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Access to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) at the State and Substate Levels: Meaning and Measurement

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Access to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) at the State and Substate Levels: Meaning and Measurement

Kegan O'Connor, Mark Prell, Linden McBride, Thomas B. Foster, Renuka Bhaskar, Maria Perez-Patron, Erik Vickstrom, Brian Knop, and Michaela Dillon

Abstract

This study estimates eligibility and access rates for the U.S. Department of Agriculture's (USDA) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) using micro-level WIC administrative data linked with American Community Survey (ACS) data. This study is one result of a long-term research collaboration among USDA's Economic Research Service; the U.S. Department of Commerce, Bureau of the Census; USDA's Food and Nutrition Service (FNS); and participating State WIC agencies. By analyzing WIC participation at the State and substate levels, the report provides insights into program reach and demographic differences. The findings confirm that the Census Bureau estimates meet high statistical reliability standards, providing valuable data for program officials, managers, and other stakeholders to enhance program outreach and effectiveness. A key focus of the report is the comparison between Census Bureau and USDA, FNS estimates, which differ in methodology and measurement scope. Using data from the Arizona Department of Health Services for a case study, the analysis finds that Census Bureau estimates of WIC access rates for infants and children vary widely across Arizona counties, ranging from about 13.3 percent to 79.0 percent. The relatively low access rates of some counties reflect how a large proportion of their WIC clients may access the program through an Indian Tribal Organization, in which case their participation is not recorded in data of the Arizona Department of Health Services.

Keywords. Supplemental Nutrition Assistance Program for Women, Infants, and Children (WIC); WIC participation; WIC participation rate; WIC coverage rate; WIC access rate

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Access to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) at the State and Substate Levels: Meaning and Measurement

WIC Eligibility and Access Rates

This report outlines the methods, including novel data linkages, by which the U.S. Department of Commerce, Bureau of the Census (Census Bureau) estimates eligibility and access rates for the U.S. Department of Agriculture's (USDA) Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The Census Bureau bases its WIC eligibility and access rates on methods adapted from those USDA, Economic Research Service (ERS) developed for estimating eligibility and access for USDA's Supplemental Nutrition Assistance Program (SNAP) using SNAP administrative data linked to the American Community Survey (ACS) (Newman & Scherpf, 2013). The two data sources for the Census Bureau estimates of WIC eligibility and access are the ACS and WIC administrative data provided by participating States. The survey and administrative data are linked at the person level in a secure data environment, protecting confidentiality.

This report describes major similarities and differences between the methods used by the Census Bureau and those used by USDA's Food and Nutrition Service (FNS) to develop estimates of participation among eligible individuals. We examine Census Bureau estimates of WIC eligibility and access at the State level and at the county level for Arizona, which is a midsized State with total WIC participation (for women, infants, and children) ranked 13th among State WIC agencies in fiscal year 2021 (USDA, Food and Nutrition Service, 2024a). State agencies have requested a report that compares methods used by the Census Bureau and USDA, FNS. This report is intended to meet that request, informing State agencies as well as other program stakeholders and researchers. While the use case of this report considers a single State, Arizona, and cross-county comparisons within Arizona, program officials and researchers interested in other States can use these methods and adapt its insights for other States.

WIC aims to safeguard the health of five categories of participants: pregnant women, breastfeeding postpartum women, non-breastfeeding postpartum women, infants, and children up to age 5. To be eligible for WIC benefits, an individual (from one of the five categories) must be at nutritional risk and belong to a family with income less than or equal to 185 percent of the Federal Poverty Guidelines based on family size.¹ WIC provides nutritious foods to supplement diets, breastfeeding promotion and support, information on healthy eating, and referrals to health care and social services.

WIC touches the lives of many U.S. residents. In fiscal year 2021, the year on which the study focuses, about 39 percent of all U.S. infants, 17 percent of pregnant women, 22 percent of postpartum women, and 23 percent of children between 1 and 4 years of age participated in the program (Kessler et al.,

¹ Certain individuals can be deemed adjunctively income-eligible based on: their eligibility to receive benefits from the Supplemental Nutrition Assistance Program (SNAP), Medicaid, or Temporary Assistance for Needy Families (TANF); or certain family members being eligible for Medicaid or TANF; or, if a State agency adopts the option, the individuals are eligible to participate in certain other programs administered by the State (USDA, Food and Nutrition Service, 2024).

2023a). At that time, total participation in WIC was 6.2 million people in a typical month at an annual Federal cost of \$5.0 billion (Jones et al., 2022). More recent figures for fiscal year 2022 are 6.3 million WIC participants and \$5.7 billion for the annual Federal cost (Toossi & Jones, 2023).

The estimates of WIC eligibility and access examined in this report use combinations of survey and administrative data from calendar years 2018 through 2021, the most recent year for which WIC administrative data were available at the time of the analysis. Additional substate estimates for Arizona and other States are available on the Census Bureau’s website (Census Bureau, 2021a). In 2024, public estimates are available on the Census Bureau’s website for eight State WIC agencies: Arizona, Colorado, Idaho, Kansas, Montana, Pennsylvania, South Dakota, and Wisconsin.² The estimates are developed as part of the Census-FNS-ERS Joint Project—a research partnership among the Census Bureau; USDA, FNS; USDA, ERS, and participating State WIC agencies (USDA, Economic Research Service, 2022).

The Census Bureau provides estimates of two rates (proportions) for WIC infants and children:

- Eligibility rate—the number of infants and children who are estimated to be eligible for WIC as a share of the overall number of infants and children in the general population.
- Access rate—the number of infants and children participating in WIC as a share of the number of those estimated to be eligible for WIC.

Of these, the WIC access rate is often of particular interest because it measures program reach—the effectiveness of WIC in reaching the people the program is designed to serve.

A strength of the Census Bureau estimates and the USDA, ERS methodology (Newman & Scherpf, 2013) on which they are based is that substate estimates are possible, providing highly detailed information within a State on its counties and demographic and socioeconomic subgroups. Such information is valuable to WIC policymakers, program managers, researchers, stakeholders, and the public. Knowing the demographic characteristics of those who receive WIC benefits and those who, among eligible individuals, do not, strengthens WIC administration and research, including the assessment and improvement of program performance and targeting outreach.

The set of estimates has limitations. First, eligibility and access estimates for women are not available because women’s categorical eligibility is largely unobservable in the available data. This lack of observability occurs because the survey data used for the estimates do not specifically identify pregnant or postpartum women. Second, although estimates are made for infants and children by age (estimates are produced separately for each of 0-, 1-, 2-, 3-, and 4-year-olds) and by combining all 0–4-year-olds, estimates for the combined 1–4-year-olds—those categorized as children and not infants by the WIC program—are not currently reported by the Census Bureau.³ Third, not all State agencies share an extract of WIC administrative data with the Census Bureau. Finally, some States have Indian Tribal Organizations (ITOs) that operate as independent WIC agencies and whose WIC participants are recorded in ITO data and not in data of the WIC agency that serves most of the area in the State. For example, for this study’s use case, WIC administrative data provided to the Census Bureau from the Arizona Department of Health Services (ADHS) do not include data from two ITOs that operate in Arizona. As a result, a limitation of the estimates of WIC access rates for Arizona, though not necessarily for other States, is that they are subject to a type of coverage error described in more detail below.

² Data-sharing agreements are in place with some States besides those listed, but estimates are not yet available on the Census Bureau website. The Census Bureau welcomes participation from additional WIC State agencies.

³ No technical or data disclosure issue prevents estimates for children as a subgroup, but currently such estimates have not been developed.

By examining methodology, data quality, and interpretation of estimates, this study can aid WIC administrators and researchers to better understand and use the Census Bureau estimates. Methods and lessons from this study and the Census-FNS-ERS Joint Project can inform other efforts to measure eligibility and access for other Federal programs. Administrative data and linked data provide opportunities for measuring the extent to which a program serves various populations, including smaller populations, which can be difficult to measure well in a survey.

The primary audience for this study includes State-level WIC program administrators, researchers, and other program stakeholders interested in measuring how well WIC reaches the people it is designed to serve. This report's focus is on the essentials of estimation and the interpretation of the Census Bureau estimates. To provide fuller understanding of the measurement and meaning of the Census Bureau estimates, the study first compares them with USDA, FNS estimates, which are based on different data and methods. Then the study examines State-level and county-level estimates for the State of Arizona. It assesses the estimates' statistical reliability, a key dimension of data quality, using standards adopted by the Census Bureau for the ACS. A related study by McBride et al. (2022) includes demographic estimates and certain technical details on estimation that are not included here.

Glossary

ACS: American Community Survey

ADHS: Arizona Department of Health Services

CBDRB: Census Bureau Disclosure Review Board

CDC: Centers for Disease Control and Prevention

Census Bureau: U.S. Department of Commerce, Bureau of the Census

CI: Confidence Intervals

CV: Coefficient of Variation

CPS/ASEC: Current Population Survey, Annual Social and Economic Supplement

CWF: Constructed WIC Family

DHHS: U.S. Department of Health and Human Services

ERS: USDA, Economic Research Service

FNS: USDA, Food and Nutrition Service

FPG: Federal Poverty Guidelines

FY: Fiscal Year

IPUMS: Integrated Public Use Microdata Series

ITO: Indian Tribal Organization

continued on next page ►

ITCA WIC: Inter Tribal Council of Arizona WIC
ME: Margin of error
NNWIC: Navajo Nation WIC
NSWP-III: Third National Survey of WIC Participants
PII: Personally Identifiable Information
PIK: Protected Identification Key
PVS: Person Identification Validation System
SE: Standard Error
SFTP: Secure File Transfer Protocol
SIPP: Survey of Income and Program Participation
SNAP: Supplemental Nutrition Assistance Program
SSN: Social Security Number
TANF: Temporary Assistance for Needy Families
USDA: United States Department of Agriculture
WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

Definitions of Coverage Rates and Access Rates

For many years, USDA, FNS has published estimates of the WIC-eligible population and of participation among the eligible at the national, regional, and State levels (Kessler et al., 2023a; 2023b). USDA, FNS estimates have informed a number of national activities, including helping guide USDA, FNS and USDA preparation of WIC budgetary requests for the U.S. Congress; supporting evaluation of program reach; supporting research on effects of changes in WIC legislation, administrative policies, or external factors such as macroeconomic conditions and fertility behaviors; and informing outreach to eligible populations with relatively lower participation (Ver Ploeg & Betson, 2003).

The Census Bureau; USDA, FNS; and USDA, ERS developed and implemented plans in partnership with State WIC agencies to construct similar estimates at the substate level, tailoring the data and methodology as needed.⁴

Both the Census Bureau and USDA, FNS develop estimates that share a common purpose: to measure participation among eligible individuals. However, the data and methods that generate the Census Bureau estimates differ from those that generate the USDA, FNS estimates (table 1). The differences between the Census and USDA, FNS estimates are substantial enough that two terms have been

⁴ In addition to supporting estimation of WIC access rates, WIC administrative data provided by States informs decisions about how to improve Census Bureau surveys (which collect data on WIC participation), the decennial Census of Population and Housing, the measurement of poverty, and data-linkage processes.

adopted to distinguish them: access rates (Census Bureau) and coverage rates (USDA, FNS). For a given State and year, access rates and coverage rates may be similar to one another at the State level, where they can both be measured and compared. Even so, the two rates can be expected to differ for more reasons than sampling error.

Table 1

Key features of USDA, Food and Nutrition Service (FNS) WIC coverage rate and Census Bureau WIC access rate

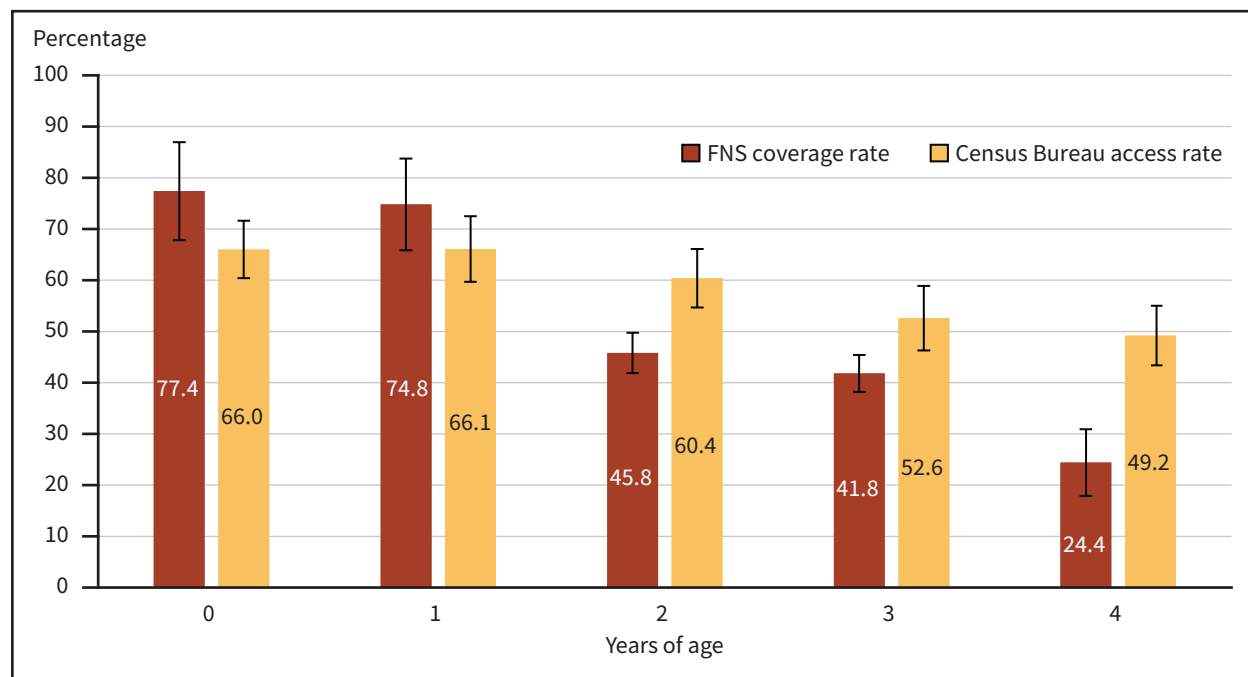
Feature	USDA, FNS WIC coverage rate	Census Bureau WIC access rate (on Census Bureau website)
Concept of prevalence	Point prevalence	Period prevalence
Timeframe for eligibility	Average month (of the year)	At some time (ever) during a 12-month period; the 12-month period differs across households, spanning 2 years
Timeframe for participation	Average month (of the year)	At some time (ever) during a 2-year period
Key survey data	Current Population Survey, Annual Social and Economic Supplement (CPS/ASEC); Survey of Income and Program Participation (SIPP); American Community Survey (ACS)	American Community Survey (ACS)
Years of survey data	1 year of CPS/ASEC, although State proportions to allocate national totals to States are based on 2 years of ACS data; adjustment factors that address differences in monthly and annual income and differences in certification periods are from the SIPP	Either 1 year or 3 years for State-level; 3 for county level
Type of WIC administrative data	Aggregated (to subgroup level)	Individual level
Years of administrative data	1	2 for State-level; 4 for county level
Formation of the rate	Aggregate approach: a ratio of two (aggregate) numbers obtained separately; can and has exceeded 100.0 percent	Linkage approach: a subgroup as a proportion of a group (participants as proportion of eligible individuals); cannot exceed 100.0 percent
Geographic granularity	National; regional; all individual States	Certain individual States; counties within those States
Demographic granularity at national level	By participant category; children's age; urbanicity; annual family income relative to 185 percent of Federal Poverty Guidelines	Not available
Demographic granularity at State level	By participant category; children's age; and race/ethnicity	Infants and children (as a combined group); by infant's or child's age; by race/ethnicity; by additional subgroups based on demographic information in ACS
Demographic granularity at county level	Not available	Infants and children (as a combined group); by infant's or child's age; by race/ethnicity; by additional subgroups based on demographic information in ACS

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service based on Kessler et al., (2023), U.S. Department of Commerce, Bureau of the Census (2021a), and authors' summary.

For 2021, figure 1 shows estimated USDA, FNS coverage rates for Arizona, with separate estimates for infants, with years of age of 0, through children 4 years of age, along with 95-percent confidence intervals. Alongside each age-specific coverage rate is the Census Bureau access rate for each age category. Age-specific differences between coverage rates and access rates are sometimes positive, with the coverage rate exceeding the access rate, and sometimes negative.

Figure 1
WIC coverage rate and WIC access rate in Arizona, by years of age, 2021



Note: USDA, Food and Nutrition Service (FNS) estimates the Special Supplemental Nutrition Program for Women, Infants, and Children program (WIC) coverage rates and the U.S. Department of Commerce, Bureau of the Census estimates the WIC access rates for Arizona for 2021. The figure shows 95-percent confidence intervals based on reported 95-percent margins of error for Census Bureau estimates and deriving the intervals from report coefficients of variation for the FNS estimates.

Estimated access rates do not include infants and children who receive benefits from Navajo Nation WIC or Inter Tribal Council of Arizona WIC.

Source: USDA, Economic Research Service based on Kessler et al., (2023b), Arizona WIC administrative records, 2020–21) linked to 1-year American Community Survey data, 2021. Census Bureau Disclosure Review Board release numbers CBDRB-FY19-167, CBDRB-FY19-575, CBDRB-FY20-154, CBDRB-FY21-108, CBDRB-FY22-190 and CBDRB-FY23-0376.

For example, for infants, the difference between the coverage rate of 77.4 percent and the access rate of 66.0 percent is 11.4 percentage points. While this difference can plausibly be attributed to sampling error based on the 95-percent confidence intervals, factors besides sampling error also affect it. The difference for the two estimates for infants reflects, in part, the timing of data receipt at the Census Bureau and the availability of related data that the Census Bureau uses to create and assign Protected Identification Keys (described below) for the agency’s linkage process (McBride et al., 2022). Such factors as timing and data availability may lead to underestimates of access rates for infants. The Census Bureau is exploring whether adjusting the process for creating the Protected Identification Keys can improve the completeness of data available for linking. In addition to these factors, other, more important, differences in data sources and methods contribute to differences between access rates and coverage rates for infants and for other age categories.

Ultimately, the Census Bureau estimates are complementary to the USDA, FNS estimates because information can be gleaned from both of them. The Census Bureau access rates can be used, metaphorically, as a common “yardstick” for making comparisons between: (a) State-level estimates of different States; (b) intra-State estimates for different areas or demographic groups; and (c) one State’s substate geographic or demographic estimate and another State’s estimate.⁵ This report’s use case contains two county-level analyses based on Census Bureau estimates for WIC eligibility rates and WIC access rates. These county-level comparisons are based on a common measure, one that uses common data sources and methods. In contrast, making a comparison between access rates and coverage rates involves two measures and two different yardsticks, as we consider in the sections that follow.

WIC Coverage Rates from USDA, FNS

In general terms, USDA, FNS defines the WIC coverage rate for a given year as the number of women, infants, and children participating in WIC compared with the number of people modeled to be eligible for WIC.⁶

(1) *Coverage rate for infants, children, and women*

$$= 100 * \frac{\# \text{ Participants in an average month of a year}}{\# \text{ Modeled eligible individuals in an average month of a year}}$$

We emphasize that the USDA, FNS coverage rates are estimates for an “average” month; the Census Bureau access rates use a different timeframe.

The estimation process in equation (1) is based on an aggregate approach by which figures for participants and modeled eligible individuals are obtained separately from one another.

Because the coverage rate in (1) is defined at the broadest level across all participant categories, it would need to be tailored or adapted to obtain a coverage rate for a subgroup. For example, if the coverage rate of just 4-year-olds is to be considered, the definition in (1) would be tailored to include participants and eligible individuals only from that subgroup.

Studies have found that WIC participants—like participants in other government assistance programs—tend to underreport participation to surveys.⁷ As an alternative to survey data, USDA, FNS coverage rates use WIC administrative data to obtain the numerator in (1), obtaining a very high degree of accuracy.

⁵ The USDA, FNS coverage rates, which are available at the State level, can also be compared across States.

⁶ The coverage rate has also been called a “participation rate among the eligibles” (Ver Ploeg & Betson, 2003) and a “take-up rate” (Bitler et al., 2003). We focus on official coverage rates estimated by USDA, FNS, although other studies, such as Bitler et al. (2003) and Jacknowitz and Tiehen (2010), have also estimated coverage rates using various data and methods.

⁷ See Meyer et al. (2015) for a study of underreporting of WIC benefit receipt on four national surveys. See Fox and Hoyakem (2022) for a study that linked the CPS/ASEC to WIC administrative data for eight States covering 2009–17 (survey years 2010–18); not all eight States provided data for the entire study period. On average, about two-fifths (41.5 percent) of WIC participants who were in WIC administrative records did not report receiving WIC in the CPS/ASEC (underreporting); about 1.2 percent of those who did report receiving WIC in the survey data were not found in the WIC administrative records (overreporting).

The number of eligible individuals (in the denominator of (1)) must be estimated. Estimates of the eligible population—regardless of whether they applied for WIC—require a demographic survey and a model that is designed to identify as well as possible with available data which individuals would be eligible if they did apply for WIC.⁸ Survey data do not capture all the information that WIC offices use to determine eligibility; therefore, the estimation, or modeling, of eligibility is imperfect.

USDA, FNS coverage rates use income data from the Annual Social and Economic Supplement (ASEC) of the Current Population Survey (CPS), along with CPS/ASEC data on household composition, to estimate income eligibility for WIC. Although the income data are subject to reporting error, they are considered to be high-quality data.⁹ Households are surveyed for the CPS/ASEC in February through April; most CPS/ASEC data are collected in March (Census Bureau, 2006). Income data in the CPS/ASEC refer to annual income of the previous calendar year (Census Bureau, 2019a).

Some households are income-eligible for WIC for some months of the year, based on having low income for those months, even if they have annual income that exceeds 12 times the monthly limit on income. Based on data from the Survey on Income and Program Participation (SIPP), the USDA, FNS methodology introduces adjustment factors to account for (a) differences between annual and monthly income, and (b) differences in the certification periods (6 months or 12 months) that States adopt for WIC children, while 12-month certification periods are the same for all infants (Kessler et al., 2023a). Thus, the adjustment factors are the statistical device by which data on annual income support estimation of the number of eligible individuals in an average month of the year.

Social science research has two broad approaches for defining the proportion of a population experiencing some characteristic such as WIC participation. Each approach adopts a particular timeframe for reference. These approaches are distinguished carefully in epidemiology, and here we adapt that field's terminology. The point prevalence is the number of people, as a proportion of the population, who have the characteristic (WIC participation) at a specific time (Gordis, 2009). In contrast to a point prevalence, a period prevalence is the proportion of people who have exhibited the characteristic “at some time” (or “ever”) within a stated time period, such as a year or several years.¹⁰

For a rough analogy, consider the prevalence of U.S. households that experience the condition of very low food insecurity, characterized by instances of reduced food intake and disrupted eating patterns (Rabbitt et al., 2022). Based on nationally representative data collected from December 11 to 20, 2022, an estimated 2.8 percent of U.S. households experienced the condition in the 30 days prior to the survey. That estimate is a point prevalence.¹¹ Based on data from all households in the same sample, an estimated 5.1 percent of U.S. households experienced the condition sometime in the previous 12 months, that is, “at some time during the year,” a period prevalence. Both estimates involve food insecurity, but they are not two measures of the same thing. Even if complete data for all U.S. households were available instead of sample data, the 30-day and the 12-month measures of food security would differ because they cover two different timeframes.

⁸ Requirements for WIC eligibility are summarized below when reviewing the Census Bureau methodology for estimating WIC eligibility.

⁹ The Census Bureau uses the income data to develop official estimates of the number of individuals in poverty and the U.S. poverty rate (Creamer et al., 2022).

¹⁰ This distinction in timeframes is encountered on Federal surveys that solicit information on SNAP participation and must specify a timeframe for the question. A question with a point-in-time timeframe asks whether a survey household “currently” receives SNAP (in the current month). A question with an at-some-time timeframe may ask whether SNAP was received in one or more months of the past year.

¹¹ The 30-day food security measure is not a perfect analogy for the USDA, FNS coverage rate. The 30-day food security measure is for a 30-day period that occurs before the household's interview data. In contrast, the USDA, FNS coverage rate is for an “average month” of the year, which reflects data that pertain across all the months of the year. Nevertheless, an average-month measure resembles a point prevalence more than a period prevalence that refers to “sometime during the year.”

Operationally, a “point in time” (cross-section) prevalence need not refer to a single day. In the context of WIC, the proportion of people who receive WIC benefits in a given calendar month (rather than a given calendar day), relative to all who are eligible that month, can be deemed to be a point prevalence.

Of the point prevalence and period prevalence, the USDA, FNS coverage rate resembles a point prevalence most closely. The USDA, FNS coverage rate refers to an “average month” of a calendar year rather than a specific calendar month. The USDA, FNS coverage rate is tantamount to a point prevalence for an “average month.”¹² In contrast, the Census Bureau access rate resembles a period prevalence most closely.

Reflecting the use of a ratio of two aggregates, which are measured separately from one another, the estimated USDA, FNS coverage rate can exceed 100.0 percent (even though, conceptually, participation among eligible individuals cannot exceed 100.0 percent). USDA, FNS estimates of coverage rates on occasion exceed 100.0 percent for some subgroups for some States (and, more rarely, for a subgroup at the regional or national level). USDA, FNS has attributed these unusual rates largely to sampling variability in survey data used to estimate the number of eligible individuals (Kessler et al., 2023a).

USDA, FNS publishes coverage rates for the WIC-eligible population and for the several categories of eligible individuals, and for children by age (Kessler et al., 2023a).¹³ Table 2 reports national coverage rates based on USDA, FNS data. Infants have the highest estimated coverage rate, with 78.0 percent of eligible infants participating in WIC in 2021. Children have the lowest coverage rate, with less than half—43.2 percent—of eligible children participating (on average across age subgroups). USDA, FNS estimated the overall 2021 WIC coverage rate at 51.2 percent.

Table 2
Estimated national Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) coverage rates for infants, children, and women, calendar year 2021

Category	Participants (average monthly) (1)	Estimated number of eligible individuals (average monthly) (2)	Coverage rate (3) 100*(1)/(2)
Infants	1,440,283	1,846,394	78.0
Children	3,395,487	7,851,014	43.2
1-year-olds	1,191,689	1,852,884	64.3
2-year-olds	906,409	2,051,553	44.2
3-year-olds	800,319	1,932,072	41.4
4-year-olds	497,070	2,014,506	24.7
Women	1,369,373	2,433,888	56.3
Overall	6,205,143	12,131,296	51.2

Note: The category of women combines the separate WIC categories of pregnant, breastfeeding postpartum, and non-breastfeeding postpartum women. Figures may not sum to totals exactly due to rounding error.

Source: USDA, Economic Research Service based on Kessler et al., (2023a), and calculations by authors using reported data.

¹² This same measure can also be called an “average annual” point prevalence as long as “average annual” is understood to be an average of 12 monthly values within a specified year rather than an average of many years. To obtain an “average annual” unemployment rate based on monthly data, the Bureau of Labor Statistics uses the ratio $(\sum U_t / \sum L_t)$ where U_t and L_t represent 12 monthly values for the numbers of unemployed and the numbers in the civilian labor force, respectively (U.S. Department of Commerce, Bureau of the Census, 2019b). Although it uses a multiplier to assist with estimation of eligibles in an average month, the USDA, FNS coverage rate is designed to be akin to the ratio $(\sum W_t / \sum E_t)$ where W_t and E_t represent 12 monthly values for WIC participants and eligibles, respectively, making the result an “average annual” participation rate and an “average annual” point prevalence.

¹³ USDA, FNS also reports 2021 coverage rates at the national level in a two-way classification by participation category and race/ethnicity, and at the State level by participant category and, separately, by race/ethnicity (Kessler et al., 2023a).

WIC Eligibility and Access Rates from the Census Bureau

Using the Census Bureau methods, the WIC eligibility rate for infants (I) and children (C) together, as a combined group, is:¹⁴

(2) *Eligibility rate for infants and children*

$$= 100 * \frac{\# I \text{ and } C \text{ modeled as eligible "at some time" in 2-year period}}{\# I \text{ and } C \text{ in the general population}}$$

The WIC access rate for infants and children together can be defined as:

(3) *Access rate for infants and children*

$$= 100 * \frac{\# I \text{ and } C \text{ participating "at some time" in 2-year period}}{\# I \text{ and } C \text{ modeled as eligible "at some time" in 2-year period}}$$

This section and the next two explain differences between the definitions of the access rate in (3) and the coverage rates in (1) apart from the inclusion of women in the USDA, FNS coverage rate in (1) and the omission of women in the Census Bureau access rate in (3). That is, even if coverage rates and access rates are compared for the same target population, inherent differences exist between the coverage and access rates.

The access rate in (3) is the broadest access rate that the Census Bureau measures. The definition is tailored or adapted to obtain an access rate for a subgroup. For example, if just 4-year-olds are to be considered, the definition in (3) is tailored to include participants and eligible individuals only from that subgroup.

Like the USDA, FNS estimates, the Census Bureau estimates use WIC administrative data to measure participation. An issue of WIC administrative data is that they contain limited demographic information.¹⁵ A strength of survey data is that they contain detailed information on several demographic and socioeconomic characteristics. By acquiring and then linking administrative and survey data, the WIC access rates leverage the strengths of both data sources.

The linkage approach used for the access rate in (3) starts with the ACS file that pertains to a calendar year (but has as its reference period for questions on income the 12 months prior to the interview, which can span calendar years) and estimates who in the file can be deemed to be eligible for WIC. The process then links to the WIC administrative data and “counts” an eligible individual as a participant if that individual is found (via linkage) in WIC State agency records. Thus, the process tallies up the number of participants as a subgroup among a group of linked eligible individuals. This linkage method has a subtle and desirable statistical effect. The estimated access rate must necessarily be a proportion that cannot exceed 100.0 percent (in contrast to the aggregate approach used to estimate the USDA, FNS coverage rate). Further details on the linkage process, including identifying WIC participants who are initially missed when identifying eligible individuals, are provided after describing data sources that the Census Bureau uses for estimating WIC eligibility and access rates.

¹⁴ The section below on “Twelve-month reference period for reporting income” explains that income eligibility is modeled using a 12-month reference period for any one infant or child, but that for infants and children as a group the period of eligibility is a 2-year period due to the rolling sample used in the American Community Survey.

¹⁵ It is typical for administrative data to collect little information beyond what is required to conduct program operations.

The definition of WIC eligibility and access rates in (2) and (3) and the discussion that followed are based on using a single year’s worth of ACS records for analysis, which is closest to the USDA, FNS methodology. When the Census Bureau uses this approach, the results are known as “1-year estimates.”¹⁶ However, to obtain sufficiently large sample sizes for estimates at substate levels of geography, the approach used to obtain county-level estimates of WIC eligibility and access rates relies on 3 years’ worth of ACS, resulting in “3-year estimates.” For infants and children in Arizona in 2021, the 1-year estimate of the WIC eligibility rate is 55.3 percent, with a margin of error (ME) of 1.9 percent. The 1-year estimate of the WIC access rate for infants and children is 58.5 percent, with an ME of 3.3 percent.

In addition, for comparability with the county-level estimates, the Census Bureau produces 3-year estimates at the State level for eligibility and access rates, thus using the same data spanning the same years for both county-level and State-level.

Data Sources

The Census Bureau receives WIC administrative data from participating State WIC agencies and uses the agency’s own American Community Survey for the aforementioned survey data.

WIC Administrative Data

To produce a 1-year State-level estimate of a WIC access rate for a single (calendar) year of ACS data, the Census Bureau methodology requires 2 successive (calendar) years of WIC administrative data.¹⁷ For example, the 2021 State-level estimates require ACS data for 2021 and WIC administrative data for 2021 and 2020. The need for 2 years’ worth of WIC administrative data springs from the use of the ACS and the combination of its 12-month reference period for income and its rolling sample design.

In contrast to the Census Bureau WIC access rates, the USDA, FNS WIC coverage rates for a given (calendar) year involve WIC administrative data for only that year. For this reason, and others, the Census Bureau and USDA, FNS State-level estimates are not directly comparable even when 1-year WIC access rates are considered.

For county-level estimates, produced at a finer level of geography than the State-level estimates, 3 years of ACS data and 4 successive years of WIC administrative data are used.

The Census Bureau research team identifies WIC participation using WIC benefits that are issued, received, or redeemed, depending on what is available in the State’s files. Some States send data that include WIC participants alone, while others may include variables that flag active monthly participants. While this variation in the way participants are identified across States complicates cross-State comparisons, it is necessary due to the variation in the data that are voluntarily transferred from the States to the Census Bureau. As documented in McBride et al. (2022), despite the variations in the input data, Census Bureau researchers benchmark monthly participant estimates against those

¹⁶ The terminology refers to the number of years of ACS data involved even though 2 years’ worth of WIC administrative data are used.

¹⁷ A participating State shares an extract of its WIC administrative data with the Census Bureau for statistical and research purposes. To ensure that the data remain confidential, State WIC agencies send data to the Census Bureau using a secure file transfer protocol (SFTP) or by CD or DVD. In return for the State’s data, the Census Bureau provides the State a package of eligibility and access rates at the State and substate level.

publicly available through USDA, FNS. The participant data received from the Arizona Department of Health Services (ADHS) are based on issuances of WIC benefits to an individual.

It was noted above that WIC administrative data provided to the Census Bureau by the ADHS do not include data from two ITOs that operate in Arizona; the Navajo Nation WIC (NNWIC) and the Inter Tribal Council of Arizona (ITCA WIC). The lack of complete data introduces a type of coverage error.

In traditional methodology for survey statistics, a target population is a set of units to be studied, while the frame is the list of units from which the sample will be drawn (Groves et al., 2009). If the frame is missing some units of the target population, so that those units have no opportunity to be included in the sample, then a coverage error exists that can also be called an undercoverage error. Recently, with the increasing use of linked, integrated, or blended data, the concept of coverage error has been extended beyond the realm of survey data. With a secondary re-use of other sources of data, such as administrative data, a new type of coverage error occurs when the universe or target population for which the data were originally collected does not match the new target population under study (Federal Committee on Statistical Methodology, 2020).

To estimate the WIC access rate either for the State of Arizona or for its constituent geographic counties, it is presumed that the target population is all infants and children who are eligible for WIC, regardless of whether those eligible individuals would apply for and access WIC benefits from the ADHS, NNWIC, or ITCA WIC. To identify the full group of participants among that target population, participation data would be needed for NNWIC and ITCA WIC in addition to ADHS. Because the available WIC administrative data do not include—do not “cover”—ITO participants, they cannot be counted; coverage error here means that not all participation among individuals eligible for WIC is being counted. As a result, the estimated access rates are biased downward—lower than what they would be if full data on participants were available.¹⁸

American Community Survey (ACS)

The ACS is an ongoing, nationally representative survey of U.S. households that collects data on household and individual characteristics, including age, sex, race, ethnicity, income, participation in government assistance and social insurance programs, and household and family structure.¹⁹ Among the many aspects of the ACS that affect the estimation of WIC eligibility and access rates, we concentrate on four: sample size, demographic data, the rolling sample design, and the reference period for income items.

Sample size. A key benefit of the ACS for modeling WIC eligibility and access rates is that the ACS is the largest survey conducted by the Federal Government (Census Bureau, 2014). The Census Bureau contacts more than 3.5 million households each year for the ACS (Census Bureau, 2017). The large sample size supports estimation of WIC eligibility and access rates at the substate level while protecting data confidentiality.

Demographic data. The ACS does not collect data on whether a woman is pregnant, postpartum and non-breastfeeding, or postpartum and breastfeeding. The lack of such data in the ACS limits the Census Bureau’s ability to estimate WIC eligibility and access rates for women. Even so, an area of

¹⁸ In statistics, the term “error” does not imply that a mistake has been made. Instead, errors are factors that create differences between an ideal measurement or statistic and the actual one at hand.

¹⁹ See U.S. Department of Commerce, Bureau of the Census (2020) for a list of data collected by the ACS and U.S. Department of Commerce, Bureau of the Census (2022) for the archive of ACS questionnaires.

ongoing research at the Census Bureau is how other potential data sources could be used, in conjunction with the ACS and WIC administrative data, to broaden the set of Census Bureau estimates to include women.²⁰

Rolling sample. While some Census Bureau surveys are fielded to collect data during some part of the year, the ACS is designed to collect data (from different households) each month, resulting in a “rolling” sample. A calendar year of ACS data is composed of 12 distinct monthly samples. Data collection for a given monthly sample lasts 3 months (not just 1 month).²¹ Even so, for discussion we set aside the complication of 3-month collection and suppose that survey respondents provide information in the first month of a monthly sample. That is, the January sample responds to the ACS questionnaire in January, the February sample responds in February, and so forth.

12-month reference period for reporting income. The ACS collects detailed information on income by requesting separate figures for several “sources” or “types” of income such as wage or salary income, self-employment income, and Supplemental Security Income, among other sources (Census Bureau, 2014).²²

To explain the effects of the 12-month ACS reference period for income (in combination with the ACS rolling sample), we first considered how income data are collected on the CPS/ASEC, which FNS uses, together with National Vital Statistics System data, to estimate income-eligible infants and children for national coverage rates (Kessler et al., 2023a).²³ As shown in upper panel (a) of figure 2, the CPS/ASEC income data collected from all surveyed households between February and April 2021 have a reference period for income of January to December 2020. This method of data collection supports estimating eligibility and participation for an “average month” of a single calendar year.

In contrast, the ACS questionnaire (for 2021, for example) asks how much income (from various sources) a person obtained in the “past 12 months” (Census Bureau, 2020). As depicted in lower panel (b), the 12-month reference period for income for a given ACS household depends on which month that household is surveyed. Following the pattern described by the ACS methodology report, for a household surveyed in January 2021 the “previous 12 months” is January 2020 to December 2020, which lies entirely in 2020. All other ACS households surveyed in 2021 report incomes that straddle 2020 and part of 2021.

²⁰ Following a 2020 revision of eligibility estimation methods, FNS estimates the national numbers of pregnant, postpartum, and breastfeeding women who are eligible, and their associated national coverage rates, using the CPS/ASEC and data from the National Immunization Survey and the National Vital Statistics System, both provided by the Centers for Disease Control and Prevention (CDC) (Kessler et al., 2023a). State-level coverage rates for these categories use the CDC data with ACS data rather than CPS/ASEC data (Kessler et al., 2023a).

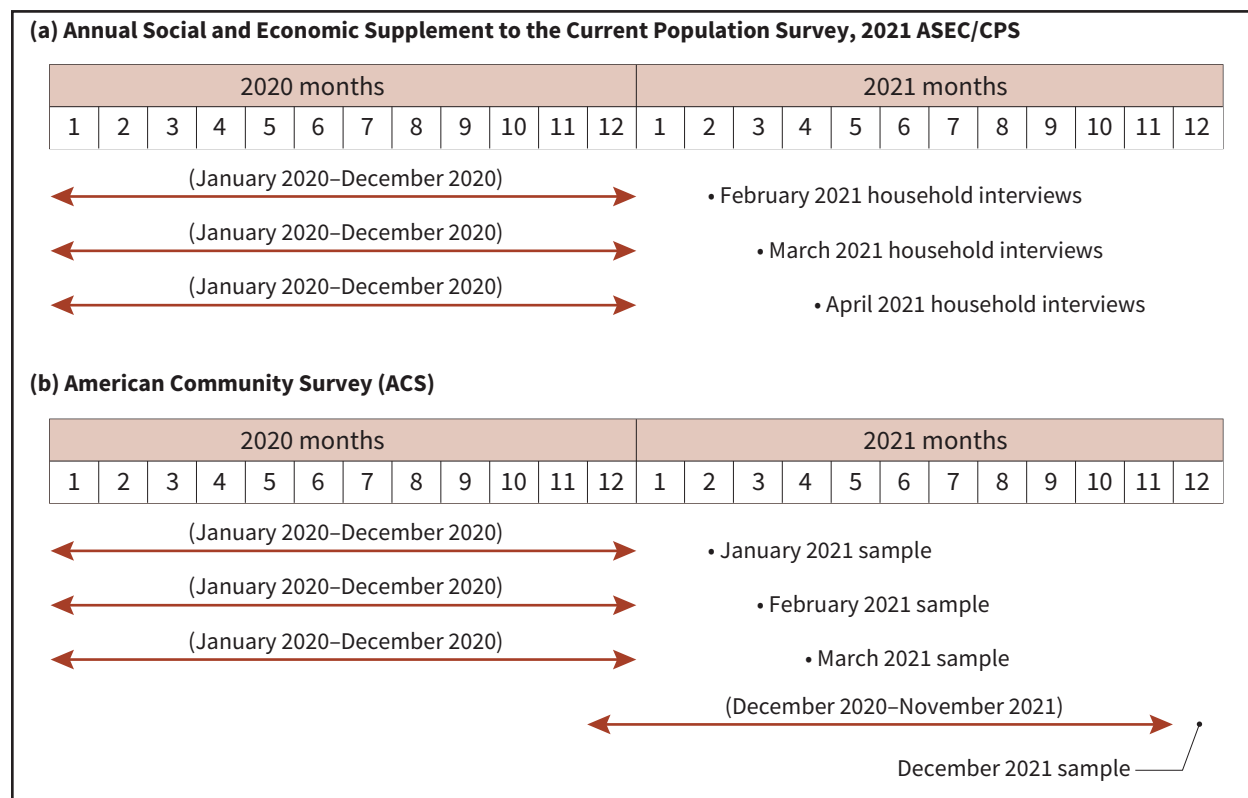
²¹ The 3-month cycle allows for collecting responses from households by mail or the internet in the first month (mail and internet responses are accepted in all three months), contacting households by phone in the second month, and contacting households with a personal visit in the third month (Census Bureau, 2014).

²² Missing values receive an “imputed” value estimated by the Census Bureau (Census Bureau, 2014); imputations are subject to error.

²³ In addition to CPS/ASEC data, ACS data are used to estimate infants and children who are adjunctively eligible by making an adjustment for underreporting in CPS/ASEC data of participation in Medicaid and SNAP; see below the section “Estimating Eligibility” for details on the meaning and measurement of adjunctive eligibility.

Figure 2

The reporting period for income for households in two Census Bureau surveys



Source: USDA, Economic Research Service.

The USDA, FNS national coverage rates and the Census Bureau State access rates both model income eligibility for WIC using a 12-month (annual) period of income.²⁴ Where they differ is that in the USDA, FNS national estimates the income reference periods all co-align with a calendar year, while the income reference periods in the Census Bureau estimates are 12 months long, but they are different 12-month periods of time. The use of 12-month reference periods that stretch across 2 calendar years prompts the phrase “at some time in a 2-year period” to define eligibility and access rates in (2) and (3). The 12-month period for any particular infant or child in the ACS depends on the month of the interview. The estimated income-eligible infants and children as a group are meeting WIC annual income guidelines “at some time” during the 2-year period. Thus, the timeframes used by USDA, FNS for its national coverage rates and by the Census Bureau for its State access rates differ, with the former using “average month” (of a single calendar year) and the later using “at some time” or “ever” (during a 2-year period).

The USDA, FNS coverage rates at the State level originate in the USDA, FNS national-level estimates of the numbers of infants and children, by age—infants, and children ages 1, 2, 3, and 4 years (Kessler et al., 2023a) Thus, like the USDA, FNS national coverage rate, USDA, FNS State-level coverage rates relies on CPS/ASEC data and their calendar-year reference period for income. For each separate age group, the national estimate of eligible individuals is allocated across the States as the product of the

²⁴ In particular, some cases of WIC eligibility are missed by an eligibility model that relies on survey data on annual income; monthly income is not available in the CPS/ASEC, the ACS, or other sufficiently large surveys. Some infants and children can be officially income-eligible when a WIC office uses current monthly income (and the WIC family has a period of relatively low monthly income, due to income fluctuations), but they would not be modeled as income-eligible based on a high annual income that exceeds the WIC annual income limit.

national estimate and a State’s estimated share. ACS data, rather than CPS/ASEC data, are used to obtain the State’s estimated share because the ACS has such a large sample size in all States (Johnson et al., 2017).²⁵ For each age group, a State’s estimated share is obtained by using the ACS data to estimate numbers of infants and children that are eligible for WIC, by State, summing those estimates to obtain a national total, and then deriving each State-specific share.²⁶

Modeling Eligibility

For a person to be officially eligible for WIC benefits, a WIC office must determine that an applicant meets four types of criteria: (A) categorical; (B) residential; (C) income; and (D) nutritional risk (USDA, FNS, 2024c). In its first stage, the Census Bureau model of WIC eligibility (hereafter, the WIC eligibility model) uses ACS data to estimate eligibility for a surveyed infant or child in the ACS. Some of the model’s elements replicate official criteria exactly or quite closely, while other elements are rough approximates. In the model’s second stage, a further and final adjustment in modeling eligibility occurs after linkage between the ACS and the WIC administrative data.

A. Categorical eligibility. A person must be an infant, a child, or a woman who is pregnant or postpartum (USDA, FNS, 2024c). Infants are under 1 year of age. Children are 1 year of age or older but have not yet reached their fifth birthday.²⁷

The Census Bureau WIC eligibility model estimates categorical eligibility for an infant or child using the ACS variable age.

B. Residential eligibility. A person must live in the State where they apply for WIC benefits (USDA, FNS, 2024c). Some of the WIC agencies are ITOs, which set their own residency requirement.

The WIC eligibility model uses ACS information on the State in which the household address is located. The model assumes that all ACS persons reported to reside at that address have resided in that State up to 2 years; this assumption means that the WIC files of only the current State need to be checked for WIC participation.²⁸

The WIC eligibility model does not identify which people living within the State of Arizona might ultimately receive benefits from the Arizona Department of Health Services if they were to apply and which other people might ultimately receive benefits from an ITO if they were to apply. Thus, the number of infants and children estimated to be eligible for WIC, in the denominator of the WIC access rate, includes some people for whom no measure of participation is available for the numerator of the rate.

C. Income eligibility. We highlight five measurement issues encountered in modeling whether an infant or child in the ACS is income-eligible for WIC: a person’s membership in the “WIC family”;

²⁵ Although the data source is often described as ACS, the methodology uses ACS with imputations from the Minnesota Population Center’s Integrated Public Use Microdata Series (IPUMS) data to capture better the relationships between persons not related to the householder.

²⁶ Beginning in 2021, the estimated shares for States began to make use of 2 years’ worth of ACS data (Kessler et al., 2023a).

²⁷ Postpartum women who are not breastfeeding are categorically eligible up to six months after the birth of an infant or the end of the pregnancy, while breastfeeding women are categorically eligible up to 12 months postpartum.

²⁸ The residency assumption may not be appropriate for people who resided in a different State—and perhaps received WIC benefits in that State—prior to a recent move to the current State.

sources of income; comparison of WIC family income to WIC income guidelines; timeframes for determining income; and adjunctive eligibility (through participation in another government program).

1. WIC family. The official WIC definition of a family (or WIC family) is a “group of related or nonrelated individuals who are living together as one economic unit, except that residents of a homeless facility or an institution shall not all be considered as members of a single family.” (Government Publishing Office, 2022).

In the ACS, as in other Census Bureau surveys, a “household” is an address-based concept that includes all people who reside at the same address. An ACS household may contain a single economic unit, in which case everyone in that household belongs to the same constructed WIC family (CWF). However, a household can include more than one economic unit. For example, a boarder may rent a room from the home-owning family, and the boarder pays for food and other items separately from the family. In this case, the boarder would be part of the ACS household (because of living in the same house), but the boarder would be a one-person “economic unit” and thus a one-person CWF. The other people in the household would belong to their own CWF. The challenge for the WIC eligibility model is to use ACS data to identify, as well as possible, the CWF(s) at a given address that includes only those people who would be part of an official WIC family if an application were submitted to a WIC office.

2. Income sources. When determining the income eligibility of a WIC applicant, a WIC office considers many “sources” of income, such as salaries and wages, and adds them together to find the total income of the WIC family (Government Publishing Office, 2022). These same sources of income are captured in the ACS by a detailed set of items on income (Census Bureau, 2018).

3. Income eligibility limit. The Census Bureau WIC eligibility model adopts the 185 percent of the Federal Poverty Guidelines (FPG) threshold to model income eligibility, combining incomes and the number of people in the CWF to estimate income relative to poverty. Federal guidelines delegate to the State WIC agencies the decision of the State’s income standard for a WIC applicant (or, more fully, for the WIC family of which the applicant is a member). However, the State’s income standard must be between 100 and 185 percent of the FPG, which are issued each year by the Department of Health and Human Services (DHHS) (Magness et al., 2021a; 2021b). For the Third National Survey of WIC Participants (NSWP-III), all 89 State WIC agencies (covering the 50 States, the District of Columbia, five U.S. territories, and 33 ITOs) were contacted for 2019 information, and 82 agencies responded. Of these, only two ITOs reported using a threshold of income eligibility lower than 185 percent of poverty; the other 80 agencies used the threshold of 185 percent of poverty.

4. Accounting period for determining income. Due to month-to-month and even week-to-week changes in income, a family can have income that is above 185 percent of poverty when their income is measured for one period (such as a year), but below 185 percent for another (such as a month). While various accounting periods may be used, USDA, FNS reported for an early study on income variability that States “most often use monthly income in determining eligibility” (Gordon et al., 1997).

The Census Bureau WIC eligibility model uses an accounting period for income of 12 months because of the ACS reference period of the “previous 12 months” (prior to the month of the ACS interview) for collecting income data. If a CWF’s income (relative to poverty) falls below the annual limit, the model considers all infants and children in the family to be income-eligible. The income guidelines that are in effect in WIC offices on January 1 are used to model income eligibility for those who are interviewed by the ACS between January 1 and December 31 of that year.

By relying on 12-month income, the Census Bureau WIC eligibility model misses counting as eligible those who would be officially eligible if they applied at the WIC office during a month of particularly low income (the ACS does not record monthly income). As a result, it is considered likely that the Census Bureau WIC eligibility model tends to underestimate the numbers (or prevalence) of people who are income eligible for WIC (McBride et al., 2022). The underestimation of income eligibility by the model has the effect of overestimation of the WIC access rate (participation among eligible individuals), holding other factors constant.

The absence of adjustment factors to account for differences between monthly and annual income for the Census Bureau estimates of WIC access rates reduces their comparability with FNS estimates. Whether and how to integrate adjustment factors into the Census Bureau’s methodology—which is built around individual-level linkages rather than estimates of separate aggregates for numerator and denominator of (1)—remains a topic for future research at the Census Bureau (McBride et al., 2022).

5. Adjunctive and automatic eligibility. Individuals are deemed to have met the WIC income-eligibility requirement “adjunctively” by participation in another government program when: (a) they themselves participate in SNAP, Medicaid, or Temporary Assistance for Needy Families (TANF) or (b) are members of a family that receives TANF or are members of a family in which a pregnant woman or an infant participates in Medicaid. Individuals can meet the WIC income-eligibility requirement “automatically” if they participate in certain other qualifying State-administered programs (at the State’s option) (Kessler et al., 2023a; Government Publishing Office, 2022).

Using ACS data, the Census Bureau model of WIC eligibility identifies the adjunctively income-eligible through several programs—SNAP, TANF, and State and local welfare programs, and Medicaid and State public health insurance. The effects of adjunctive eligibility on the numbers of infants and children estimated by the model to be eligible will depend in part on the set of programs that confer eligibility in a State and on the income limits of those programs. For example, States that have income limits for Medicaid and the Children’s Health Insurance Program that exceed 185 percent of poverty can be expected to have a larger number of adjunctively eligible infants and children in WIC than those where the income limits are set at 185 percent.

The use of self-reported ACS data on participation in such programs can contribute to underestimation of adjunctive eligibility for WIC because program participation in general is known to be underreported on survey data (Meyer et al., 2015). On the other hand, the modeling may overestimate adjunctive eligibility to some extent. The model assumes that everyone who reports to the ACS that they participated in State and local welfare and health programs is adjunctively eligible for WIC. In some cases, that assumption may not match official determinations of adjunctive eligibility. First, it is likely but not automatic that a State or local program qualifies by Federal regulations as one that can confer adjunctive eligibility for WIC. Second, the State has the option of deeming the program’s participants to be adjunctively eligible for WIC, and not all States exercise that option.

It is plausible that underreporting of program participation outweighs other factors, in which case the model underestimates adjunctive eligibility for WIC. If so, then the resulting WIC access rate is overestimated. The extent of overestimation can be expected to differ across States, depending on how many adjunctive eligibles are present in a State and whether misreporting rates are not uniform. The extent of overestimation may not be large because of a built-in sequence of steps in the eligibility model. Adjunctive eligibility matters only for those who have not first been deemed by the model to be income-eligible by their 12-month income.

D. Nutritional risk. The nutritional requirement for eligibility entails assessment by a competent professional authority who determines whether the individual is at “nutritional risk” based on either a medical or dietary assessment (Government Publishing Office, 2022). In the absence of nutrition data in the ACS, the Census Bureau WIC eligibility model supposes that each person who is modeled to be income or adjunctively eligible is at nutritional risk. The extent of overestimation of nutritional risk may well be small. At WIC offices, the nutrition requirement is nearly always met by otherwise eligible individuals based on the inadequacy of their diets (Bitler et al., 2003).

Linking WIC Administrative and ACS Data

The Census Bureau methodology links WIC administrative data and the ACS at the person level using Protected Identification Keys (PIKs) as the linking variable. The Census Bureau creates a person-specific PIK that is as unique as a Social Security number (SSN). PIKs serve to link a person’s records across multiple files, whether the files contain survey data or administrative data. PIKs also permit deduplication of records within a file. The Census Bureau creates and assigns PIKs using its Person Identification Validation System (PVS) based in part on Personally Identifiable Information (PII) found in the source files (Wagner & Layne, 2014). Assigning PIKs to records in the WIC administrative data relies on name, sex, address, and date of birth.

The Census Bureau is able to assign PIKs to most but not all ACS and WIC administrative records. For example, for 16 States for which the Census Bureau has calculated WIC access rates for 2019, the arithmetic average of State-level PIK rates for the ACS was 96 percent, meaning that 4 percent of the ACS records of all surveyed individuals could not be assigned a PIK (McBride et al., 2022). The average State-level PIK rate for the WIC files (of all observations on the file) was 95 percent.²⁹ These PIK rates of 95 to 96 percent for ACS and WIC files are relatively high compared with PIK rates for surveys, which are somewhat lower than PIK rates for some other administrative data files.³⁰

A PIK rate under 100 percent, and differences in PIK rates across demographic subgroups, raises the issue of representativeness—how well the ACS sample data resemble the population from which the sample was drawn.³¹ A study on bias of linked ACS records concluded, “Researchers linking ACS data should be aware that the characteristics of persons who can be linked to external data sources vary considerably from the full set of ACS persons. Researchers may wish to alter the survey weights accordingly when conducting analysis” (Bond et al., 2014). To address this potential bias, the Census

²⁹ The proximity of the average PIK rates for the ACS and the WIC files—96 percent versus 95 percent—is notable. In contrast to the ACS, which is a sample from the general population, the infants and children included on the WIC files are a subpopulation that necessarily differs from the general population in terms of age and income. Moreover, WIC infants and children could have characteristics, observed and unobserved, that differ from those of the general population and are associated with probabilities of receiving a PIK. For ACS 2010 data, which had a PIK rate of 92.57 percent for the general U.S. population, the PIK rates were 91.98 percent for infants and children 0–2 years of age; 92.23 percent for children aged 3–5 years of age; and 88.50 percent for people in poverty (Bond et al., 2014, p. 12). The proximity of the PIK rates for the ACS and WIC files means, in part, that the various factors that influence PIK rates, including differences in income, balance out to yield a relatively small net effect on the difference in PIKs between the two data sources.

³⁰ A study of the effects of a 2010 improvement in the PIK methodology found that the PIK rate for the ACS in 2010 was 92.57 percent, an increase from 88.07 percent in 2009 (Bond et al., 2014). A 2011 review of Census Bureau surveys and the Decennial Census reported that PIK rates in general were about 90 to 93 percent, while a set of administrative data from certain Federal programs had PIK rates of about 98 percent (Mulrow et al., 2011, p. 7).

³¹ Holding constant other factors, the opportunity for the linkage process itself to bias the estimated WIC access rate tends to be reduced when the PIK rate is higher.

Bureau follows a method for reweighting the ACS survey weights that was introduced in a study that linked ACS and SNAP administrative data (Meyer & Goerge, 2011); for further details on developing PIK-adjusted weights for WIC files, see McBride et al. (2022).

For an eligible child in the ACS in 2021 (in any month), the temporal window for checking WIC administrative data for participation at some time (not necessarily in the ACS interview month) covers all months of 2020–21 for each child.³² Upon linking the ACS data to the WIC administrative data, one can identify ACS infants and children who were initially modeled as ineligible (using ACS data alone) but actually received WIC benefits and who, therefore, were found by a WIC office to be officially eligible (assuming no false matches are made). In the model’s second stage, these ACS infants and children are recategorized as “eligible,” eliminating known cases of false negatives. A first-stage false negative rate is the proportion of all estimated eligible infants and children (obtained after the recategorization) who were initially deemed ineligible based solely on the first stage of the WIC eligibility model and ACS data. For the 2021 Arizona WIC data under study, the first-stage false negative rate was found to be 12.5 percent. This false negative rate is avoided in the final estimate of the State access rate by including participating infants and children as eligible individuals in the model’s second stage.

Comparisons Between Coverage Rates and Access Rates for Children

Figure 1 presents differences between 2021 estimates of WIC coverage rates and WIC access rates for infants and children in Arizona, by years of age. A notable feature is that estimated coverage rates decreased sharply with years of age, while access rates decreased by relatively smaller amounts. This section considers how this difference in the two trends across years of age can reflect in part how the coverage rate, as a statistic, is akin to a point prevalence for an average month of 2021 while the access rate is akin to a period prevalence for 2020–21.

First, while both rates depend on estimates of eligibility, the patterns shown in figure 1 may depend much more on how participation is measured for each rate than on how eligibility is measured. Table 2 above provides national USDA, FNS estimates of the average monthly number of children, by age, who participated in WIC and the number who were eligible in 2021.³³ As they age, children exhibit a declining coverage rate: The estimated rate of 64.3 percent for 1-year-olds fell by more than half to 24.7 percent for 4-year-olds. This decrease was largely due to the decrease in participation across the age groups, which itself fell by more than half from 1-year-olds to 4-year-olds. Meanwhile, the increase in the number of eligible individuals between the two age groups is relatively smaller, growing by less than 10 percent. Thus, declining participation, rather than increasing eligibility, is the primary explanation for the decrease in national WIC coverage rates as children age.

The difference in how participation is measured for coverage rates and access rates is a factor, perhaps the primary factor, that explains the difference in patterns in figure 1 for Arizona children. Tailoring the definitions for a given age group, the coverage rate in (1) uses administrative data for a single year to measure participation in an average month, while the access rate in (3) uses administrative data for 2 years to measure participation at any time during the 2-year period. The effect of that methodological difference may be easiest to recognize by examining the two rates for 4-year-olds.

³² For an ACS infant, the length of the period for checking WIC administrative records is shorter—up to 1 year and some number of months depending on the month in which the infant is born.

³³ While table 2 data are national, we expect that what they reveal about changes in eligibility and in participation as children age to be found at the State level.

The WIC 2021 coverage rate for 4-year-olds in Arizona is estimated to be 24.4 percent (Kesser et al., 2023b). The estimate is the answer to the question: “Of those 4-year-olds who are eligible in an average month in 2021 in Arizona, what percentage of them receive WIC in an average month?” The corresponding 2021 access rate is estimated to be 49.2 percent, which is the answer to the question: “Of those 4-year-olds who are eligible over the previous 12 months when interviewed in 2021, what percentage of them receive WIC at some time in 2020–21?”³⁴

By counting participation in WIC at any time in 2020–21—not just in an average month of 2021—the access rate for 4-year-old children exceeded the coverage rate for 4-year-olds. In effect, the characteristic being measured by the access rate for 4-year-olds is “WIC participation at some time while either 3 years or 4 years old.” Similarly, the characteristic being measured by the access rate for 2-year-olds is “WIC participation at some time while either 1 year or 2 years old.” Both the coverage rate and access rates decline with years of age, but the trend is less negative for access rates in part due to including some amount of (declining) participation from the previous age group.

The difference between the coverage rate and the access rate and, more generally, between a point prevalence and a period prevalence, raises the question of which measure might be preferred for various use cases, assuming that both measures are available. For budgetary purposes, the single-year timeframe for the coverage rate provides a natural tie to the annual budgetary process. For that purpose, a coverage rate could be preferable to an access rate.

However, the 2-year timeframe for the access rates allows for a cohort-type analysis for pre-kindergarten children, with two access rates covering the span of 4 years: The access rate for 2-year-olds reflects WIC participation as 1- or 2-year-olds, followed by an access rate for 4-year-olds that reflects WIC participation as 3- or 4-year-olds.

A third potential use case involves an analysis of children’s nutrition-related health and developmental outcomes. Such studies may consider participation among eligible individuals using a period prevalence, thereby considering whether there is receipt of WIC benefits at some time during a 2-year period, rather than in an average month of a single year. A health outcome measured for a given year may depend on more than WIC participation in the current year. It may also depend on participation over the previous year. Additional research may be able to distinguish which types of health outcomes are related more closely to a point prevalence and which to a longer-term period prevalence.

Finally, when comparing State-level estimates across States, or when comparing counties within a State, a straightforward comparison is possible if a set of estimates consists of either coverage rates or access rates. Because county-level estimates are available only for access rates, we rely on them next for our cross-county comparisons. Directors of State WIC agencies can use county-level access rates to identify areas within their States for outreach as showcased in the following section for Arizona.

³⁴ The 2-year period for participation is used because, as explained above, the reference period of the “previous 12 months” in the ACS question on income covers 2 years due to the rolling sample of the ACS.

County-Level Estimates for Arizona

This section serves as a guide for how to understand and interpret county-level estimates. Arizona was chosen for this study because it is a mid-sized State that has a relatively small number of counties, which permits a detailed discussion of estimates for each county as well as between-county comparisons. The benefit of selecting any one State, such as Arizona, for a use case is that examination of actual estimates provides a concrete example for deeper understanding of the meaning, interpretation, comparison, and reliability of the Census Bureau estimates. Lessons and insights from this examination may be extended to other States even though their estimates differ numerically from those of Arizona. Two motivations for intra-State statistical analysis are to estimate the levels of WIC eligibility and access within small geographic areas (or within demographic and socioeconomic groups), and to make comparisons between estimates.

WIC eligibility and access rates are estimated with some degree of uncertainty because of sampling error. Standard errors (SE) for estimates of the WIC eligibility and access rates reflect the survey design of the ACS and use ACS sample weights and replicate weights, as do associated margins of error (ME) and confidence intervals (CI). CIs are “one way to represent how ‘good’ an estimate is,” with a wider CI requiring more caution when using the estimate (Census Bureau, 2021b). These measures capture the extent to which sampling variability would result in a set of different possible estimates if the ACS sampling process were to be repeated indefinitely and a fresh estimate were developed with each repetition. Throughout this report, the 95-percent level of confidence is used for MEs, CIs, and tests of statistical significance.

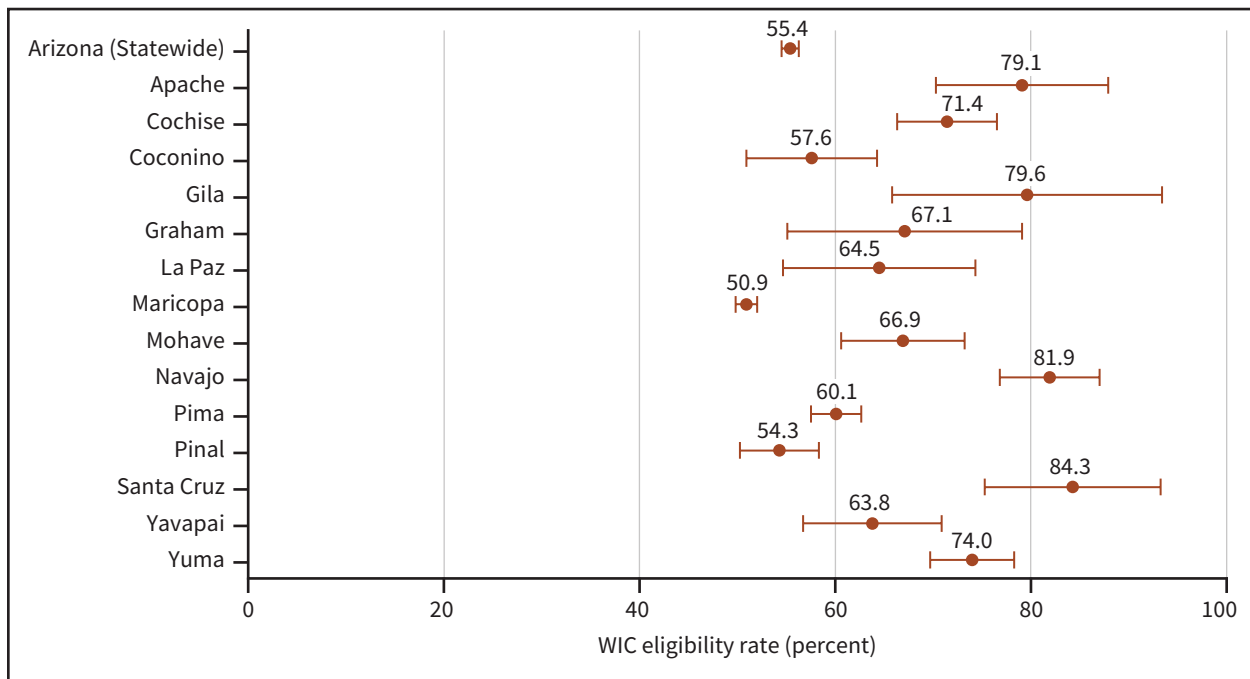
For estimates at the county level, we combined 3 years of ACS data for 2019–21 and 4 years of WIC administrative data (beginning in 2018, to allow for identifying participation at some time during 2018–21 for eligible infants and children in the ACS in 2019 or later). Combining 3 years of ACS data is required to obtain sufficient sample sizes for small, less-populated counties. Even with pooling data for 3 years, a county may not obtain a sufficient sample size, in which case an estimate for the county is not made available.

In figure 3, the 3-year estimate of the WIC eligibility rate for Arizona is estimated to be about 55.4 percent, with an ME of 0.9 percent. That is, more than half of all infants and children in Arizona are estimated to be eligible for WIC at some time during the 2019–21 study period. The Statewide average masks substantial variation that the county-level WIC eligibility rates display around the average. Across 14 counties in Arizona, the estimated WIC eligibility rate ranges from a low of 50.9 percent in Maricopa County to a high of 84.3 percent in Santa Cruz County where more than 4 out of 5 infants and children are estimated to be eligible for WIC. An eligibility rate for Greenlee County was not available separately due to insufficient sample size.³⁵ The figure shows that only Maricopa County and Pinal County have an eligibility rate below the Statewide eligibility rate of 55.4 percent, while 12 counties have rates above that average. The Statewide rate is equivalent to a weighted average of the counties’ rates, with Maricopa County, in which the capital city of Phoenix is located, receiving the greatest weight by far because it is the most populous county.

³⁵ Data for Greenlee County, as for any county, is included in the State-level estimates for Arizona.

Figure 3

Estimated Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) eligibility rates for infants and children, Arizona, by county, 2019–21



Note: An eligibility rate for Greenlee County is not available due to insufficient sample size. Confidence intervals are specified at the 95-percent level. No dot is added to demark the estimated eligibility rate for Arizona given the narrow confidence interval.

Source: USDA, Economic Research Service based on Arizona WIC administrative records (2018–21) linked to the 2019–21 American Community Survey. Census Bureau Disclosure Review Board release numbers CBDRB-FY19-167, CBDRB-FY19-575, CBDRB-FY20-154, CBDRB-FY21-108, CBDRB-FY22-190, and CBDRB-FY23-0376.

The figure also shows the 95-percent confidence interval for each estimate. For example, the ME for Maricopa County’s estimated eligibility rate (of 50.9 percent) is 1.1 percent, resulting in a CI which ranges from 49.8 to 52.0 percent. Maricopa County’s eligibility rate is measured with a relatively high degree of precision, which reflects its relatively large population. The MEs for other counties are larger and the CIs are wider.

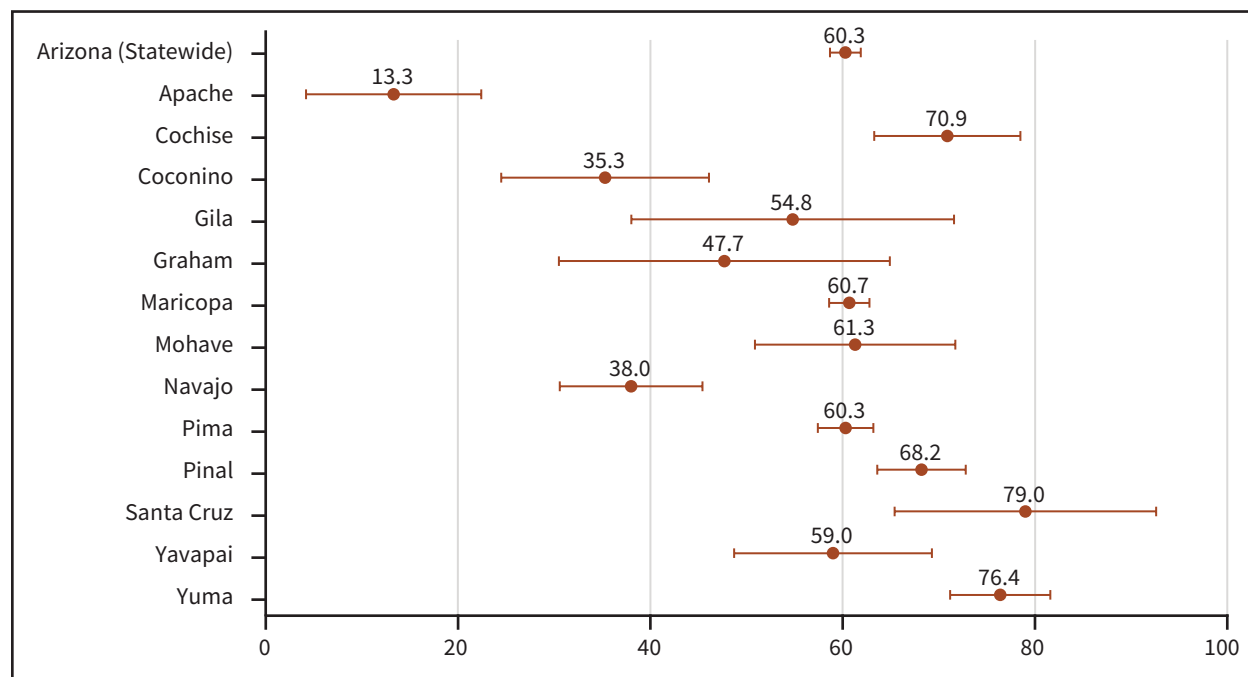
As shown in figure 4, the 3-year Statewide WIC access rate for Arizona for 2019–21 is estimated to be 60.3 percent, with an ME of 1.6 percent. That is, of all the infants and children who are estimated to be eligible for WIC in Arizona (at some time during the 2019–21 period), about three-fifths received WIC benefits according to WIC administrative records (at some time during the 2018–21 period).

The county-level access rates range from a low of 13.3 percent in Apache County to a high of 79.0 percent in Santa Cruz County. Access rates for Greenlee County and La Paz County are not available due to insufficient sample size. The relatively low estimated access rates for some counties are not driven by gross inaccuracies in either WIC data or ACS data. Instead, they reflect the administrative structure of WIC and how in some States like Arizona, ITOs serve a share of the WIC participants. For example, Apache County has an estimated access rate of 13.3 percent, no doubt because of substantial coverage error—Ito participants are not included in the estimates—and the downward bias that

occurs due to that omission. Thus, the amount of downward bias due to coverage error is not uniform across counties in Arizona.³⁶

Figure 4

Estimated Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) access rates for infants and children, Arizona, by county, 2019–21



Note: Access rates for Greenlee County and La Paz County are not available due to insufficient sample size. Confidence intervals are specified at the 95-percent level. Estimated access rates do not include infants and children who receive benefits from Navajo Nation WIC or Inter Tribal Council of Arizona WIC.

Source: USDA, Economic Research Service based on Arizona WIC administrative records (2018–21) linked to the 2019–21 American Community Survey. Census Bureau Disclosure Review Board release numbers CBDRB-FY19-167, CBDRB-FY19-575, CBDRB-FY20-154, CBDRB-FY21-108, CBDRB-FY22-190, and CBDRB-FY23-0376.

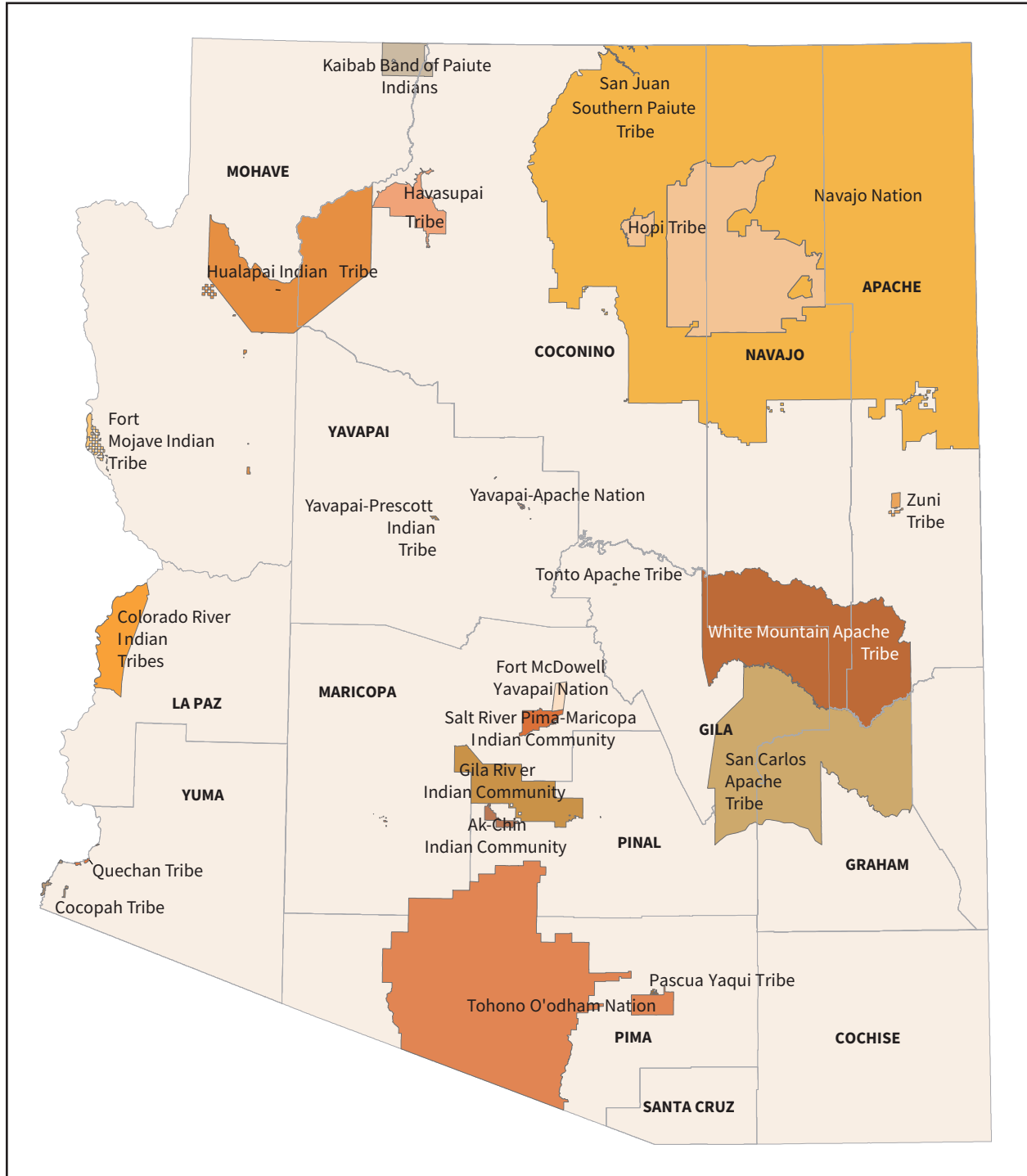
The potential for coverage error is not so small as to be ignorable in part because the numbers of infants and children served by ITOs are large enough to have an effect. In fiscal year 2021, NNWIC served 3,805 infants and children in WIC in an average month, while ITCA WIC served 5,753. Combined, the two ITOs served 9,558 infants and children, which is about 9.2 percent, or about one-eleventh, as large as WIC participation of 104,147 infants and children through the Arizona Department of Health Services (USDA, FNS, 2024b). Furthermore, estimated access rates are unusually low in the counties in which the proportion of infants and children who are likely to be served by an ITO is large. Specifically, the effects of coverage error are apparently more concentrated and larger in those counties that geographically overlap Tribal reservations.

³⁶ Despite downward biases, however large, all counties were retained for the report’s analysis and are presented below, at least for counties with a sufficient sample size. By including all counties in the analyses and graphs, the effect that coverage error can have at the county level is demonstrated and documented. Furthermore, the relatively low access rates in these counties can enhance rather than detract from confidence in the Census Bureau’s methodology because it detects unusually low access rates in the very counties where coverage error would be expected to be relatively larger.

Figure 5 shows Tribal reservations within Arizona. The reservation of the Navajo Nation lies in north-eastern Arizona; the Navajo Nation also straddles Utah, New Mexico, and Colorado.³⁷ The relatively low estimated access rates in Apache and Navajo counties, and in Coconino County to a lesser extent, reflect that infants and children in those counties are covered by ACS data (which enables them to be counted in the model's estimates as eligible individuals) but tend not to be covered by the WIC records kept by the Arizona Department of Health Services (and used for the Census Bureau estimate for Arizona). In contrast to the geographic concentration of the NNWIC clinics and participants, the WIC clinics and participants of ITCA WIC are dispersed across Arizona (Inter Tribal Council of Arizona, undated), making the omission of ITCA WIC difficult to notice in the access rate of one particular county or another.

³⁷ WIC clinics listed by NNWIC are located in northeast Arizona and in northwest New Mexico (Navajo Nations WIC, undated).

Figure 5
Federally recognized Indian Tribes in Arizona



Note: County names are in capitalized bold font. The names of Tribes shown in the figure are typically shortened forms. Full names of these federally recognized Tribal entities are: Ak-Chin Indian Community; Cocopah Tribe of Arizona; Colorado River Indian Tribes of the Colorado River Indian Reservation, Arizona and California; Fort McDowell Yavapai Nation, Arizona; Fort Mojave Indian Tribe of Arizona, California & Nevada; Gila River Indian Community of the Gila River Indian Reservation, Arizona; Havasupai Tribe of the Havasupai Reservation, Arizona; Hopi Tribe of Arizona; Hualapai Indian Tribe of the Hualapai Indian Reservation, Arizona; Kaibab Band of Paiute Indians of the Kaibab Indian Reservation, Arizona; Navajo Nation, Arizona, New Mexico, & Utah; Pascua Yaqui Tribe of Arizona; Quechan Tribe of the Fort Yuma Indian Reservation, California & Arizona; Salt River Pima-Maricopa Indian Community of the Salt River Reservation, Arizona; San Carlos Apache Tribe of the San Carlos Reservation, Arizona; San Juan Southern Paiute Tribe of Arizona; Tohono O'odham Nation of Arizona; Tonto Apache Tribe of Arizona; White Mountain Apache Tribe of the Fort Apache Reservation, Arizona; Yavapai-Apache Nation of the Camp Verde Indian Reservation, Arizona; Yavapai-Prescott Indian Tribe; Zuni Tribe of the Zuni Reservation, New Mexico. Some tribes have additional land in States adjacent to Arizona (not shown).

Source: USDA, Economic Research Service based on information and data from Federal Register (2024) and U.S. Department of Commerce, Bureau of the Census (2024).

Assessing Reliability of Estimates for Arizona

It can be imagined that a survey is repeatedly administered under essentially the same conditions. However, each time a different random sample of households is chosen, it results in a sample-based estimate that differs from one administration to another. Although in practice the survey is administered just once, yielding a single estimate, survey methods produce measures of how variable the estimate would be if repeated administrations were to be done. In the context of sample statistics, reliability refers to various measures of an estimate's variability, such as its variance or its standard error (SE). An estimate that has a low SE is an estimate that has a high reliability because its value would be expected to change little under repeated sampling. As used here, the concept of reliability refers only to how precisely an estimate is measured, even allowing for that estimate to be a biased, inaccurate estimate; accuracy and reliability are not synonyms.

For some purposes, the Census Bureau uses a coefficient of variation (CV) as a measure of an estimate's reliability (Heimel, 2014). The CV is another measure of variability that expresses the estimate's standard error (SE) relative to the estimate itself, that is, $CV = (SE/Estimate)$.³⁸ It is desirable to have a CV that is a lower value (rather than a higher value), indicating that an estimate was measured with lower variability, which means greater reliability.

To examine the reliability of the county-level estimates for Arizona, table 3 shows the standard error (SE) and coefficient of variation for each of the counties' estimated eligibility and access rates. Across the counties, the CVs for the estimated WIC eligibility rate range from a low of about 0.011 (or 1.1 percent) for Maricopa County to a high of 0.091 (9.1 percent) for Graham County, with a median value of 0.050. The WIC access rates have CVs that range from 0.018 for Maricopa County to 0.349 for Apache County, with a second-highest CV of 0.184 for Graham County and a median of about 0.088.

Table 3
Estimated Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) eligibility rates and WIC access rates, infants and children, Arizona, 2019–21

	Estimates of population July 1, 2021	Eligibility rate			Access rate		
		Estimate (percent)	ME (percent)	CV	Estimate (percent)	ME (percent)	CV
Statewide, Arizona	7,264,877	55.4	0.9	0.008	60.3	1.6	0.014
County							
Apache	65,385	79.1	8.8	0.057	13.3	9.1	0.349
Cochise	125,763	71.4	5.1	0.036	70.9	7.6	0.055
Coconino	142,780	57.6	6.7	0.059	35.3	10.8	0.156
Gila	53,521	79.6	13.8	0.088	54.8	16.8	0.156
Graham	38,882	67.1	12.0	0.091	47.7	17.2	0.184
Greenlee	9,377	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
La Paz	16,391	64.5	9.8	0.078	n.a.	n.a.	n.a.
Maricopa	4,494,693	50.9	1.1	0.011	60.7	2.1	0.018
Mohave	216,957	66.9	6.3	0.048	61.3	10.4	0.087

continued on next page ►

³⁸ Sometimes the definition for a CV adjusts the result by a factor of 100 to express the CV as a percentage.

	Estimates of population July 1, 2021	Eligibility rate			Access rate		
		All ages	Estimate	ME	Estimate	ME	CV
			(percent)	(percent)		(percent)	
Navajo	107,621	81.9	5.1	0.032	38.0	7.4	0.099
Pima	1,048,895	60.1	2.6	0.022	60.3	2.9	0.025
Pinal	448,144	54.3	4.0	0.038	68.2	4.6	0.034
Santa Cruz	48,034	84.3	9.0	0.054	79.0	13.6	0.088
Yavapai	242,193	63.8	7.1	0.057	59.0	10.3	0.089
Yuma	206,241	74.0	4.3	0.030	76.4	5.2	0.035
Median				0.050			0.088

ME = 95-percent margin of error; CV = coefficient of variation; n.a. = not available.

Note: Estimated access rates do not include infants and children who receive benefits from Navajo Nation WIC or Inter Tribal Council of Arizona WIC.

Source: USDA, Economic Research Service based on eligibility and access rates from Arizona WIC administrative records (2018–21) linked to the 2019–21 American Community Survey. Census Bureau Disclosure Review Board release numbers CBDRB-FY19-167, CBDRB-FY19-575, CBDRB-FY20-154, CBDRB-FY21-108, CBDRB-FY22-190, and CBDRB-FY23-0376, and U.S. Department of Commerce, Bureau of the Census (2023) for population data.

For a standard by which to assess the reliability of the WIC eligibility and access rates, we used a study conducted by the Census Bureau. As part of a comprehensive 2014 review of the ACS, the Census Bureau combined 5 years’ worth of ACS data (2008–14) and calculated the CV for an ACS item at the county level for each U.S. county (or county-level equivalent) (Heimel, 2014).³⁹ The study examined the distribution of the CVs across the counties and used the median of the CVs as an overall measure of the item’s reliability. For a three-level standard, the study grouped the resulting median CVs into categories of: low CVs (high reliability), with median values that ranged from 0 to 0.124; medium CVs, with median values between 0.1353 and 0.3372; and high CVs (Heimel, 2014).

The county-level estimates of WIC eligibility are based on 3 years of ACS data rather than 5 years’ worth of data, which were used in the Census Bureau ACS report. Even so, we have adopted the standard of the Census Bureau ACS report to assess the data quality of the WIC estimates. For our two sets of county-level CVs, the median value is 0.050 for the CVs of the eligibility rates and 0.088 for the CVs of the access rates. These median values lie roughly in the middle of the range of 0 to 0.124 that the Census Bureau used to classify CVs as “low.”⁴⁰ Low CVs indicate that the estimates exhibit little variability due to sampling error, and therefore they have high reliability. We conclude that the estimated WIC eligibility and access rates have high data quality in terms of reliability.

³⁹ The study reports that an estimate based on 1-year or 3-year data was used if a 5-year estimate was not available for an item (when a new item was added during the study period) and that simulation was used to adjust the standard error to a 5-year basis (Heimel, 2014).

⁴⁰ If the estimated WIC eligibility rates had been based on 5 years of ACS data rather than just 3 years, it could be expected that our estimated CVs would have been even lower.

Cross-County Comparisons of Access Rates in Arizona

We focused on county-level estimates of access rates, although the approach and key points apply to other substate estimates and comparisons. We used Maricopa County as a “reference county” since it is by far the largest county in Arizona. Moreover, Maricopa County has an estimated access rate of 60.7 percent, which differs from the Statewide access rate of 60.3 percent by less than 1 percentage point.

For any given county, three questions can be posed:

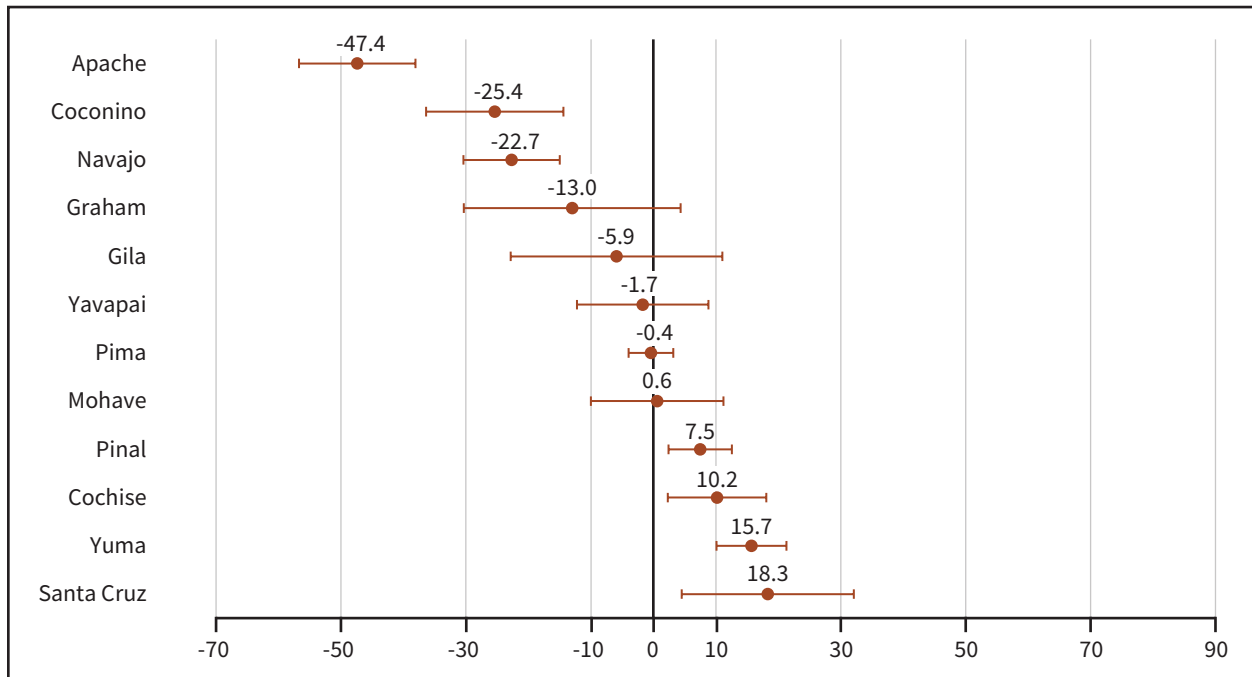
- How large is the estimated difference between the county’s access rate and the rate for Maricopa County?
- How reliable is the estimated difference?
- How important is the estimated difference?

Answers to the first two questions are rooted in statistical analysis that we discuss below. The third question is rooted in WIC program administration. The threshold at which a difference in WIC access rates becomes important, in a programmatic or practical sense, is a decision that rests with policy officials and program managers. A difference of 2.0 percent may be considered “small” from the perspective of officials in a State WIC agency. A larger difference may be required to register as “large” or “important” for program administration. Once a difference is deemed to be administratively important, a State WIC agency might devote time and effort to consider potential reasons for the low (or high) WIC access rate in a county and to gather additional information.

Figure 6 shows several counties have differences with Maricopa County that are negative. The larger differences for Apache, Coconino, and Navajo counties reflect the likelihood that WIC participants in those areas may participate through an Indian Tribal Organization rather than Arizona WIC.

Figure 6

Difference of estimated Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) access rates for infants and children between counties and Maricopa County, Arizona, 2019–21



Note: The sample sizes in Greenlee County and La Paz County were not sufficiently large for analysis. Estimated access rates do not include infants and children who receive benefits from Navajo Nation WIC or Inter Tribal Council of Arizona WIC.

Source: USDA, Economic Research Service based on Arizona WIC administrative records (2018–21) linked to the 2019–21 American Community Survey. Census Bureau Disclosure Review Board release numbers CBDRB-FY19-167, CBDRB-FY19-575, CBDRB-FY20-154, CBDRB-FY21-108, CBDRB-FY22-190, and CBDRB-FY23-0376.

Gila County’s access rate is estimated to be 5.9 percentage points below the rate for Maricopa County. That value represents our “best guess” for the true, unknown difference between the two rates. The difference of -5.9 percentage points might not be deemed trivially small in terms of practical significance. When considering possible reasons for such a difference, though, a statistical issue is the reliability of the estimate: How easily might the difference be attributed to sampling error? Differences between estimates of the two counties’ access rates can be due in part to sampling error, to non-sampling errors, or to sociodemographic differences between Gila and Maricopa and to factors such as convenience of WIC clinics, office hours, other local policies, supportiveness of staff, and so forth. The possible role of sampling error as an explanation for observed differences is captured by analysis of CIs.

Figure 6 shows that for Gila County, the CI is relatively wide, reflecting that the 5.9 percentage-point difference is not measured with as much precision as are differences for other counties; the estimated CI ranges from about -22.8 percent to +11.0 percent.

Pinal County’s access rate is estimated to be 7.5 percentage points above the rate for Maricopa County. The CI for Pinal County ranges from 2.4 to 12.6 percent—a range that excludes 0.0. In the language of hypothesis testing, the estimated access rate for Pinal County is statistically significantly different from the estimated access rate for Maricopa County. That is, if the true difference between the two counties’ access rates were 0.0, an estimated difference of 7.5 percent is unlikely to be attributable to sampling error (to “chance”).

The estimate differences for Gila and Pinal, although of opposite sign, indicate that their estimated access rates differ from the access rate for Maricopa by about the same amount (-5.9 versus 7.5 percent). Even so, the estimates are measured with quite different precisions, as shown by the quite different widths of the CIs for Gila and Pinal.

However, the results also highlight the role of sampling error. For example, if the difference between Gila and Maricopa had been estimated with the same precision as the difference between Pinal and Maricopa, then the CI for Gila's estimated difference would have ranged from -11.0 to -0.8 percent. With that higher precision, Gila's interval would have excluded 0.0 and the estimated difference (from Maricopa's access rate) for Gila of -5.9 percent would not have been statistically significant. This counterfactual exercise highlights a key point: Whether or not an estimated difference for a given county (from Maricopa's access rate) is statistically significant depends on both the magnitude of the estimated difference (such as -5.9 percent for Gila) and the precision with which that difference is estimated.

So far, we have used Maricopa County as a reference county against which to compare access rates for each of the other Arizona counties. It is possible to make comparisons between other pairs of counties, but showing the CIs for each possible pair would require a prohibitive amount of space.

Alternatively, a p-value is a statistic that condenses information substantially and permits comparisons for all possible pairs of counties. For each comparison between a pair of counties, table 4 shows the p-value and an associated shading. The table's "upper triangle" is a mirror image of its "lower triangle" because the p-value for a comparison of access rates for counties *A* and *B* is the same as for *B* and *A*; order does not matter.

Table 4

Tests of statistical significance for the difference of estimated Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) access for infants and children, by county pairs, Arizona, 2019–21

		Apache	Coconino	Navajo	Graham	Gila	Yavapai	Pima	Maricopa	Mohave	Pinal	Cochise	Yuma	Santa Cruz
County	Access Rate	13.3	35.3	38.0	47.7	54.8	59.0	60.3	60.7	61.3	68.2	70.9	76.4	79.0
Apache	13.3		0.002	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coconino	35.3	0.002		0.686	0.231	0.056	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Navajo	38.0	0.000	0.686		0.310	0.073	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Graham	47.7	0.001	0.231	0.310		0.563	0.269	0.157	0.141	0.185	0.024	0.016	0.002	0.005
Gila	54.8	0.000	0.056	0.073	0.563		0.676	0.527	0.495	0.519	0.132	0.087	0.016	0.028
Yavapai	59.0	0.000	0.002	0.001	0.269	0.676		0.812	0.751	0.758	0.110	0.068	0.003	0.022
Pima	60.3	0.000	0.000	0.000	0.157	0.527	0.812		0.827	0.856	0.004	0.011	0.000	0.008
Maricopa	60.7	0.000	0.000	0.000	0.141	0.495	0.751	0.827		0.912	0.004	0.011	0.000	0.009
Mohave	61.3	0.000	0.001	0.000	0.185	0.519	0.758	0.856	0.912		0.234	0.144	0.011	0.043
Pinal	68.2	0.000	0.000	0.000	0.024	0.132	0.110	0.004	0.004	0.234		0.551	0.021	0.140
Cochise	70.9	0.000	0.000	0.000	0.016	0.087	0.068	0.011	0.011	0.144	0.551		0.242	0.308
Yuma	76.4	0.000	0.000	0.000	0.002	0.016	0.003	0.000	0.000	0.011	0.021	0.242		0.726
Santa Cruz	79.0	0.000	0.000	0.000	0.005	0.028	0.022	0.008	0.009	0.043	0.140	0.308	0.726	

p-values

< 0.01
 0.01–0.049
 0.05–0.099
 0.10 and over

Note: Cell values show the p-value associated with a two-sided test for a difference of estimated access rates. Shaded cells show that the difference between the associated pair of access rates is statistically significant at 1-percent, 5-percent, or 10-percent levels. Estimated access rates do not include infants and children who receive benefits from Navajo Nation WIC or Inter Tribal Council of Arizona WIC.

Source: USDA, Economic Research Service authors' calculations from Arizona WIC administrative records (2018–21) linked to the 2019–21 American Community Survey. Census Bureau Disclosure Review Board release numbers CBDRB-FY19-167, CBDRB-FY19-575, CBDRB-FY20-154, CBDRB-FY21-108, CBDRB-FY22-190, and CBDRB-FY23-0376.

The shading is a four-category grouping of p-values. A dark blue shade for a cell shows that the difference between the two counties' access rates is statistically significant even if a 1-percent level of significance were adopted. If instead a 5-percent level of significance were adopted, cells shaded dark blue or medium blue (with p-values up to 4.99 percent) show differences that are statistically significant. If a 10-percent level of significance were adopted, cells shaded dark blue, medium blue, or light blue (with p-values up to 9.99 percent) show differences that are statistically significant. For a 10-percent level of significance, unshaded (white) cells show that the difference between the two counties' access rates is statistically insignificant.

As an example, suppose, as in figure 6, that Maricopa County is compared to other counties and that a 5-percent level of significance is adopted as a standard. The comparison can be done using either the row or the column in table 4 for Maricopa. However, by using the column, a close connection to figure

6 can be made that is helpful for interpreting other cells in the table. Looking down the column for Maricopa, we find several cells of interest:

Cochise. The cell is shaded medium blue, indicating that difference between the estimated access rates for Cochise and Maricopa is statistically significant at the 5-percent level. This information corresponds with the information in figure 6, which showed that the 95-percent confidence interval for this pair of counties does not include 0.0.

Graham. The cell is white, indicating that the estimated access rate for Graham is not statistically significantly different from Maricopa even at the 10-percent level; the more stringent standard of 5 percent would also result in the conclusion that the difference is not statistically significant. The table's implied information—that the Graham-Maricopa difference is not statistically significant even at the 5-percent level—dovetails with the information in figure 6, which shows that the confidence interval for this pair of counties includes 0.0.

Apache. The cell is shaded dark blue, indicating that the estimated difference of access rate for Apache and Maricopa is statistically significant at the 1-percent level. This pairwise difference would also be statistically significantly different at a less stringent 5-percent level. The table's implied information—that the Apache-Maricopa difference is statistically significant at the 5-percent level—dovetails with the information in figure 6, which shows that the interval for this pair of counties does not cover 0.0.

Another example from the table is a comparison between Gila and Coconino counties, although this comparison has no correspondence to figure 6 because the figure uses Maricopa as the reference county. In the table, the cells for Gila and Coconino are shaded light blue, indicating the estimated difference of their access rates is statistically significant at the 10 percent level, but not at the 5 percent level.

The advantage of the table-based summary information is that it conveys which pairwise differences of access rates would or would not be covered by a confidence interval, at various levels of significance and their corresponding confidence levels, without requiring multiple pages showing each set of confidence intervals.

Conclusion

Based on USDA, ERS methods developed for estimating SNAP eligibility and access rates (Newman & Scherpf, 2013), the Census Bureau provides estimates of WIC eligibility rates and access rates at the State level and for geographic areas and demographic and socioeconomic groups within a State. State WIC agencies can use these highly granular estimates, along with other information, to target outreach and to assess and guide State and local WIC policies and practices. Estimates are available for infants and children at various ages and for infants and children as a combined category. Estimates are not available for pregnant, postpartum breastfeeding, and postpartum non-breastfeeding women, although Census Bureau researchers are conducting research on how such estimates may be developed. For the State of Arizona, and for other States that have ITOs, the lack of data on WIC participation by those who receive benefits from ITOs results in a type of coverage error and a downward bias in the estimated access rate.

Reliability of the Census Bureau estimates for Arizona counties was measured using the coefficient of variation. Based on a Census Bureau three-way categorization of high, medium, and low values for coefficients of variation for county-level ACS estimates, we find that the county-level WIC eligibility and access rates have low coefficients of variation (at the median) and thus a high level of reliability.

Given the multifaceted nature of WIC eligibility criteria, it is challenging to model eligibility accurately. The Census Bureau must rely on the limited data available in the ACS. In contrast, when determining official eligibility for WIC, a State WIC agency has much more information available. Limitations of data and errors of modeling can affect the Census Bureau estimates no less than other efforts to measure participation among eligible individuals.

USDA, FNS estimates of a WIC coverage rate use an “average monthly” timeframe: the number of WIC participants (perhaps in a given participant category) in an average month relative to the number of eligible individuals in an average month. In contrast, the Census Bureau estimates of a WIC access rate (for infants and children) use a timeframe “at some time in 2 years”: the number of infants and children who participate in WIC “at some time” in a 2-year period as a proportion of infants and children who are estimated to be eligible “at some time” in that period.

Other differences between the USDA, FNS and Census Bureau estimates also matter. The two sets of estimates rely on different surveys, one of which has a rolling sample. While both sets of estimates use WIC administrative data, the USDA, FNS estimates use aggregates (counts) of WIC participants, while Census Bureau estimates use microlevel data. They use different numbers of years of administrative data for a single estimate. The USDA, FNS estimates are obtained as the ratio of two aggregates (participants and modeled eligible individuals are measured separately), while the Census Bureau estimates are obtained by linking administrative and survey data at the individual level (resulting in participants as a subset among modeled eligible individuals). The Census Bureau approach guarantees that estimates will not exceed 100.0 percent.

Census Bureau estimates and USDA, FNS estimates are each available at the State level (for some States) by age group (0 years to 4 years, by year). The two sets of estimates may be compared to see what difference is made in the rates due (in part) to different timeframes, keeping in mind that differences are also due to different data sources, methodologies, and sample error. Ultimately, because of the different timeframes, the two estimates are best interpreted as two measures of two different constructs, rather than two measures of the same construct.

The best ways to use and interpret the Census Bureau estimates for WIC eligibility and access rates are to compare estimates between States using State-level rates; within a State using substate estimates for geographic areas or sociodemographic subgroups; or between two substate geographies or subgroups of two States with a corresponding substate estimate from each.⁴¹ These comparisons use the Census Bureau estimates alone and therefore rely on the same timeframe, data, and methodology—the same “yardstick.”⁴² The USDA, FNS coverage rates also can be compared across States, which has been done for many years, because those rates share common data and methodology.

⁴¹ When making such comparisons within or between States, sometimes a difference in rates can be affected by the omission of ITO data from the estimates.

⁴² Many caveats would be needed about differences between data and methods, as described in this report, to compare, say, the Census Bureau WIC access rate for a county with the USDA, FNS WIC coverage rate for the State.

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