

# Data sources for identifying low-income, uninsured populations: application to public health—National Breast and Cervical Cancer Early Detection Program

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## Abstract

**Objective** To provide information on the sources of data for estimating low-income, uninsured populations. To recommend uses of these data sources. To demonstrate the application of these data sources in the public health field, using the National Breast and Cervical Cancer Early Detection Program as an example.

**Methods** We describe U.S. Census Bureau data sources for identifying low-income, uninsured populations using two population surveys: the Annual Social and Economic Supplement to the Current Population Survey (CPS ASEC) and the American Community Survey (ACS), and using one model-based estimation program, the Small Area Health Insurance Estimates (SAHIE). We provide recommendations for use of these data sources, and we use CPS ASEC and SAHIE to estimate the percent of U.S. women eligible for the National Breast and Cervical Cancer Early Detection Program (NBCCEDP).

**Results** CPS ASEC, ACS, and SAHIE are produced by the U.S. Census Bureau, and they are reliable sources for estimates of the low-income, uninsured populations in the USA. Key characteristics of these three data sources were presented to highlight the strengths of each to meet the needs of various programs at national and local levels. Recommendations are made on the use of the data sources. Based on these three data sources, estimates of NBCCEDP eligibility showed substantial variation over time at the national and state levels, and across states and counties.

**Conclusions** Publicly funded programs that are directed toward low-income, uninsured individuals require information on their eligible populations to make decisions about program policy and resource allocation, and to monitor and evaluate the effectiveness of the programs. The U.S. Census Bureau produces three data sources (CPS ASEC, ACS, and SAHIE) for these estimates. The percent of U.S. women eligible for NBCCEDP varies over time and across states and counties. The data sources for these estimates are changing in order to measure key dimensions of the Affordable Care Act (ACA) and can provide helpful information for assessing the legislation's impact.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official positions of the U.S. Census Bureau or of the Centers for Disease Control and Prevention.

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## Introduction

Public health programs for medically underserved individuals require population estimates of their target groups by economic (federal poverty level (FPL) ratio, health

insurance coverage status), demographic (age, race, gender), geographic (national, state, county levels), and clinical characteristics (such as cancer screening or vaccination intervals). Federal, state, and local program administrators, decision makers, and researchers need these estimates to assess the size, location, and makeup of populations enrolled or eligible for publicly funded programs, to assess the reach of the programs, to inform outreach efforts, and to make resource allocation decisions.

Many public health programs do not have the funding and staffing resources to produce these estimates on their own. The U.S. Census Bureau produces estimates of the low-income, uninsured population by characteristics of interest to public health programs and other data users. Census Bureau estimates are advantageous because the Bureau has access to high-quality source datasets and has the knowledge and expertise to work with them. A key advantage of Census Bureau estimates is that they are produced using standardized processes, and a uniform methodology is applied across all geographic areas.

The purpose of this paper is to describe the three publicly available health coverage data sources produced by the Census Bureau, recommend when each data source can be used, and illustrate their application to the Centers for Disease Control and Prevention's (CDC's) National Breast and Cervical Cancer Early Detection Program (NBCCEDP).

### Data sources for identifying low-income uninsured populations

There are two nationwide household surveys that have sufficient sample size to support reliable estimates of health insurance coverage at the national, state, or substate levels: the Annual Social and Economic Supplement to the Current Population Survey (CPS ASEC) and the American Community Survey (ACS). Both are produced by the U.S. Census Bureau. The Census Bureau also produces the Small Area Health Insurance Estimates (SAHIE), a set of model-based estimates, derived from either CPS ASEC (before 2008) or ACS (since 2008) that match the source data at the national level while attaining greater precision at the state and local levels. All three sources have information on family income and are capable of measuring poverty and health insurance coverage status. They differ in years of available data, length and detail of the survey questionnaire, the number of households interviewed, the methodology used to collect and process the data, and consequently, in the health insurance coverage estimates produced. The following sections contain more detailed descriptions of each of these three data sources, with key characteristics summarized in Table 1.

### CPS ASEC

The CPS is a monthly survey conducted by the Census Bureau for the Bureau of Labor Statistics, primarily to estimate the unemployment rate. Questions about age, family size, sex, race, and Hispanic origin are included in the basic CPS. The CPS ASEC is an annual supplemental survey of about 100,000 addresses (yielding approximately 78,000 responding households) and includes detailed questions regarding health insurance coverage, income received, and place of residence during the previous year. CPS ASEC interviews are conducted from February through April and ask about the prior calendar year [1]. The household respondent is asked whether anyone in the household had specific types of health insurance coverage during the previous calendar year, and if so, which household members were covered by the insurance.

The CPS ASEC is the most widely used source of data on health insurance coverage in the USA, with a consistent time series of estimates from 1999 to 2012 (i.e., 2000 CPS ASEC to the 2013 CPS ASEC). There are also some periods of consistent time series between 1987 and 1999, and a new time series begins with the 2013 data (i.e., 2014 CPS ASEC) [1].

### ACS

The ACS asks health insurance coverage questions and numerous questions on housing and socioeconomic characteristics such as income, age, family size, and race/ethnicity. The ACS is an ongoing nationwide survey that is conducted throughout the year. In the USA and Puerto Rico, approximately 3–3.5 million addresses per year receive the ACS. One-year estimates are available for areas with population size 65,000 or more. In the 2012 ACS, published 1-year estimates (estimates that incorporate one calendar year of data) exist for 811 (26 % of all) counties and are not published for the remaining 2,332 counties. Three-year estimates (estimates that incorporate three calendar years of data) are available for areas with population size 20,000 or more. In the 3-year ACS for 2010–2012, published estimates exist for 1,840 (59 % of all) counties and are not published for the remaining 1,303 counties. Five-year estimates (estimates that incorporate five calendar years of data) are available for all areas, including all counties, census tracts, block groups, and American Indian and Alaska Native governmental and statistical areas.

The ACS first began to ask questions on health insurance coverage in 2008. The 1-year ACS estimates became available in 2009, and the 2008–2012 5-year estimates became available in 2013. Respondents are asked whether each household member is currently covered (by specific types of health insurance) at the time of interview. This is in contrast to the CPS ASEC which asks about health

**Table 1** U.S. Census Bureau health insurance coverage data source comparison table

	CPS ASEC <sup>a</sup>	ACS <sup>b</sup>	SAHIE <sup>c</sup>
Principal purpose	CPS labor force participation and unemployment ASEC Supplement to the basic CPS focusing on social and economic characteristics	General household survey, replaced decennial census long form	Administration of federal programs
Geography	Nation, states, regions, and divisions	1-year estimates for areas with population 65,000 or more 3-year estimates for areas with populations of 20,000 or more 5-year estimates for all	1-year estimates for every county and state in the United States
Years	1987–1998, 1999–2012, 2013–present	2008–present	2000–2001, 2005–present
Sample size	100,000 addresses	3–3.5 million addresses annually	Model-based estimates which combine survey data with other data sources.
Data collection method	Personal and telephone interviews	Mailout, telephone non-response follow-up, and personal visit non-response follow-up; internet response option added for 2013	For SAHIE 2008–present, ACS data are used as the survey input. For 2000, 2001, and 2005–2007, the CPS ASEC is used as the survey input.
Health insurance coverage reference period	Any coverage during the last calendar year	Coverage at the point in time of the interview	The administrative records sources provide over 100 million records and are collected at various points in time
Population universe	Civilian non-institutionalized population	Entire population	
Data collection period	February–April	Continuous	
Race/ethnicity groups	All groups available through public-use microdata. Some pre-generated tables also available	All groups available through public-use microdata. Some pre-generated tables also available	Pre-generated tables of: All Races White, non-Hispanic Black, non-Hispanic Hispanic
Age groups	All groups available through public-use microdata. Some pre-generated tables	All groups available through public-use microdata. Some pre-generated tables	Pre-generated tables of: 0–64, 0–18, 18–64, 40–64, 50–64
Income groups	All groups available through public-use microdata. Some pre-generated tables also available	All groups available through public-use microdata. Some pre-generated tables also available	Pre-generated tables of: All incomes, 0—≤138 % poverty, >138—≤400 % poverty, 0—≤ 200 % poverty, 0—≤250 % poverty, 0—≤400 % poverty
Additional benefits	Numerous socioeconomic characteristics available through public-use microdata for researchers interested in tabulating their own summary levels. Some pre-generated tables also available	Numerous socioeconomic characteristics available through public-use microdata for researchers interested in tabulating their own summary levels. Some pre-generated tables also available	Estimates are available in a user-friendly format. The SAHIE interactive tool gives researchers the ability to easily create and export their own data tables, maps, and trend charts

Source: U.S. Census Bureau [1]

<sup>a</sup> CPS ASEC Annual Social and Economic Supplement to the Current Population Survey

<sup>b</sup> ACS American Community Survey

<sup>c</sup> SAHIE Small Area Health Insurance Estimates

insurance coverage at any point during the previous year. Despite the differences in the way the health insurance coverage question is asked for the CPS ASEC and the ACS, the two surveys yield relatively similar estimates at the national and state levels [2].

SAHIE

SAHIE is the only source of single-year health insurance coverage data for all counties, i.e., estimates based on one calendar year of data. SAHIE is a model-based estimates

program that combines survey estimates from the ACS (the CPS ASEC was used before 2008) with auxiliary information, including administrative records and census data, to create more accurate single-year estimates of the population uninsured by race/Hispanic origin (state level only), age, sex, and income for every state and county in the USA.

SAHIE uses ACS 1-year estimates for *all* states and counties by socioeconomic groups, including those which are not publicly available. For each of these groups, SAHIE models both the proportion in each of five income categories (0— $\leq 138$  % poverty,  $>138$ — $\leq 400$  % poverty, 0— $\leq 200$  % poverty, 0— $\leq 250$  % poverty, 0— $\leq 400$  % poverty) and, within each income category, the proportion insured. These estimates are combined with population data to obtain the estimated number in each income category as well as the numbers insured and uninsured within each income category.

Calculations are made separately for states and counties. They are conceptually the same, with the exception that race and Hispanic origin detail is included at the state level. County-level estimates are adjusted to sum to state-level estimates, and the state-level estimates are consistent with national ACS direct survey estimates for several key socioeconomic categories. More detail about the SAHIE model is available on the Census Bureau's SAHIE web site [3].

Although SAHIE does not offer the flexibility of survey data, it increases the precision of the estimates for the socioeconomic groups modeled by utilizing additional sources of data. In this sense, it can be considered “enhanced ACS.” Comparisons between ACS direct estimates and SAHIE suggest that for most small domains (state/age/race/sex estimates for each income group), SAHIE offers a large improvement over using survey-only estimates [4].

One of SAHIE's greatest advantages is the level of detail in the socioeconomic groups for which it models. It produces estimates for the full cross-classification of the above characteristics, e.g., 1-year estimates (estimates that incorporate one calendar year of data) of uninsured women ages 40–64,  $\leq 250$  % of the FPL (FPL) for every U.S. county, which is a group of interest to the NBCCEDP.

#### *Recommended use of U.S. Census Bureau health insurance coverage data*

Table 2 presents general recommendations from the Census Bureau as to which data source to use for different geographic levels. The CPS ASEC is primarily useful for estimates at the national level, but can also be used for state-level estimates and trends if multiyear averages are used. The ACS is useful for estimates at the state and county levels. SAHIE is the primary source of data for county-level estimates. These recommendations are based primarily on availability of data at the geographic level(s) and year(s) of interest. Tables 1 and 2 together

should be used as a starting point when selecting the appropriate source for estimates of low-income and uninsured populations of interest.

In the data application described in this article, the purpose was to examine variation in the percent of age-appropriate U.S. women eligible for NBCCEDP cancer screening services over the time period 1997 through 2012. The time period was selected based on availability of the administrative data from the NBCCEDP of the number of women who had received the screenings. Using the time period of interest as a guide, we determined that the only data source with estimates available for that time period was the CPS ASEC. The primary geographic levels of interest were the national and state levels, using data that represent two or three calendar years of data, depending on the population of interest. Since the CPS ASEC can be used to produce state-level estimates for all states if they are pooled over multiple years, the CPS ASEC was a satisfactory choice. For our example here, as well as for most studies requiring estimates of the low-income, uninsured population, the geographic level of interest (nation, state, county, etc.) and the year(s) of interest should be the primary guide. Data users can refer to Table 2 of this article, which is also available on the Census Bureau's web site [1] for guidance.

In addition to geographic level and time period of interest, availability of socioeconomic detail versus statistical precision may be considered. Model-based estimates are developed for a key set of estimates of special importance to the sponsor of the estimation. For example, NBCCEDP state grantees need estimates at the substate level, by a set of socioeconomic characteristics that are more timely and statistically precise than estimates available through survey data alone. Since these more tailored estimates are published on the Census Bureau's SAHIE web site [5], other data users can access these estimates. If the SAHIE socioeconomic characteristics are not exactly the categories another data user requires, then the data user can weigh the statistical precision of SAHIE against the additional socioeconomic detail of the ACS when deciding which source to use.

Another factor to take into account when determining which data source to use is accessibility of the data. The CPS, ACS, and SAHIE all have free tools available on the Census Bureau's web site so that data users can easily create customized tables, graphs, and maps [5–8]. These tools should meet the majority of data users' needs. Data users with the knowledge and expertise can use CPS ASEC and ACS microdata to create custom tabulations [9]. For instance, ACS pre-tabulated estimates are available through Census Bureau tools such as the American FactFinder. These pre-tabulated estimates use the full sample of the ACS for most geographic areas. In contrast,

**Table 2** U.S. Census Bureau health insurance coverage data source recommendations by geographic level

Geographic level	Recommended data source
United States	ACS 1-year estimates for detailed demographic groups CPS ASEC for income groups
State	ACS 1-year estimates for 2008–present CPS ASEC 2-year averages prior to 2008 <sup>a</sup>
Counties	SAHIE if available for domains of interest, else refer to ACS below
Other Substate: Areas with population size 65,000 or more	ACS 1-year period estimates
Areas with population size 20,000–65,000	ACS 3-year period estimates <sup>b</sup>
Areas with population size <20,000	ACS 5-year period estimates <sup>c</sup>

Source: U.S. Census Bureau [1]

<sup>a</sup> Use CPS ASEC non-overlapping 2-year averages when examining state trends that include years prior to 2008

<sup>b</sup> ACS recommends using non-overlapping periods for trend analysis with multiyear estimates. For example, comparing 2005–2007 ACS 3-year estimates with 2008–2010 ACS 3-year estimates is preferred for identifying change

<sup>c</sup> ACS recommends using non-overlapping periods for trend analysis with multiyear estimates. For example, comparing 2006–2010 ACS 5-year estimates with 2011–2015 ACS 5-year estimates is preferred for identifying change

the ACS Public-Use Microdata Sample (ACS PUMS) consists of a subsample (about 67 % of all records) of the full ACS, due to confidentiality concerns. The ACS PUMS can be used to create more customized data, such as for a particular age and/or income group (for example, ages 21–64 years with family income up to 185 % of the FPL). It is also possible to request the Census Bureau to create even more customized tabulations of the survey data. In contrast, since SAHIE uses aggregated data in models, simply retabulating microdata alone would not produce new estimates. Still, SAHIE could potentially research, model and incorporate additional sub-categories for which there is sufficient demand.

In summary, when selecting a data source for estimates of low-income, uninsured populations, data users should first prioritize the key characteristics of their planned study, noting that level of geography and year(s) of interest should be key considerations. If there is flexibility in the study in these two characteristics, the data user can then make the selection based on other characteristics such as statistical precision, availability of socioeconomic detail, and data accessibility.

### Application of U.S. Census Bureau health insurance coverage data in the NBCCEDP

#### Background

Authorized by the Breast and Cervical Mortality Prevention Act of 1990, the NBCCEDP is a public health program that helps low-income women with little or no insurance gain access to screening services for the early detection of breast and cervical cancers. CDC currently funds all 50 states, the District of Columbia, 5 U.S. territories, and 11 tribes and tribal organizations through cooperative

agreements to deliver cancer screening services to eligible women [10, 11]. Federal guidelines establish an eligibility baseline to direct services to age-appropriate low-income, uninsured, and underinsured women at or below 250 % of FPL; ages 40–64 years for breast cancer screening and ages 21–64 years for cervical cancer screening. Medicare covers recommended cancer screenings for women ages 65 years and over.

“Low-income” is defined by percentages of the FPL. Within federal guidelines that set the eligibility baseline at or below 250 % of FPL, grantees have flexibility to select the FPL multiple they will use within their programs. In 2012, 31 grantees defined low income as 250 % FPL, 17 defined it as 200 % FPL, 2 used 225 % FPL, and 1 used 185 % FPL. In 2012, the poverty level for a family of four, including two related children, was \$23,283 [12]. For example, women in families with 2012 incomes at or below \$58,208 met the low-income qualification for  $\leq 250$  % FPL, and those at or below \$46,566 met the low-income qualification for  $\leq 200$  % FPL.

In addition to economic eligibility criteria, the NBCCEDP uses the clinical recommendations of the U.S. Preventive Services Task Force (USPSTF) to inform the program’s operational policies. The program provides breast cancer screening for women ages 40–64 years every 2 years, with a priority population of women ages 50–64 years, and cervical cancer screening every 3 years for women ages 21–64 years (ages 18–64 years prior to 2012 when recommendations were updated to start screening at age 21 [13]). The full description of the history of the NBCCEDP is provided elsewhere [10, 11].

In 2010–2012, approximately 11 % of age-appropriate U.S. women were eligible for NBCCEDP cervical cancer screening, and about 10 % for breast cancer screening [14, 15]. Since 1991, NBCCEDP has served

more than 4.6 million women, provided more than 11.6 million breast and cervical cancer screening examinations, and diagnosed more than 64,718 breast cancers, 3,576 invasive cervical cancers, and 167,169 premalignant cervical lesions, of which 40 % were high grade [10]. The proportion of the NBCCEDP-eligible population screened by the grantees is low. For the period 2010–2012, the NBCCEDP provided screening services to 6.5 % of its eligible population and 0.7 % of U.S. women ages 18–64 years for cervical cancer, and to 10.6 % of its eligible population and 1 % of U.S. women ages 40–64 years for breast cancer. Furthermore, screening proportions for NBCCEDP-funded cancer screening services vary substantially across grantees, from 1.5 to 32.7 % for cervical cancer and from 1.6 to 52.8 % for breast cancer [14, 15].

Until now, no study has been done to assess variation in the percent of age-appropriate U.S. women eligible for NBCCEDP over time. In this manuscript, we estimate the percent of age-appropriate U.S. women eligible for the NBCCEDP at the national and state levels from 1997 through 2012 and at the county level for 2012.

## Methods

### Data sources

We obtained estimates of age-appropriate U.S. women and the number of women eligible for the NBCCEDP at the national and state levels using CPS ASEC data for 1997 through 2012 and at the county level using SAHIE data for 2012. Census Bureau estimates are not available for all the U.S. territory populations. The CPS ASEC was selected for national- and state-level estimates rather than the ACS because of its longer time series. The earliest ACS data available have a reference year of 2008. CPS ASEC estimates of the number of women eligible for NBCCEDP-funded cervical cancer screening required one additional adjustment. The USPSTF recommends that only women with a cervix receive Papanicolaou (Pap) testing [13]. Women who have had hysterectomies are not eligible for cervical cancer screening through the NBCCEDP. Since the CPS ASEC does not include questions about hysterectomy, auxiliary data sources were used. The adjustments were done at the national level using the 2005 National Health Interview Survey (NHIS) and at the state level using the Behavioral Risk Factor Surveillance System (BRFSS).

The 2005 NHIS included a supplement on cancer control, and it provided estimates of the national proportion of U.S. women who have had a hysterectomy [16]. The BRFSS provides state-level hysterectomy data [17]. Both

the NHIS and the BRFSS are discussed in more detail elsewhere [14]. Using the hysterectomy proportions from NHIS (at the national level) and BRFSS (at the state level), the CPS ASEC estimates were ratio-adjusted to account for women who have had hysterectomies. This yielded national- and state-level estimates of women eligible for NBCCEDP-funded Pap tests. For consistency across estimates, the BRFSS-adjusted estimates were calibrated to sum to the NHIS-adjusted national estimate. The result was a final estimate of the NBCCEDP-eligible population for cervical cancer screening at the national and state levels.

### Data analysis

The percent of age-appropriate U.S. women eligible for NBCCEDP-funded cancer screening services (hereafter referred to as “percent eligible” or “eligibility percentage”) is the number of uninsured, low-income women within age groups recommended for breast or cervical cancer screenings, divided by the number of all women in the USA in those age groups, multiplied by 100. For consistency, “low income” is defined here as at or below 250% of the appropriate poverty threshold. We calculated the eligibility percentages at the national and state levels using CPS ASEC data for 1997–2012 and at the county level using SAHIE data for 2012. The CPS ASEC national- and state-level estimates were computed as 3-year averages for cervical cancer screening and 2-year averages for breast cancer screening. This approach aligns the estimates with the timing intervals of the USPSTF recommendations for breast and cervical cancer screening [18, 19]. An additional advantage of using multiple years is that it makes the estimates more reliable. The CPS ASEC is designed to produce single-year estimates for the nation and some large states, but multiple years were combined to produce reliable estimates for all states. The county-level percent eligible estimates using SAHIE are for a single year. These county-level estimates are reliable because they incorporate ACS data with data from other sources such as anonymized federal income-tax returns and Medicaid participation.

Estimates of the number of women eligible for the NBCCEDP (hereafter referred to as “eligible women”) are based on sample surveys and are thus subject to sampling error. The technique for computing confidence intervals for the estimates of the eligible women has been described previously [20]. Consistent with Census Bureau convention [21], we report 90 % confidence intervals (CIs) for estimates of the eligible women and the percent eligible. Any comparative statements herein about differences in the percent eligible have undergone statistical testing and are significant at the 90 % confidence level unless otherwise noted.

## Results

The following figures display CPS ASEC and SAHIE data, which are being used to estimate eligibility percentages for the NBCCEDP at the national, state, and county levels.

### Percent of women eligible for NBCCEDP at the national level

Figure 1 shows trends in the percent of U.S. women ages 40–64 years eligible for NBCCEDP-funded mammograms. There is a break in 1999 due to the addition of the insurance verification question to the CPS ASEC, which resulted in lower measures of the uninsured and of the eligible women [21]. The percent eligible varied during the time period 1999–2012. The percent of eligible women increased sharply during the last recession and continued to rise after the recession officially ended. The 2007–2008 percent eligible was an estimated 8.8 % (90 % CI 8.6–9.1 %), and it increased to an estimated 10.9 % (90 % CI 10.6–11.2 %) in 2010–2011. The shaded areas indicate recession periods as defined by the National Bureau of Economic Research [22].

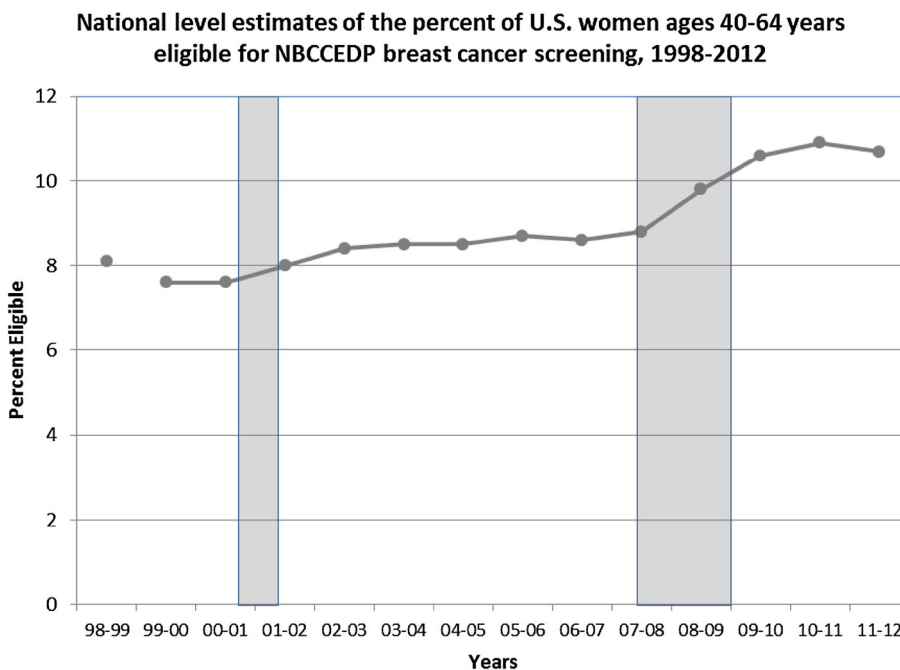
### Percent of women eligible for NBCCEDP at the state level

Figure 2 shows the percent of age-appropriate U.S. women eligible for NBCCEDP breast and cervical cancer

screening services at the state level between 1997 and 2012. Again, there is a break in 1999 due to the addition of the verification question to the CPS ASEC. The percent eligible varies across states, both for breast cancer screening among females ages 40–64 years (left panels) and for cervical cancer screening among females ages 18–64 years (right panels). In panel A, the NBCCEDP percent eligible for breast cancer screening ranged from 1.4 % (90 % CI 0.7–2.2 %) to 17.5 % (90 % CI 14.2–20.8 %) during 2011–2012. In panel B, the NBCCEDP percent eligible for cervical cancer screening ranged from 2.5 % (90 % CI 1.8–3.2 %) to 19.1 % (90 % CI 18.2–19.9 %) during 2010–2012. In panel C, the NBCCEDP percent eligible ranged from 2.9 % (90 % CI 0.0–5.9 %) to 16.7 % (90 % CI 10.2–23.2 %) during 1998–1999. In panel D, the NBCCEDP percent eligible ranged from 4.2 % (90 % CI 1.7–6.8 %) to 18.4 % (90 % CI 13.9–22.8 %) during 1997–1999.

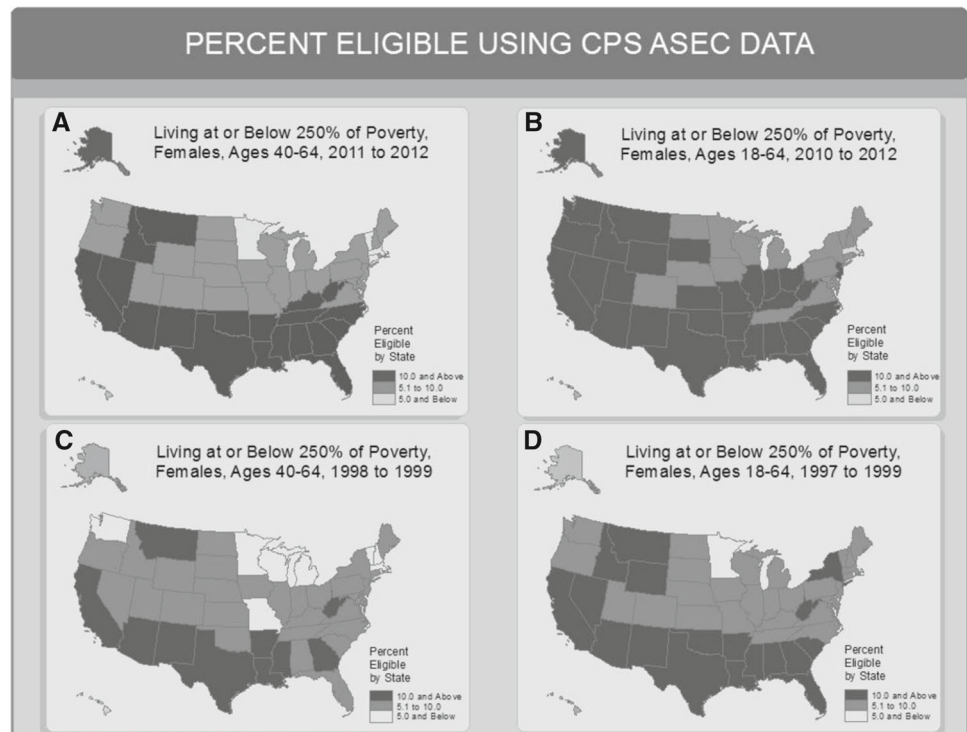
Looking regionally [23], in the south and west, during 2011–2012, roughly two-thirds and three-quarters of states had NBCCEDP percent eligible of 10 % or more, respectively. In the Northeast and Midwest, during 2011–2012, no states had NBCCEDP percent eligible of 10 % or more. Looking across time, in 1998–1999, roughly one-fifth of all states had NBCCEDP percent eligible of 10 % or more. In 2011–2012, roughly two-fifths of all states had NBCCEDP percent eligible of 10 % or more. Although not shown, state-level ACS estimates also illustrate wide state-to-state

**Fig. 1** National level estimates of the percent of U.S. women ages 40–64 years eligible for NBCCEDP breast cancer screening, 1998–2012



Source: Authors' tabulations of 1999–2013 Current Population Survey, Annual Social and Economic Supplements  
 Notes: Shaded areas roughly capture recession periods, as given by National Bureau of Economic Research.  
 There is a break in the time series in 1999 due to the addition of the insurance "verification" question.

**Fig. 2** State level estimates of the percent of U.S. women ages 40–64 and 18–64 years eligible for NBCCEDP breast and cervical cancer screening, 1997–1999 and 2010–2012



Source: Annual Social and Economic Supplement to the Current Population Survey, created in September 2014, U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce

Notes: USPSTF recommends breast cancer screening every two years (panels A and C) and cervical cancer screening every three years (panels B and D) [18, 19]. There is a break in the time series in 1999 due to the addition of the insurance “verification” question.

variation in the NBCCEDP percent eligible for women in the ages 40–64 years and ages 18–64 years age groups.

### Percent of women eligible for NBCCEDP at the county level

Figure 3 shows the percentage of U.S. women ages 40–64 years eligible for NBCCEDP-funded mammograms at the county level using 2012 SAHIE data. The eligibility percentages vary across the USA, with a range from 1.5 % (90 % CI 1.2–1.8 %) to 39.0 % (36.4–41.6 %). County-level maps identify regional differences in distribution of low-income uninsured women within each state. Such information is critical for allocation of resources and outreach efforts at the local level.

### Discussion

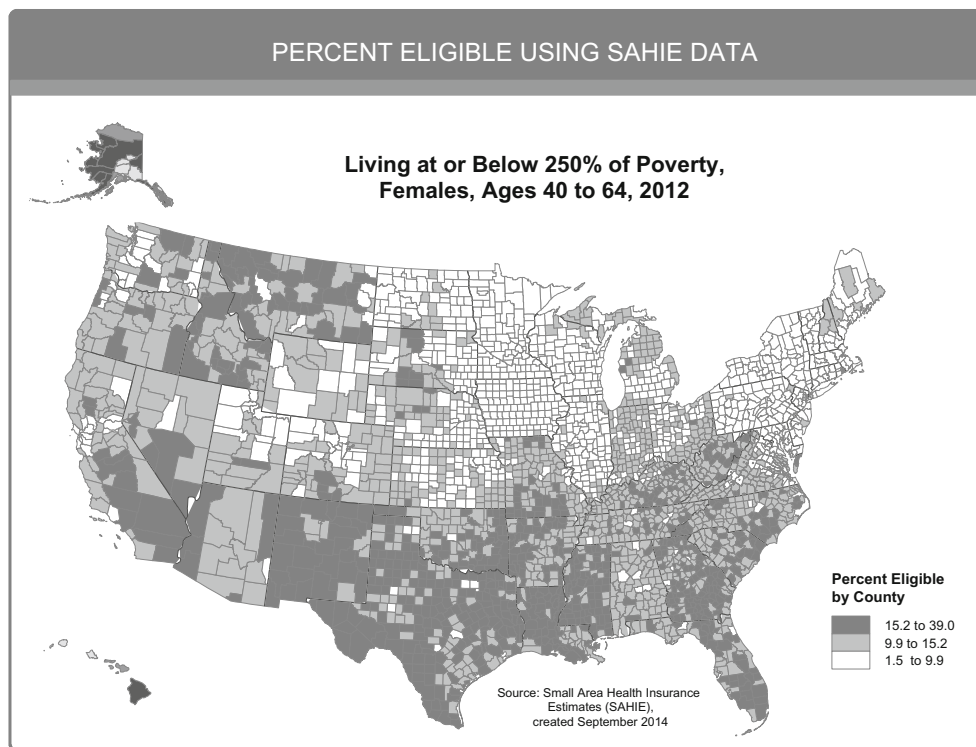
The Census Bureau provides valuable data that can be used to estimate populations eligible for public health programs. This information is crucial for making decisions about program policy and resource allocation, and for monitoring and evaluating the effectiveness of programs. CPS ASEC

data provide a long time series at national and state levels. For more recent years, ACS estimates provide greater geographic and socioeconomic status detail and more statistical precision. SAHIE provides single-year estimates for all counties with yet greater overall statistical precision.

Census Bureau datasets are being used by many public health programs, including the NBCCEDP, to estimate the number and distribution of women eligible to receive program services, taking into consideration economic criteria (health insurance status, income), clinical recommendations (screening ages, intervals), and demographic characteristics (gender, race, ethnicity, geography). CPS ASEC has been used to assess the reach of the NBCCEDP [14, 15]. Because the NBCCEDP was used as an example in this article to show the application of health insurance coverage data, the focus here has been on the low-income, uninsured population. One key advantage of estimates from the Census Bureau is that uniform methodology is used across geographic areas. Such information can help identify geographic areas with the greatest need.

In this report, we demonstrate the use of Census Bureau data in estimating the percent of U.S. women eligible for NBCCEDP breast and cervical cancer screening services. During and after the previous recession (2007–2011), the





Source: Small Area Health Insurance Estimates (SAHIE) program, created in September 2014, U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce

**Fig. 3** County level estimates of the percent of U.S. women ages 40–64 years eligible for NBCCEDP breast cancer screening, 2012

percent of U.S. women eligible for breast cancer screening through the NBCCEDP increased sharply. The unemployment and poverty rates also increased over that time period. In 2007, there were 21.0 million women in poverty (90 % CI 20.7–21.3 million) compared with 25.7 million women in poverty (CI 25.4–26.0 million) in 2011. The poverty rate among women increased by 2.5 % points, from 13.8 % (90 % CI 13.5–14.1 %) in 2007 to 16.3 (90 % CI 15.9–16.7 %) in 2011 [24].

Figures 2 and 3 showed variation in percent eligible across states and also within states at the county level. State-to-state variation may result in part from the fact that many health insurance programs are managed at the state level, most notably Medicaid and the Children’s Health Insurance Program (CHIP), in which some states have greater percentages of benefits recipients than others [25]. Another contributing factor could be that states and counties can vary widely in their demographic/socioeconomic compositions. For example, state and local variation in immigration status may be particularly important, as undocumented immigrants who would otherwise have income and categorical eligibility for Medicaid can only obtain emergency services, and legal permanent residents who would otherwise have income and categorical eligibility for Medicaid or CHIP may be ineligible for those programs if

they have not been resident in the USA for 5 or more years [26]. Also, cost of living is not accounted for in the FPL, so some less costly places to live may have a larger population with income <250 % FPL [27]. For these reasons, program administrators at the state and substate levels can play a very helpful role in assessing how their individual programs should define “low-income” and how to use the eligibility estimates.

There are a number of limitations to the data sources discussed here and the estimates of percent eligible calculated from them. CPS ASEC and ACS estimates are based on responses from a sample of the population and may differ from actual values because of sampling and non-sampling error. Estimates of sampling error are provided with both CPS ASEC and ACS data. Estimates of non-sampling error cannot be determined [21, 28]. SAHIE contains errors stemming from model error, sampling error, and non-sampling error. SAHIE CIs are provided to indicate the reliability of the estimates. Subject to the validity of the underlying model assumptions, these reflect uncertainty due to the effects of model error and sampling error, but do not account for the effects of non-sampling error. Another limitation is that while Census Bureau data provide estimates of the population without health insurance coverage, NBCCEDP eligibility may extend to

“underinsured” women whose coverage does not include the full cost of screening. Also, the Census Bureau determines poverty status using the income levels defined by the federal poverty thresholds, which are used for official poverty statistics. In contrast, the NBCCEDP grantees may determine income eligibility based on the federal poverty *guidelines*, which are a simplified version of the poverty thresholds [29]. Finally, all data presented in figures are based on calculations representing the FPL at or below 250 %, rather than individual state-specific poverty levels used by each program.

The Census Bureau has made some changes and is considering additional adjustments to the data sources (CPS ASEC, ACS, and SAHIE) in order to reflect the Affordable Care Act (ACA) implementation. Starting with the 2014 CPS ASEC, the health insurance questions were redesigned to include questions on health insurance exchanges. The 2014 CPS ASEC will serve as a baseline for 2013 health insurance coverage to facilitate the assessment of the impact of the new legislation [30, 31]. ACS data currently cannot distinguish between coverage through an exchange and other types of coverage, although this will likely be investigated in the future. The first set of post-ACA implementation estimates for all U.S. counties is expected to be the release of 2014 SAHIE in 2016. The SAHIE program is developing a methodology to incorporate more current Medicaid participation data so that the 2014 SAHIE will reflect Medicaid participation expansion as a result of the ACA. These developments in data sources will assist programs such as the NBCCEDP in determining how their eligible populations have changed over time, perhaps as a result of the ACA [32].

Census Bureau data sources (CPS ASEC, ACS, SAHIE) provide reliable estimates of health insurance coverage by socioeconomic characteristics within various geographic levels in the USA. These data sources have proven to be useful for federal, state, and local program administrators; policy makers and researchers for assessing the size, location, and makeup of populations in need; the impact of programs; and for making policy and resource allocation decisions. In addition to being used by the NBCCEDP, these Census Bureau data sources can be used to assess the reach of many other kinds of programs whose eligibility criteria include FPL and health insurance coverage status. The data sources continue to evolve with the implementation of the ACA and can provide helpful information for assessing the legislation’s impact.

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## Erratum to: Data sources for identifying low-income, uninsured populations: application to public health—National Breast and Cervical Cancer Early Detection Program

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In the original publication of the article, references 14 and 15 have not been cited properly. The corrected references are given below.

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