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# Age adjustment of diabetes prevalence: Use of 2010 US Census data*

**Chaoyang LI**[1], **Earl S. FORD**[2], **Guixiang ZHAO**[2], **Xiao-Jun WEN**[1], **Carol A. GOTWAY**[2]

[1]Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[2]Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

## Abstract

**Background:** There is a growing interest in using the 2010 US Census data for age adjustment after the Census data are officially released. This report discusses the rationale, procedures, demonstrations, and caveats of age adjustment using the 2010 US Census data.

**Methods:** Empirical data from the Behavioral Risk Factor Surveillance System and the 2010 US Census age composition were used in demonstrations of computing the age-adjusted prevalence of diagnosed diabetes by race/ethnicity, across various geographic regions, and over time.

**Results:** The use of the 2010 US Census data yielded higher age-adjusted prevalence of diagnosed diabetes than using the 2000 projected US population data. The differences persisted across geographic regions, among racial/ethnic groups, and over time. Sixteen age compositions were generated to facilitate the use of the 2010 Census data in age adjustment. The SAS survey procedures and SUDAAN software programs yielded similar age-adjusted prevalence estimates of diagnosed diabetes.

**Conclusions:** Using the 2010 US Census data tends to yield a higher age-adjusted measure than using the 2000 projected US population data. Consistent use of a standard population and age composition is recommended once they are chosen for age adjustment.

### Keywords

age adjustment; Behavioral Risk Factor Surveillance System; diabetes; the 2010 US Census data

## Introduction

Public health professionals and data analysts often need to compare the rates (e.g. mortality, incidence, or prevalence) of chronic diseases or conditions (e.g. cardiovascular disease,

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**Correspondence:** Chaoyang Li, 4770 Buford Highway, MS F60, Atlanta, GA 30341, USA. Fax: +1 770 488 1538, cli@cdc.gov.

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cancer, diabetes, and metabolic syndrome) or health risk factors (e.g. smoking, heavy drinking, and physical inactivity) and to compare the means of health indicators measured on a continuous scale (e.g. body mass index, blood pressure, and blood cholesterol concentrations) across various racial/ethnic groups, over time, or across different geographic regions. Age has been recognized as the most important non-modifiable risk factor for many causes of death and for incidence and prevalence of many chronic diseases or conditions.[1] Age compositions may differ among various subpopulations, across different geographic regions, and over time.[2] Therefore, the aim of direct age adjustment is to apply observed age-specific estimates of a measure to age composition of a hypothetical 'standard' population to eliminate differences in crude measures in the populations of interest that result from differences in the age composition of the populations.

The 2000 projected US population data have been recommended as a standard population for computing age-adjusted (or age-standardized) death rates and indicators in Healthy People 2010 in the United States in the past decade.[3–5] There is growing interest in using the 2010 US Census data for age adjustment after the census data are officially released. Furthermore, it may be more realistic to use the 2010 US Census data for age-adjustment because they represent the most recent actual age compositions of the US population. Therefore, the objective of this report was to discuss the rationale and procedures of computing age-adjusted measures using the 2010 US Census data as a standard population, and to illustrate the differences in age-adjusted estimates that results from using different standard populations. Data from the Behavioral Risk Factor Surveillance System (BRFSS) were used in demonstrations of computing the age-adjusted prevalence of diagnosed diabetes by race/ethnicity, across various geographic regions, and over time.

## Methods

### Data

The summary data of the 2010 US Census were obtained from the US Census Bureau.[6] According to the 2010 Census data, the US population increased by 9.7% from the year 2000 (281.4 million) to the year 2010 (308.7 million).[2] The median age increased from 35.3 years in 2000 to 37.2 years in 2010. The population grew faster among the older ages than among the younger ages.[2]

Empirical data from the BRFSS, a cross-sectional telephone survey conducted by the Centers for Disease Control and Prevention (CDC) and state health departments, were used to compute age-adjusted prevalence. The BRFSS uses a multistage cluster design that is based on random digit dialing to select a representative sample from each state's civilian non-institutionalized adults aged 18 years or older. Diabetes status was determined by asking participants, 'Have you ever been told by a doctor that you have diabetes?' Responses were coded as follows: 1, yes; 2, yes, but female told only during pregnancy (i.e. gestational diabetes); 3, no; 7, don't know/not sure; or 9, refused during 1995−2003. An additional response 4 ('no, prediabetes or borderline diabetes') was added to the questionnaire during 2004−2010. Gestational diabetes and prediabetes were considered as 'no' diabetes. A detailed description of the BRFSS survey design and sampling procedures is available elsewhere.[7]

### Direct age adjustment

In epidemiologic studies, two methods of age adjustment are used, namely direct and indirect age adjustment.[3,4] In this report, we focus on direct age adjustment. Both an external population age composition and the internal age composition of available sample data can be used as a hypothetical 'standard' population age composition to eliminate the effects of any differences in age composition on the measures between the two or more populations being compared. The equation summarizing the computation of an age-adjusted measure (AAM)[3] is:

$$AAM = \sum_{i=1}^{k} (m_i \times w_{si}) \tag{1}$$

where $i$ through $k$ represents age groups, $m_i$ represents a statistic measure for age group $i$ (a rate or a mean), and $w_{si}$ represents a standard population age-adjustment weight in age group $i$. The variance of age-adjusted measure[3] is estimated as:

$$\text{var}(AAM) = \sum_{i=1}^{k} {w_{si}}^2 \times \text{var}(m_i) \tag{2}$$

### Data demonstration and analysis

We generated a master list and 16 age compositions for different age periods with population size and age adjustment weights based on the 2010 US Census data that are commonly used in major health data systems for Healthy People 2010 objectives.[5] Similar age composition structures as proposed in the report by Klein and Schoenborn[5] were used to maintain consistency. We demonstrated direct calculation of age-adjusted prevalence of diagnosed diabetes between non-Hispanic whites and Hispanics using the 2011 BRFSS data. We compared the trends in age-adjusted prevalence of diagnosed diabetes from 1995 to 2010 using the 2010 Census data and the 2000 projected US population as standard populations. We also compared the age-adjusted prevalence of diagnosed diabetes using the two age compositions across the 50 states and District of Columbia (DC).

The SUDAAN DESCRIPT (Release 10.0; Research Triangle Institute, Research Triangle Park, NC, USA) and SAS SURVEYREG (SAS version 9.3; SAS Institute, Cary, NC, USA) procedures were used for computing age-adjusted prevalence and standard errors and to account for the complex design of the BRFSS data. Sample weights were used to account for the varying probabilities of complex sampling design and non-response.

## Results

To facilitate use of the 2010 US Census data for age adjustment in various age periods and for different objectives, the 16 age compositions generated based on the master list are presented in Table 1. All other variations of age compositions may be created based on the master list (Appendix I), in which population size and age adjustment weights in single year and 5-year groups from age <1 year to ≥90 years are shown in males, females, and both sexes.

The direct calculations of age-adjusted prevalence and its standard error of diagnosed diabetes between non-Hispanic whites and Hispanics using Eqns 1 and 2 are illustrated in Table 2. The age composition #5 in Table 1 is selected for the illustration. The numbers in Columns A and F are crude prevalence rates of diagnosed diabetes in each age group among non-Hispanic whites and Hispanics, respectively. The numbers in Columns B and G are standard errors for crude prevalence rates of diagnosed diabetes in each age group among non-Hispanic whites and Hispanics, respectively. The numbers in Columns C and H are age-adjustment weights for each age group adopted from the age composition #5 in Table 2. The numbers in Columns D and I are computed using Eqn 1 in each age group, respectively. The numbers in Columns E and J are computed using the Eqn 2 in each age group, respectively. The age-adjusted prevalence of diagnosed diabetes among non-Hispanic whites is 8.1%, which is the sum of values in Column D in each age group. The standard error of age-adjusted prevalence of diagnosed diabetes among non-Hispanic whites is 0.07%, which is the square root of sum of values in Column E in each age group. Similarly, the age-adjusted prevalence of diagnosed diabetes and its standard error among Hispanics are 13.8% and 0.36%, respectively. Compared with the crude prevalence, the age-adjusted prevalence among non-Hispanic whites is lower than the non-adjusted prevalence (from 9.1% to 8.1%), whereas age-adjusted prevalence among Hispanics is higher than the non-adjusted prevalence (from 10.1% to 13.8%).

Crude and age-adjusted prevalences of diagnosed diabetes among adults from 1995 to 2010 using the annual BRFSS data are shown in Figure 1. The magnitude in age-adjusted prevalence of diagnosed diabetes using the 2010 US Census data was larger than that using the 2000 projected US population at each year of the BRFSS survey. However, the trend in age-adjusted prevalence appeared to be similar when two standard populations were used.

Crude and age-adjusted prevalences of diagnosed diabetes among adults across the 50 states and DC in 2010 are given in Table 3. The age-adjusted prevalences using the 2000 projected US population were lower than those estimated using the 2010 US Census data for all states and DC combined ($P < 0.0001$). The absolute difference in age-adjusted prevalence of diabetes among 50 states and DC ranged from 0.27% to 0.69% (all $P > 0.10$), and the relative difference ranged from 3.37% to 7.41%. The age-adjusted prevalence estimates of diagnosed diabetes by race/ethnicity using the SUDAAN DESCRIPT and SAS SURVEYREG procedures are identical (Appendix II). However, the standard errors of age-adjusted prevalence estimates differed slightly between the two software programs, which yielded slightly different 95% confidence intervals.

Examples of the SUDAAN DESCRIPT procedure for testing the linear and quadratic trends in age-adjusted prevalence during the 18 survey years (from 1995 to 2010) are illustrated in Appendix III. Examples of the SUDAAN DESCRIPT and SAS SURVEYREG procedures for computing age-adjusted prevalence by race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other) are illustrated in Appendices IV and V, respectively.

## Discussion

This report illustrates the use of a new alternative standard population for age adjustment using the 2010 US Census data. The master list of single year and 5-year age group population size and age-adjustment weights were provided to facilitate generation of a specific age composition to fulfill a special need. The selected 16 age compositions were generated to facilitate use of standard population for various objectives. Compared with results using the 2010 US Census data as the standard population, age-adjusted prevalence of diagnosed diabetes using the 2000 projected US population tend to be smaller in magnitude, although the overall trends over time appeared to be similar.

Age adjustment is common practice among health professionals. From the perspective of epidemiologic studies, age adjustment is a means of controlling for the possible confounding effects of age when age is associated with a health outcome (e.g. diagnosed diabetes or blood pressure) and there are differences in age compositions among subpopulations being compared. A crude rate reflects the 'absolute' disease burden in a region or a time period; it is useful for making health policies. An age-adjusted rate reflects the 'relative' disease burden when comparing two or more regions, time periods, or specific subpopulations based on a standard population; it is useful for evaluating program effects, secular trends, and disparities after eliminating the confounding effects of age. The use of an available standard population is to facilitate comparisons across different studies, in diverse populations, or over time.

The 2000 projected US population has been used as a standard population for age adjustment in the US in the past decade.[3–5] The use of a single age-adjustment standard by federal agencies may be helpful in facilitating comparisons of health indicators among federal and state health agencies.[3] In addition, the World Health Organization (WHO) has constructed a world standard population for age adjustment,[8] which has been used in European countries and other countries outside the US. Although there is no theoretical justification for using one population standard over another, using different standard populations may impact the magnitude and, to some extent, the trend of age-adjusted measures (e.g. death rates).[3,4] Consistent with previous reports,[3,4] our results suggest that using an earlier population age composition tends to yield a lower age-adjusted measure than using the most recent population age compositions. Because diabetes prevalence is higher among older people than among younger people,[2] using an earlier or younger population age composition with a lower proportion of older ages could yield a lower age-adjusted prevalence.

It is arbitrary whether to choose the 2010 US Census data, as suggested in this report, the 2000 projected US population,[5] the WHO world standard population,[8] or a specific standard population created by a health professional or data analyst. However, there are several considerations when one chooses a standard population for computing age-adjusted measures. First, because age-adjusted measures using different standard population are not comparable, a standard population should be used consistently in all comparisons once it is chosen. Second, a standard population should have a similar age composition as the study population. A standard population with abnormal or unnatural age composition relative to the study population should be avoided. Therefore, one of the selected 16 age compositions with a reasonable age structure according to the sample size and crude prevalence (or mean) estimates in each age group could be used for age adjustment in the US. Third, a pooled standard population may be used when comparing measures across different countries to minimize variance. The WHO world standard population accounts for the average age composition structure of the world population and time series of observation and eliminates the impact of historical events, such as wars and famine, on the age composition of certain populations.[8] Therefore, a pooled standard population of two or more countries or the WHO world standard population may be used as a standard population when one compares measures between two or more countries.

It is of note that both the SUDAAN DESCRIPT and SAS SURVEYREG procedures yielded identical age-adjusted prevalence estimates of diagnosed diabetes but slightly different standard errors for the prevalence estimates. It has been shown that when the analysis includes all participants with no missing data for all analytic variables and the Taylor variance estimation method is used, SUDAAN and SAS survey procedures yield identical estimates.[9] However, when certain strata have only one primary sampling unit or cluster, SUDAAN and SAS survey procedures may yield different results because the two software programs use different variance estimation methods: SUDAAN uses the difference between the stratum's value and the overall population mean to estimate the variance, whereas SAS estimates the variance by zero.[9]

It is worth commenting on the caveats for age adjustment. First, an age-adjusted measure is a hypothetical measure. It does not reflect the actual status in the populations. However, an age-adjusted measure could be useful to evaluate the effects of health risks other than age on the health outcome among subpopulations or over time. Second, age-adjusted measures may mask interesting differences in age-specific measures. For example, if there is an age by time interaction, it is inappropriate to report age-adjusted rates or means.[10] Instead, age-specific trends may be reported separately when an age by time interaction exits. Third, age-adjusted measures may not be comparable when different population standard or age composition structures are used. Applying different population standards or age composition to the same data could result in different results and interpretations. Thus, it is imperative and critical to ensure the use of identical standard populations when comparing age-adjusted health indicators between state and federal agencies, among subpopulations, across data systems, or over time.

In conclusion, direct age adjustment is a common practice in public health data analysis and epidemiologic studies. It requires selection of a standard population. The same standard population and age composition should be used consistently once they are chosen. The 2000 projected US population recommended by the National Center for Health Statistics has been used in the US in the past decade. With the official release of the 2010 Census data, there is a growing interest in using the most recent population data as a standard population for age adjustment in health survey data analysis. For readers who are interested in using the most recent age compositions to adjust their data for age, this report demonstrates the use of the 2010 US Census age composition and provides detailed procedures on how to compute age-adjusted measures.

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## Appendix I: Master list: The 2010 US Census population and age-adjustment weights

| | Both sexes | | Male | | Female | |
|---|---|---|---|---|---|---|
| **Age** | **Population** | **Adjustment weight** | **Population** | **Adjustment weight** | **Population** | **Adjustment weight** |
| **Total population (all ages)** | **308 745 538** | **1.000000** | **151 781 326** | **1.000000** | **156 964 212** | **1.000000** |
| **Under 5 years** | **20 201 362** | **0.065430** | **10 319 427** | **0.067989** | **9 881 935** | **0.062957** |
| Under 1 year | 3 944 153 | 0.012775 | 2 014 276 | 0.013271 | 1 929 877 | 0.012295 |
| 1 year | 3 978 070 | 0.012885 | 2 030 853 | 0.013380 | 1 947 217 | 0.012405 |
| 2 years | 4 096 929 | 0.013270 | 2 092 198 | 0.013784 | 2 004 731 | 0.012772 |
| 3 years | 4 119 040 | 0.013341 | 2 104 550 | 0.013866 | 2 014 490 | 0.012834 |
| 4 years | 4 063 170 | 0.013160 | 2 077 550 | 0.013688 | 1 985 620 | 0.012650 |
| **5–9 years** | **20 348 657** | **0.065908** | **10 389 638** | **0.068451** | **9 959 019** | **0.063448** |
| 5 years | 4 056 858 | 0.013140 | 2 072 094 | 0.013652 | 1 984 764 | 0.012645 |
| 6 years | 4 066 381 | 0.013171 | 2 075 319 | 0.013673 | 1 991 062 | 0.012685 |
| 7 years | 4 030 579 | 0.013055 | 2 057 076 | 0.013553 | 1 973 503 | 0.012573 |
| 8 years | 4 046 486 | 0.013106 | 2 065 453 | 0.013608 | 1 981 033 | 0.012621 |
| 9 years | 4 148 353 | 0.013436 | 2 119 696 | 0.013965 | 2 028 657 | 0.012924 |
| **10–14 years** | **20 677 194** | **0.066972** | **10 579 862** | **0.069705** | **10 097 332** | **0.064329** |
| 10 years | 4 172 541 | 0.013514 | 2 135 996 | 0.014073 | 2 036 545 | 0.012975 |
| 11 years | 4 114 415 | 0.013326 | 2 103 264 | 0.013857 | 2 011 151 | 0.012813 |
| 12 years | 4 106 243 | 0.013300 | 2 100 145 | 0.013837 | 2 006 098 | 0.012781 |
| 13 years | 4 118 013 | 0.013338 | 2 104 914 | 0.013868 | 2 013 099 | 0.012825 |
| 14 years | 4 165 982 | 0.013493 | 2 135 543 | 0.014070 | 2 030 439 | 0.012936 |
| **15 to 19 years** | **22 040 343** | **0.071387** | **11 303 666** | **0.074473** | **10 736 677** | **0.068402** |
| 15 years | 4 242 820 | 0.013742 | 2 177 022 | 0.014343 | 2 065 798 | 0.013161 |
| 16 years | 4 316 139 | 0.013980 | 2 216 034 | 0.014600 | 2 100 105 | 0.013380 |
| 17 years | 4 395 295 | 0.014236 | 2 263 153 | 0.014911 | 2 132 142 | 0.013584 |
| 18 years | 4 500 855 | 0.014578 | 2 305 473 | 0.015189 | 2 195 382 | 0.013987 |
| 19 years | 4 585 234 | 0.014851 | 2 341 984 | 0.015430 | 2 243 250 | 0.014291 |
| **20–24 years** | **21 585 999** | **0.069915** | **11 014 176** | **0.072566** | **10 571 823** | **0.067352** |
| 20 years | 4 519 129 | 0.014637 | 2 308 319 | 0.015208 | 2 210 810 | 0.014085 |
| 21 years | 4 354 294 | 0.014103 | 2 223 198 | 0.014647 | 2 131 096 | 0.013577 |
| 22 years | 4 264 642 | 0.013813 | 2 177 797 | 0.014348 | 2 086 845 | 0.013295 |
| 23 years | 4 198 571 | 0.013599 | 2 140 799 | 0.014104 | 2 057 772 | 0.013110 |
| 24 years | 4 249 363 | 0.013763 | 2 164 063 | 0.014258 | 2 085 300 | 0.013285 |
| **25–29 years** | **21 101 849** | **0.068347** | **10 635 591** | **0.070072** | **10 466 258** | **0.066679** |
| 25 years | 4 262 350 | 0.013805 | 2 161 308 | 0.014240 | 2 101 042 | 0.013385 |
| 26 years | 4 152 305 | 0.013449 | 2 097 088 | 0.013817 | 2 055 217 | 0.013094 |
| 27 years | 4 248 869 | 0.013762 | 2 140 651 | 0.014104 | 2 108 218 | 0.013431 |
| 28 years | 4 215 249 | 0.013653 | 2 118 605 | 0.013958 | 2 096 644 | 0.013357 |
| 29 years | 4 223 076 | 0.013678 | 2 117 939 | 0.013954 | 2 105 137 | 0.013412 |

| Age | Both sexes | | Male | | Female | |
|---|---|---|---|---|---|---|
| | Population | Adjustment weight | Population | Adjustment weight | Population | Adjustment weight |
| **30–34 years** | **19 962 099** | **0.064656** | **9 996 500** | **0.065861** | **9 965 599** | **0.063490** |
| 30 years | 4 285 668 | 0.013881 | 2 160 802 | 0.014236 | 2 124 866 | 0.013537 |
| 31 years | 3 970 218 | 0.012859 | 1 988 155 | 0.013099 | 1 982 063 | 0.012627 |
| 32 years | 3 986 847 | 0.012913 | 1 994 476 | 0.013140 | 1 992 371 | 0.012693 |
| 33 years | 3 880 150 | 0.012567 | 1 936 863 | 0.012761 | 1 943 287 | 0.012380 |
| 34 years | 3 839 216 | 0.012435 | 1 916 204 | 0.012625 | 1 923 012 | 0.012251 |
| **35–39 years** | **20 179 642** | **0.065360** | **10 042 022** | **0.066161** | **10 137 620** | **0.064586** |
| 35 years | 3 956 434 | 0.012815 | 1 980 916 | 0.013051 | 1 975 518 | 0.012586 |
| 36 years | 3 802 087 | 0.012315 | 1 890 595 | 0.012456 | 1 911 492 | 0.012178 |
| 37 years | 3 934 445 | 0.012743 | 1 953 386 | 0.012870 | 1 981 059 | 0.012621 |
| 38 years | 4 121 880 | 0.013350 | 2 049 720 | 0.013504 | 2 072 160 | 0.013201 |
| 39 years | 4 364 796 | 0.014137 | 2 167 405 | 0.014280 | 2 197 391 | 0.013999 |
| **40–44 years** | **20 890 964** | **0.067664** | **10 393 977** | **0.068480** | **10 496 987** | **0.066875** |
| 40 years | 4 383 274 | 0.014197 | 2 191 249 | 0.014437 | 2 192 025 | 0.013965 |
| 41 years | 4 114 985 | 0.013328 | 2 047 818 | 0.013492 | 2 067 167 | 0.013170 |
| 42 years | 4 076 104 | 0.013202 | 2 028 653 | 0.013366 | 2 047 451 | 0.013044 |
| 43 years | 4 105 105 | 0.013296 | 2 035 990 | 0.013414 | 2 069 115 | 0.013182 |
| 44 years | 4 211 496 | 0.013641 | 2 090 267 | 0.013772 | 2 121 229 | 0.013514 |
| **45–49 years** | **22 708 591** | **0.073551** | **11 209 085** | **0.073850** | **11 499 506** | **0.073262** |
| 45 years | 4 508 868 | 0.014604 | 2 237 450 | 0.014741 | 2 271 418 | 0.014471 |
| 46 years | 4 519 761 | 0.014639 | 2 230 982 | 0.014699 | 2 288 779 | 0.014582 |
| 47 years | 4 535 265 | 0.014689 | 2 238 248 | 0.014747 | 2 297 017 | 0.014634 |
| 48 years | 4 538 796 | 0.014701 | 2 237 734 | 0.014743 | 2 301 062 | 0.014660 |
| 49 years | 4 605 901 | 0.014918 | 2 264 671 | 0.014921 | 2 341 230 | 0.014916 |
| **50–54 years** | **22 298 125** | **0.072222** | **10 933 274** | **0.072033** | **11 364 851** | **0.072404** |
| 50 years | 4 660 295 | 0.015094 | 2 300 354 | 0.015156 | 2 359 941 | 0.015035 |
| 51 years | 4 464 631 | 0.014461 | 2 190 766 | 0.014434 | 2 273 865 | 0.014487 |
| 52 years | 4 500 846 | 0.014578 | 2 207 246 | 0.014542 | 2 293 600 | 0.014612 |
| 53 years | 4 380 354 | 0.014188 | 2 141 354 | 0.014108 | 2 239 000 | 0.014264 |
| 54 years | 4 291 999 | 0.013901 | 2 093 554 | 0.013793 | 2 198 445 | 0.014006 |
| **55–59 years** | **19 664 805** | **0.063693** | **9 523 648** | **0.062746** | **10 141 157** | **0.064608** |
| 55 years | 4 254 709 | 0.013781 | 2 073 473 | 0.013661 | 2 181 236 | 0.013896 |
| 56 years | 4 037 513 | 0.013077 | 1 956 141 | 0.012888 | 2 081 372 | 0.013260 |
| 57 years | 3 936 386 | 0.012750 | 1 905 355 | 0.012553 | 2 031 031 | 0.012939 |
| 58 years | 3 794 928 | 0.012291 | 1 834 808 | 0.012088 | 1 960 120 | 0.012488 |
| 59 years | 3 641 269 | 0.011794 | 1 753 871 | 0.011555 | 1 887 398 | 0.012024 |
| **60–64 years** | **16 817 924** | **0.054472** | **8 077 500** | **0.053218** | **8 740 424** | **0.055684** |
| 60 years | 3 621 131 | 0.011729 | 1 745 507 | 0.011500 | 1 875 624 | 0.011949 |
| 61 years | 3 492 596 | 0.011312 | 1 679 077 | 0.011062 | 1 813 519 | 0.011554 |
| 62 years | 3 563 182 | 0.011541 | 1 712 692 | 0.011284 | 1 850 490 | 0.011789 |

| Age | Both sexes | | Male | | Female | |
|---|---|---|---|---|---|---|
| | Population | Adjustment weight | Population | Adjustment weight | Population | Adjustment weight |
| 63 years | 3 483 884 | 0.011284 | 1 672 329 | 0.011018 | 1 811 555 | 0.011541 |
| 64 years | 2 657 131 | 0.008606 | 1 267 895 | 0.008353 | 1 389 236 | 0.008851 |
| **65–69 years** | **12 435 263** | **0.040277** | **5 852 547** | **0.038559** | **6 582 716** | **0.041938** |
| 65 years | 2 680 761 | 0.008683 | 1 273 310 | 0.008389 | 1 407 451 | 0.008967 |
| 66 years | 2 639 141 | 0.008548 | 1 248 276 | 0.008224 | 1 390 865 | 0.008861 |
| 67 years | 2 649 365 | 0.008581 | 1 248 906 | 0.008228 | 1 400 459 | 0.008922 |
| 68 years | 2 323 672 | 0.007526 | 1 087 296 | 0.007164 | 1 236 376 | 0.007877 |
| 69 years | 2 142 324 | 0.006939 | 994 759 | 0.006554 | 1 147 565 | 0.007311 |
| **70–74 years** | **9 278 166** | **0.030051** | **4 243 972** | **0.027961** | **5 034 194** | **0.032072** |
| 70 years | 2 043 121 | 0.006617 | 945 611 | 0.006230 | 1 097 510 | 0.006992 |
| 71 years | 1 949 323 | 0.006314 | 900 148 | 0.005931 | 1 049 175 | 0.006684 |
| 72 years | 1 864 275 | 0.006038 | 853 726 | 0.005625 | 1 010 549 | 0.006438 |
| 73 years | 1 736 960 | 0.005626 | 787 863 | 0.005191 | 949 097 | 0.006047 |
| 74 years | 1 684 487 | 0.005456 | 756 624 | 0.004985 | 927 863 | 0.005911 |
| **75–79 years** | **7 317 795** | **0.023702** | **3 182 388** | **0.020967** | **4 135 407** | **0.026346** |
| 75 years | 1 620 077 | 0.005247 | 721 008 | 0.004750 | 899 069 | 0.005728 |
| 76 years | 1 471 070 | 0.004765 | 647 804 | 0.004268 | 823 266 | 0.005245 |
| 77 years | 1 455 330 | 0.004714 | 631 884 | 0.004163 | 823 446 | 0.005246 |
| 78 years | 1 400 123 | 0.004535 | 602 458 | 0.003969 | 797 665 | 0.005082 |
| 79 years | 1 371 195 | 0.004441 | 579 234 | 0.003816 | 791 961 | 0.005045 |
| **80–84 years** | **5 743 327** | **0.018602** | **2 294 374** | **0.015116** | **3 448 953** | **0.021973** |
| 80 years | 1 308 511 | 0.004238 | 543 559 | 0.003581 | 764 952 | 0.004873 |
| 81 years | 1 212 865 | 0.003928 | 494 870 | 0.003260 | 717 995 | 0.004574 |
| 82 years | 1 161 421 | 0.003762 | 462 983 | 0.003050 | 698 438 | 0.004450 |
| 83 years | 1 074 809 | 0.003481 | 419 831 | 0.002766 | 654 978 | 0.004173 |
| 84 years | 985 721 | 0.003193 | 373 131 | 0.002458 | 612 590 | 0.003903 |
| **85–89 years** | **3 620 459** | **0.011726** | | **0.008393** | **2 346 592** | **0.014950** |
| 85 years | 914 723 | 0.002963 | 336 819 | 0.002219 | 577 904 | 0.003682 |
| 86 years | 814 211 | 0.002637 | 293 120 | 0.001931 | 521 091 | 0.003320 |
| 87 years | 712 908 | 0.002309 | 249 803 | 0.001646 | 463 105 | 0.002950 |
| 88 years | 640 619 | 0.002075 | 217 436 | 0.001433 | 423 183 | 0.002696 |
| 89 years | 537 998 | 0.001743 | 176 689 | 0.001164 | 361 309 | 0.002302 |
| **90 years and over** | **1 872 974** | **0.006066** | **515 812** | **0.001671** | **1 357 162** | **0.004396** |

Bolded values indicate the total or subtotal numbers by age groups.

Note, the 2010 US Census population data are available from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_QTP2&prodType=table (accessed 12 December 2012).

When using the master list to generate additional age composition categories not presented in Table 2, the age-adjustment weights need to be recalculated using the appropriate subtotals as denominator and the adjustment weight must add to 1.

## Appendix II: Comparison of age-adjusted prevalence estimates of diagnosed diabetes between SUDAAN and SAS, the 2011 Behavioral Risk Factor Surveillance System

| | SUDAAN PROC DESCRIPT | | | SAS PROC SURVEYREG | | |
|---|---|---|---|---|---|---|
| Race/ ethnicity | Diabetes (%) | SE | 95% CI | Diabetes (%) | SE | 95% CI |
| NH white | 8.117509 | 0.072688 | 7.975041–8.259977 | 8.117509 | 0.072688 | 7.975040–8.259978 |
| NH black | 14.870951 | 0.298228 | 14.286424–15.455478 | 14.870951 | 0.298238 | 14.286403–15.455498 |
| Hispanic | 13.807271 | 0.360795 | 13.100113–14.514429 | 13.807271 | 0.360782 | 13.100138–14.514404 |
| NH other | 10.939010 | 0.400601 | 10.153832–11.724188 | 10.939010 | 0.400610 | 10.153814–11.724206 |

NH, non-Hispanic; SE, standard error; CI, confidence interval.

## Appendix III: SUDAAN codes for testing linear and quadratic trends in age-adjusted prevalence using the 2010 US Census population age-adjustment weights over survey years, Behavioral Risk Factor Surveillance System 1995–2010

```
proc descript data=dmtrend filetype=SAS design=wr;
NEST survyear _STSTR _PSU/psulev=3 MISSUNIT; /* note 1 */
WEIGHT _finalwt; /* note 2 */
var  DM;
catlevel 1; /* note 3 */
subgroup survyear sex agedist10 race4 DM;
level 18  2  7    4 2;
tables sex;
stdvar agedist10;
stdwgt 0.220724 0.171133 0.185875 0.178898 0.124713 0.070752
  0.047905;
/* note 4 */
poly survyear=2; /* note 5 */
subpopn age>=18 & _state<=56;
setenv rowwidth = 2 colwidth = 10 rowspce=0 colspce=2
  topmgn=0
pagesize=60;
print nsum PERCENT SEPERCENT T_pct P_pct/nsumfmt = F10.0
PERCENTfmt = F20.8 SEPERCENTfmt = F20.8 style=NCHS;
title ‘Test for linear and quadratic trends in the prevalence of
   self-reported diabetes by survey year, age-adjustment using
   2010 US Census population’;
run;
```

Note 1: survyear = survey year, an indicator variable representing survey year 1 = 1995, 2 = 1996, 3 = 1997, …, 18 = 2010. The survey year variable is included in the ‘NEST’ statement to obtain appropriate variance estimates.

Note 2: _finalwt = sample weights. The original sample weights in each year are used. This sampling weight reflected landline survey only.

Note 3: catlevel statement can be omitted for continuous variables, just put the variable in the var statement (e.g. ‘var BP’; here, BP stands for blood pressure).

Note 4: either age-adjusted weights or the sample size can be used in this statement.

Note 5: poly statement specifies orthogonal polynomial contrast for linear or quadratic trends.

## Appendix IV: SUDAAN codes for computing age-adjusted by race/ethnicity using the 2010 US Census population age-adjustment weights, the 2011 Behavioral Risk Factor Surveillance System

```
proc descript data=brfss11 filetype=SAS design=wr;
nest _STSTR _PSU/missunit;
weight _LLCPWT; /* Note 1 */
var     DM;
catlevel 1;
subgroup   sex agedist10 race4;
level  2   7     4;
tables race4;
stdvar agedist10;
stdwgt 0.220724 0.171133 0.185875 0.178898 0.124713 0.070752
0.047905;
subpopn anasamp=2;
setenv rowwidth = 2 colwidth = 10 rowspce=0 colspce=2
topmgn=0 pagesize=60;
print nsum=‘SAMPLE SIZE’ percent=‘PERCENT’ sepercent=‘S.E.’
/nsumfmt = F6.0 wsumfmt = F10.0 percentfmt = F10.6
sepercentfmt = F10.6 style=NCHS;
title ‘Prevalence of diagnosed diabetes by race/ethnicity,
age-adjustment using the 2010 US Census population’;
run;
```

Note 1: the sampling weight reflected landline and cellphone surveys combined.

## Appendix V: SAS codes for computing age-adjusted prevalence by race/ethnicity using the 2010 US Census population age-adjustment weights, the 2011 Behavioral Risk Factor Surveillance System

```
PROC SURVEYREG DATA=brfss11 order=internal;
strata _STSTR ;
cluster _PSU;
weight _LLCPWT;
class race4 agedist10;
model DM01 = race4 * agedist10/NOINT SOLUTION CLPARM;/*
note 1 */
domain anasamp;
estimate ‘Age-adjusted DM %, White’ race4 * agedist10
22.0724 17.1133 18.5875 17.8898 12.4713 7.0752 4.7905
0 0 0 0 0 0 0  0 0 0 0 0 0 0  0 0 0 0 0 0 0;
estimate ‘Age-adjusted DM %, Black’ race4 * agedist10
0 0 0 0 0 0 0  22.0724 17.1133 18.5875 17.8898 12.4713 7.0752
4.7905  0 0 0 0 0 0 0  0 0 0 0 0 0 0;
estimate ‘Age-adjusted DM %, Hispanics’ race4 * agedist10
0 0 0 0 0 0 0 0 0 0 0 0 0 0
22.0724 17.1133 18.5875 17.8898 12.4713 7.0752 4.7905
0 0 0 0 0 0 0;
estimate ‘Age-adjusted DM %, Other’ race4 * agedist10
0 0 0 0 0 0 0  0 0 0 0 0 0 0  0 0 0 0 0 0 0
22.0724 17.1133 18.5875 17.8898 12.4713 7.0752 4.7905;
title ‘Age-adjusted % of diabetes by race, age composition #5,
SAS SURVEYREG, BRFSS 2011’;
run;
```

Note 1: DM01, diagnosed diabetes status coded as 1 = yes, 0 = no.

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**Significant findings of the study:**

This methodological guide provides detailed steps as to how to perform age adjustments of diabetes prevalence using the 2010 US Census population data. It also highlights the importance of using selected standard population for computing age-adjusted rates.

**What this study adds:**

This is the first study that demonstrates the use of the 2010 US Census population data for age adjustment when comparing diabetes prevalence by time, region, and subpopulations.

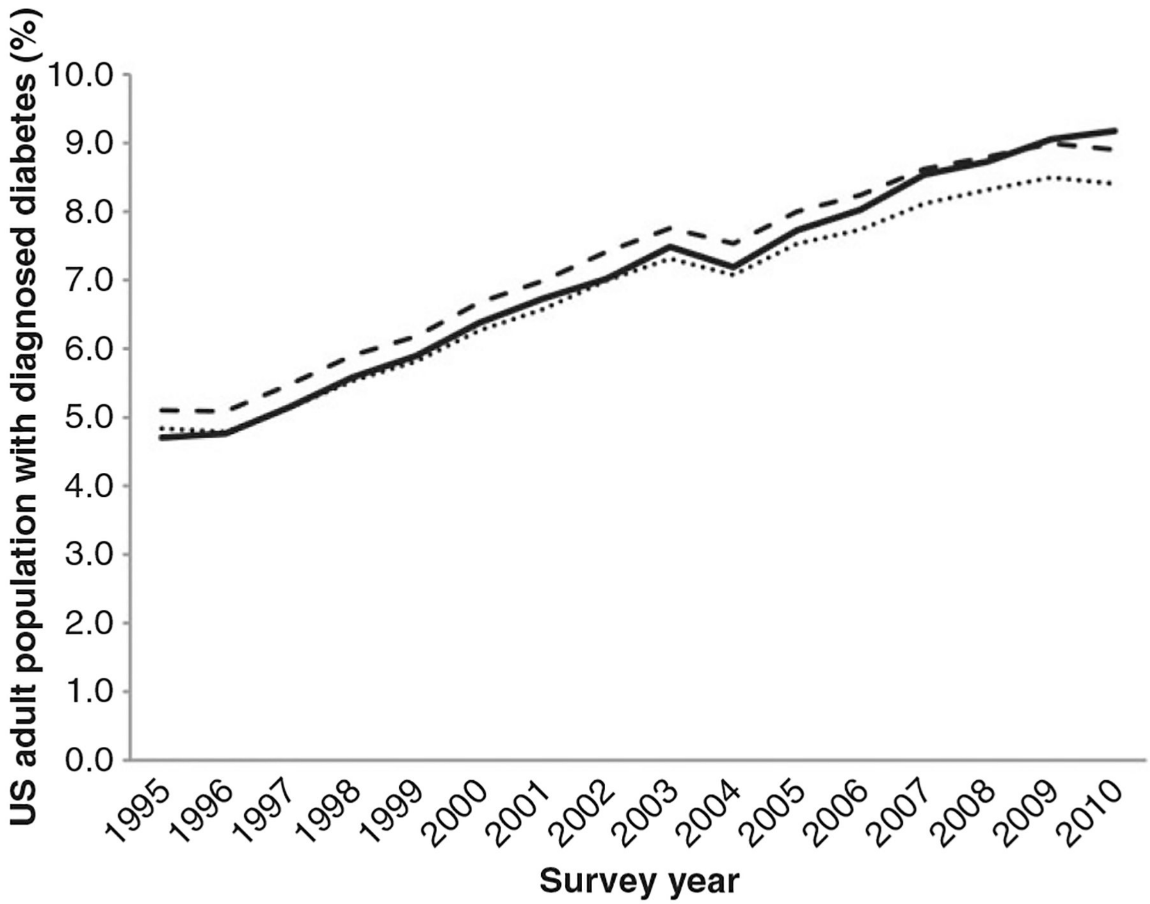


**Figure 1.**

Trends of diabetes prevalence among adults aged ≥18 years in the US, Behavioral Risk Factor Surveillance System 1995–2010. (---), crude prevalence (linear trend: $t = 71.5$, $P < 0.0001$); (·····), age-adjusted prevalence using the 2000 projected US population (linear trend: $t = 62.0$, $P < 0.0001$); (-----), age-adjusted prevalence using the 2010 US Census population (linear trend: $t = 62.6$, $P < 0.0001$).

## Table 1

Selected age compositions and age-adjustment weights based on the 2010 US census summary population data

| Age | Population | Adjustment weight | Age | Population | Adjustment weight |
|---|---|---|---|---|---|
| **Composition #1** | | | **Composition #2** | | |
| **All ages** | **308 745 538** | **1.000000** | **All ages** | **308 745 538** | **1.000000** |
| <12 years | 48 836 975 | 0.158179 | <18 years | 74 181 467 | 0.240267 |
| 12–19 years | 34 430 581 | 0.111518 | 18–44 years | 112 806 642 | 0.365371 |
| 20–29 years | 42 687 848 | 0.138262 | 45–64 years | 81 489 445 | 0.263937 |
| 30–39 years | 40 141 741 | 0.130016 | 65–74 years | 21 713 429 | 0.070328 |
| 40–49 years | 43 599 555 | 0.141215 | ≥75 years | 18 554 555 | 0.060097 |
| 50–59 years | 41 962 930 | 0.135914 | | | |
| 60–69 years | 29 253 187 | 0.094749 | | | |
| 70–79 years | 16 595 961 | 0.053753 | | | |
| ≥80 years | 11 236 760 | 0.036395 | | | |
| **Composition #3** | | | **Composition #4** | | |
| **≥2 years** | **300 823 315** | **1.000000** | **≥2 years** | **300 823 315** | **1.000000** |
| 2–5 years | 16 335 997 | 0.054304 | 2–17 years | 66 259 244 | 0.220260 |
| 6–11 years | 24 578 755 | 0.081705 | 18–44 years | 112 806 642 | 0.374993 |
| 12–19 years | 34 430 581 | 0.114454 | 45–64 years | 81 489 445 | 0.270888 |
| 20–29 years | 42 687 848 | 0.141903 | 65–74 years | 21 713 429 | 0.072180 |
| 30–39 years | 40 141 741 | 0.133440 | ≥75 years | 18 554 555 | 0.061679 |
| 40–49 years | 43 599 555 | 0.144934 | | | |
| 50–59 years | 41 962 930 | 0.139494 | | | |
| 60–69 years | 29 253 187 | 0.097244 | | | |
| 70–79 years | 16 595 961 | 0.055168 | | | |
| ≥80 years | 11 236 760 | 0.037353 | | | |
| **Composition #5** | | | **Composition #6** | | |
| **≥18 years** | **234 564 071** | **1.000000** | **≥18 years** | **234 564 071** | **1.000000** |
| 18–29 years | 51 773 937 | 0.220724 | 18–24 years | 30 672 088 | 0.130762 |
| 30–39 years | 40 141 741 | 0.171133 | 25–34 years | 41 063 948 | 0.175065 |
| 40–49 years | 43 599 555 | 0.185875 | 35–44 years | 41 070 606 | 0.175093 |

| Age | Population | Adjustment weight | Age | Population | Adjustment weight |
|---|---|---|---|---|---|
| 50–59 years | 41 962 930 | 0.178898 | 45–64 years | 81 489 445 | 0.347408 |
| 60–69 years | 29 253 187 | 0.124713 | ≥65 years | 40 267 984 | 0.171672 |
| 70–79 years | 16 595 961 | 0.070752 | | | |
| ≥80 years | 11 236 760 | 0.047905 | | | |
| **Composition #7** | | | **Composition #8** | | |
| **≥20 years** | **225 477 982** | **1.000000** | **≥20 years** | **225 477 982** | **1.000000** |
| 20–29 years | 42 687 848 | 0.189322 | 20–44 years | 103 720 553 | 0.460003 |
| 30–39 years | 40 141 741 | 0.178030 | 45–64 years | 81 489 445 | 0.361408 |
| 40–49 years | 43 599 555 | 0.193365 | ≥65 years | 40 267 984 | 0.178589 |
| 50–59 years | 41 962 930 | 0.186107 | | | |
| 60–69 years | 29 253 187 | 0.129739 | | | |
| 70–79 years | 16 595 961 | 0.073603 | | | |
| ≥80 years | 11 236 760 | 0.049835 | | | |
| **Composition #9** | | | **Composition #10** | | |
| **≥25 years** | **203 891 983** | **1.000000** | **≥40 years** | **142 648 393** | **1.000000** |
| 25–34 years | 41 063 948 | 0.201401 | 40–49 years | 43 599 555 | 0.305644 |
| 35–44 years | 41 070 606 | 0.201433 | 50–64 years | 58 780 854 | 0.412068 |
| 45–64 years | 81 489 445 | 0.399670 | ≥65 years | 40 267 984 | 0.282288 |
| ≥65 years | 40 267 984 | 0.197497 | | | |
| **Composition #11** | | | **Composition #12** | | |
| **≥45 years** | **121 757 429** | **1.000000** | **≥50 years** | **99 048 838** | **1.000000** |
| 45–49 years | 22 708 591 | 0.186507 | 50–64 years | 58 780 854 | 0.593453 |
| 50–64 years | 58 780 854 | 0.482770 | ≥65 years | 40 267 984 | 0.406547 |
| ≥65 years | 40 267 984 | 0.330723 | | | |
| **Composition #13** | | | **Composition #14** | | |
| **≥65 years** | **40 267 984** | **1.000000** | **<65 years** | **268 477 554** | **1.000000** |
| 65–74 years | 21 713 429 | 0.539223 | <18 years | 74 181 467 | 0.276304 |
| ≥75 years | 18 554 555 | 0.460777 | 18–44 years | 112 806 642 | 0.420172 |
| | | | 45–64 years | 81 489 445 | 0.303524 |
| **Composition #15** | | | **Composition #16** | | |
| **18–64 years** | **194 296 087** | **1.000000** | **<18 years** | **74 181 467** | **1.000000** |

| **Age** | **Population** | **Adjustment weight** | **Age** | **Population** | **Adjustment weight** |
|---|---|---|---|---|---|
| 18–24 years | 30 672 088 | 0.157863 | <5 years | 20 201 362 | 0.272324 |
| 25–34 years | 41 063 948 | 0.211347 | 5–11 years | 28 635 613 | 0.386021 |
| 35–44 years | 41 070 606 | 0.211382 | 12–17 years | 25 344 492 | 0.341655 |
| 45–64 years | 81 489 445 | 0.419409 | | | |

Bolded values indicate the total or subtotal numbers by age groups.

## Table 2

Direct calculation of age-adjusted prevalence of diabetes between non-Hispanic whites and Hispanics, 2011 Behavioral Risk Factor Surveillance System

| | Non-Hispanic whites | | | | | Hispanics | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Diabetes | | | | | Diabetes | | | | |
| | % | SE | Age-adjustment weight | A × C | $B^2 \times C^2$ | % | SE | Age-adjustment weight | F × H | $G^2 \times H^2$ |
| Age (years) | A | B | C | D | E | F | G | H | I | J |
| 18–29 | 1.1 | 0.1 | 0.220724 | 0.2 | 0.000430 | 1.3 | 0.2 | 0.220724 | 0.3 | 0.002305 |
| 30–39 | 2.7 | 0.2 | 0.171133 | 0.5 | 0.000724 | 4.7 | 0.5 | 0.171133 | 0.8 | 0.006827 |
| 40–49 | 6.1 | 0.2 | 0.185875 | 1.1 | 0.001185 | 10.5 | 0.8 | 0.185875 | 2.0 | 0.019624 |
| 50–59 | 10.4 | 0.2 | 0.178898 | 1.9 | 0.001288 | 19.3 | 1.0 | 0.178898 | 3.5 | 0.032786 |
| 60–69 | 17.5 | 0.2 | 0.124713 | 2.2 | 0.000914 | 29.6 | 1.4 | 0.124713 | 3.7 | 0.032553 |
| 70–79 | 20.5 | 0.3 | 0.070752 | 1.5 | 0.000470 | 30.1 | 1.9 | 0.070752 | 2.1 | 0.017264 |
| 80+ | 16.1 | 0.3 | 0.047905 | 0.8 | 0.000278 | 31.2 | 2.9 | 0.047905 | 1.5 | 0.019094 |
| Total | 9.1 | 0.1 | 1.000000 | 8.1* | 0.072727* | 10.1 | 0.3 | 1.000000 | 13.8* | 0.361183† |

*Age-adjusted prevalence (AAP) was calculated using Eqn 1 (see text for details).

†The standard error (SE) was calculated as $\sqrt{\text{var}(AAP)}$, where the variance of AAP was estimated using Eqn 2 (see text for details).

## Table 3

Comparison of crude and age-adjusted prevalence of diagnosed diabetes by state, 2011 Behavioral Risk Factor Surveillance System

| State | *n* | Crude prevalence [% (SE)] | AAP using 2010 US Census data [% (SE)] | AAP using 2000 projected US population [% (SE)] | Absolute difference* | Relative difference (%) † |
|---|---|---|---|---|---|---|
| All | 485694 | 9.73 (0.08) | 9.51 (0.08) | 9.01 (0.07) | −0.50‡ | −5.53 |
| Alabama | 7542 | 11.66 (0.46) | 11.23 (0.43) | 10.67 (0.43) | −0.56 | −5.21 |
| Alaska | 3445 | 7.86 (0.72) | 8.62 (0.73) | 8.22 (0.74) | −0.41 | −4.95 |
| Arizona | 6156 | 9.52 (0.64) | 9.42 (0.62) | 9.02 (0.62) | −0.39 | −4.35 |
| Arkansas | 4590 | 11.06 (0.59) | 10.68 (0.57) | 10.14 (0.58) | −0.55 | −5.39 |
| California | 16843 | 8.91 (0.29) | 8.86 (0.28) | 8.33 (0.26) | −0.53 | −6.36 |
| Colorado | 13239 | 6.63 (0.29) | 6.81 (0.28) | 6.55 (0.29) | −0.27 | −4.07 |
| Connecticut | 6640 | 9.33 (0.46) | 8.79 (0.41) | 8.21 (0.39) | −0.58 | −7.12 |
| Delaware | 4672 | 9.66 (0.55) | 9.1 (0.51) | 8.62 (0.51) | −0.48 | −5.56 |
| District of Columbia | 4395 | 9.12 (0.58) | 9.96 (0.56) | 9.54 (0.56) | −0.42 | −4.45 |
| Florida | 11995 | 10.44 (0.39) | 9.3 (0.36) | 8.65 (0.34) | −0.64 | −7.41 |
| Georgia | 9732 | 10.13 (0.37) | 10.65 (0.36) | 9.97 (0.35) | −0.68 | −6.78 |
| Hawaii | 7416 | 8.32 (0.41) | 8.01 (0.39) | 7.58 (0.39) | −0.44 | −5.76 |
| Idaho | 5908 | 9.34 (0.51) | 9.37 (0.5) | 8.85 (0.49) | −0.52 | −5.91 |
| Illinois | 5418 | 9.69 (0.55) | 9.71 (0.53) | 9.4 (0.54) | −0.32 | −3.37 |
| Indiana | 8262 | 10.13 (0.4) | 9.93 (0.38) | 9.43 (0.38) | −0.50 | −5.34 |
| Iowa | 7216 | 8.18 (0.35) | 7.66 (0.32) | 7.18 (0.3) | −0.49 | −6.81 |
| Kansas | 20508 | 9.53 (0.23) | 9.37 (0.22) | 8.88 (0.22) | −0.48 | −5.46 |
| Kentucky | 10566 | 10.71 (0.41) | 10.39 (0.39) | 9.81 (0.39) | −0.58 | −5.91 |
| Louisiana | 10776 | 11.85 (0.43) | 11.78 (0.42) | 11.32 (0.42) | −0.45 | −4.01 |
| Maine | 12937 | 9.53 (0.3) | 8.54 (0.27) | 8.1 (0.27) | −0.43 | −5.36 |
| Maryland | 9830 | 9.42 (0.41) | 9.29 (0.38) | 8.85 (0.38) | −0.44 | −4.98 |
| Massachusetts | 21571 | 8.02 (0.27) | 7.77 (0.25) | 7.41 (0.25) | −0.36 | −4.92 |
| Michigan | 10802 | 10.03 (0.38) | 9.55 (0.36) | 9.14 (0.36) | −0.42 | −4.56 |
| Minnesota | 15112 | 7.28 (0.28) | 7.17 (0.28) | 6.88 (0.27) | −0.29 | −4.24 |
| Mississippi | 8779 | 12.28 (0.42) | 12.19 (0.39) | 11.51 (0.39) | −0.69 | −5.97 |
| Missouri | 6308 | 10.17 (0.48) | 9.8 (0.46) | 9.33 (0.46) | −0.47 | −5.08 |
| Montana | 10137 | 7.94 (0.37) | 7.33 (0.34) | 7.03 (0.34) | −0.30 | −4.32 |

| State | *n* | Crude prevalence [% (SE)] | AAP using 2010 US Census data [% (SE)] | AAP using 2000 projected US population [% (SE)] | Absolute difference* | Relative difference (%) † |
|---|---|---|---|---|---|---|
| Nebraska | 25132 | 8.36 (0.24) | 8.16 (0.23) | 7.69 (0.22) | −0.46 | −6.02 |
| Nevada | 5316 | 10.39 (0.79) | 10.65 (0.79) | 10.19 (0.77) | −0.46 | −4.55 |
| New Hampshire | 6186 | 8.6 (0.41) | 8.12 (0.39) | 7.69 (0.39) | −0.43 | −5.60 |
| New Jersey | 14895 | 8.76 (0.31) | 8.43 (0.29) | 7.95 (0.28) | −0.48 | −6.00 |
| New Mexico | 9232 | 9.97 (0.38) | 9.8 (0.37) | 9.34 (0.37) | −0.45 | −4.87 |
| New York | 7399 | 10.27 (0.44) | 10.03 (0.42) | 9.44 (0.41) | −0.59 | −6.27 |
| North Carolina | 11319 | 10.73 (0.41) | 10.49 (0.39) | 9.95 (0.38) | −0.54 | −5.40 |
| North Dakota | 5185 | 8.27 (0.42) | 8.13 (0.4) | 7.67 (0.4) | −0.46 | −6.03 |
| Ohio | 9672 | 9.91 (0.38) | 9.42 (0.36) | 8.9 (0.35) | −0.51 | −5.76 |
| Oklahoma | 8467 | 11.11 (0.41) | 10.9 (0.4) | 10.36 (0.39) | −0.55 | −5.27 |
| Oregon | 6121 | 9.2 (0.46) | 8.64 (0.43) | 8.22 (0.44) | −0.42 | −5.12 |
| Pennsylvania | 11173 | 9.44 (0.36) | 8.68 (0.33) | 8.24 (0.33) | −0.44 | −5.29 |
| Rhode Island | 6344 | 8.4 (0.42) | 8.08 (0.4) | 7.72 (0.4) | −0.36 | −4.68 |
| South Carolina | 12518 | 11.7 (0.41) | 11.33 (0.4) | 10.83 (0.4) | −0.51 | −4.69 |
| South Dakota | 8166 | 9.48 (0.57) | 8.98 (0.54) | 8.61 (0.53) | −0.37 | −4.29 |
| Tennessee | 5818 | 11.16 (0.74) | 10.72 (0.68) | 10.1 (0.65) | −0.61 | −6.04 |
| Texas | 14565 | 10.17 (0.39) | 10.7 (0.39) | 10.16 (0.38) | −0.54 | −5.28 |
| Utah | 12430 | 6.67 (0.26) | 7.78 (0.27) | 7.39 (0.27) | −0.38 | −5.17 |
| Vermont | 6945 | 7.64 (0.36) | 7.08 (0.35) | 6.76 (0.35) | −0.32 | −4.69 |
| Virginia | 6428 | 10.4 (0.54) | 10.32 (0.51) | 9.74 (0.5) | −0.58 | −5.97 |
| Washington | 14461 | 8.83 (0.33) | 8.74 (0.32) | 8.34 (0.32) | −0.40 | −4.84 |
| West Virginia | 5228 | 12.07 (0.49) | 11.1 (0.45) | 10.6 (0.45) | −0.50 | −4.69 |
| Wisconsin | 5203 | 8.3 (0.49) | 7.95 (0.46) | 7.53 (0.44) | −0.42 | −5.55 |
| Wyoming | 6696 | 8.13 (0.48) | 7.99 (0.46) | 7.57 (0.45) | −0.42 | −5.60 |

* Difference between age-adjusted prevalence (AAP) using the 2000 projected US population and AAP using the 2010 US Census data.

† Calculated as the difference in two AAP values divided by the prevalence using the 2000 projected US population data.

‡ $P < 0.0001$; *t*-tests were used to test for equality between the two AAPs. All *P*-values for the absolute differences in the two prevalences for individual states were >0.10 (ranging from 0.13 to 0.69).