	1.36	1.77
Marital status (married):						
Widowed	1.35	1.15	1.58	1.42	1.22	1.66
Divorced or separated.	1.53	1.33	1.77	1.57	1.37	1.80
Never married	1.53	1.26	1.84	1.65	1.38	1.98
Region (West):						
Northeast	0.86	0.73	1.02	0.88	0.75	1.03
Midwest.	1.04	0.88	1.22	1.04	0.89	1.21
South.	1.03	0.89	1.19	1.04	0.91	1.19

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 24. Hazard ratios for nephritis, nephrotic syndrome and nephrosis disease mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.10	1.09	1.11	1.10	1.09	1.11
Sex (female):						
Male	1.60	1.38	1.86	1.69	1.46	1.94
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	2.33	1.96	2.77	2.40	2.03	2.84
Hispanic	1.11	0.87	1.42	1.14	0.90	1.43
Education (some college and above):						
Less than high school	1.66	1.37	2.01	1.63	1.35	1.95
High school diploma or GED.	1.38	1.13	1.67	1.40	1.17	1.69
Marital status (married):						
Widowed	1.11	0.93	1.32	1.21	1.02	1.42
Divorced or separated.	1.15	0.94	1.41	1.18	0.97	1.44
Never married	1.34	1.04	1.73	1.38	1.09	1.76
Region (West):						
Northeast	1.36	1.07	1.73	1.33	1.06	1.68
Midwest.	1.60	1.27	2.01	1.63	1.30	2.03
South.	1.55	1.25	1.93	1.55	1.25	1.92

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

Table 25. Hazard ratios for influenza and pneumonia mortality: National Health Interview Survey linked mortality files, 1997–2014 (follow-up through 2015 for sample adults only)

Characteristic	Public-use			Restricted-use		
	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)	Hazard ratio	Lower bound (95% CI)	Upper bound (95% CI)
Age, years.	1.11	1.11	1.12	1.12	1.11	1.12
Sex (female):						
Male	1.40	1.20	1.62	1.46	1.27	1.68
Race and ethnicity (non-Hispanic white):						
Non-Hispanic black.	1.19	0.94	1.51	1.18	0.95	1.46
Hispanic	0.95	0.75	1.21	0.91	0.72	1.15
Education (some college and above):						
Less than high school.	1.61	1.34	1.93	1.53	1.28	1.83
High school diploma or GED.	1.25	1.04	1.49	1.23	1.04	1.46
Marital status (married):						
Widowed	1.42	1.19	1.69	1.45	1.24	1.71
Divorced or separated.	1.26	1.01	1.56	1.28	1.04	1.58
Never married	1.94	1.48	2.56	1.96	1.51	2.54
Region (West):						
Northeast	1.01	0.80	1.28	0.97	0.79	1.20
Midwest.	0.83	0.68	1.02	0.85	0.70	1.04
South.	0.99	0.82	1.19	0.95	0.80	1.12

NOTES: CI is confidence interval. Relative risks are estimated from a Cox proportional hazards model. All models adjust for sample weights and the National Health Interview Survey complex survey design using the SUDAAN software program (11.0). Values in parentheses are reference categories.

SOURCE: NCHS, National Health Interview Survey, linked mortality files.

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