Timing of Introduction of Complementary Foods — United States, 2016–2018

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The American Academy of Pediatrics (AAP) recommends introducing complementary foods (i.e., any solid or liquid other than breast milk or infant formula) to infants at approximately age 6 months (*1*). Although a consensus on ideal timing is lacking, most experts agree that introduction of complementary foods before age 4 months is too early because of infant gastrointestinal and motor immaturity (*1*,*2*). In addition, early introduction prevents exclusively breastfed infants from reaching the recommended 6 months of exclusive breastfeeding (*1*) and might be associated with increased risk for overweight and obesity (*3*). Nationally representative data on complementary feeding are limited; state-level estimates have been previously unavailable. CDC analyzed 2016–2018 data from the National Survey of Children's Health (NSCH) (N = ~~23,927~~23,743) to describe timing of complementary feeding introduction and prevalence of early introduction of complementary foods before age 4 months (early introduction) among children aged 1–5 years. Prevalence of early introduction was ~~31.9~~15.6% nationally and varied geographically and across sociodemographic and infant feeding characteristics. These estimates suggest that ~~many~~ approximately one in six infants are introduced to complementary foods before they are developmentally ready. Efforts by health care providers and others who might influence infant feeding practices could help decrease the number of infants who are introduced to complementary foods too early.

NSCH is funded and directed by the Maternal and Child Health Bureau of the Health Resources and Services Administration. It is an annual web- and paper-based survey that collects information from parents and caregivers on their children's physical and emotional health, including infant nutrition, and is representative of noninstitutionalized U.S. children aged 0–17 years. During 2016–2018, the overall weighted response rate ranged from 37.4% to 43.1%. Missing data for race/ethnicity (1.3%) and household income relative to the federal poverty level (FPL) (16.3%) were imputed using hot-deck and sequential regression imputation methods, respectively (*4*).

Timing of introduction of complementary foods was assessed by asking respondents with children aged 0–5 years "How old was this child when he or she was first fed anything other than breast milk or formula" (*4*). To ensure that children had sufficient time to have been introduced to complementary foods, analysis was restricted to children aged 1–5 years. Participants with reported introduction to complementary foods at age ~~>~~≥12 months (887) and those with other implausible feeding patterns (recalled breastfeeding duration, infant formula introduction, and complementary feeding introduction indicated ≥2 months with no source of nutrition~~;~~; ~~101~~281) were excluded from analyses. The percentage of children who were introduced to complementary foods before age 4 months (early introduction) was calculated overall, at the state and regional levels, and by sociodemographic and infant feeding characteristics using SAS-callable SUDAAN (version 11.0; RTI International). Two-sample t-tests were used to identify statistically significant ($p<0.05$) differences across subgroups.

Among ~~23,927~~23,743 children aged 1–5 years, the mean age at introduction of complementary foods was ~~4.7~~5.7 months, with ~~31.9~~15.6% of children introduced at <4 months, ~~51.0~~63.3% at 4–6 months, and ~~17.1~~21.1% at 7–12~~11~~ months (Figure 1). Prevalence of early introduction varied across sociodemographic groups. Prevalence of early introduction was significantly higher among non-Hispanic Black (Black) children (~~40.5~~25.2%), compared with all other racial/ethnic groups, including non-Hispanic other/multiracial children (16.7%), Hispanic children (15.0%), ~~and significantly lower among~~ non-Hispanic Asian children (~~23.8~~14.4%), ~~compared with all other groups except~~and non-Hispanic white children (~~29.9~~13.8%). Prevalence of early introduction was significantly lower among children living in households at ≥400% of the FPL (~~28.5~~12.1%) and whose mothers had a bachelor's degree or higher (~~27.7~~10.9%), compared with all other household FPL and maternal education groups. The prevalence for early introduction for children living in households at <100% FLP was significantly higher than for those with 200% FLP or higher. Early introduction also differed significantly by infant milk feeding status at age 4 months: prevalence of early introduction was ~~18.5~~5.6% among children receiving only breast milk for milk feeds, ~~32.1~~14.8% among those receiving breast milk and infant formula, and ~~41.6~~23.7% among those receiving only infant formula for milk feeds (Table). At the state level, prevalence of early introduction ranged from ~~18.0~~7.6% in New Mexico to ~~49.0~~34.4% in Mississippi. In ~~34~~ 23 states, ~~≥30% of~~ the prevalence of children ~~were~~ introduced to complementary foods before age 4 months was higher than the

national prevalence (15.6%), including ~~14~~ four states in which prevalence of early introduction was at least ~~35~~20% (Supplementary Table, https://stacks.cdc.gov/view/cdc/95035) (Figure 2).

Discussion

~~Nearly~~ Approximately one in ~~three~~ six (~~31.9~~15.6%) U.S. infants is introduced to complementary foods before age 4 months, with a higher prevalence of early introduction among Black infants and infants of mothers and households at lower socioeconomic status. Reasons for early introduction to complementary foods are not fully understood; however, many early introducing mothers have reported believing that their infant was old enough to begin consuming solids (*5*). This suggests a perception of infant readiness for complementary feeding before the infant is actually ready and a potential lack of awareness of feeding recommendations, health effects associated with early introduction, and signs of developmental readiness. In general, infants show outward signs of readiness for complementary feeding when they can sit up on their own with good head control, show interest in mealtimes, are hungry in between feedings, and no longer have "tongue-thrust" or extrusion reflex, usually at approximately age 4–6 months (*2*).

Not only do younger infants lack the physiologic development to safely consume complementary foods, infants who are introduced to complementary foods too early have increased risk for multiple associated health conditions (*1*). Early introduction to complementary foods prevents infants from meeting the recommended 6 months of exclusive breastfeeding, decreasing the benefits both mothers and infants derive from exclusive breastfeeding. Compared with exclusive breastfeeding for 6 months, exclusive breastfeeding for 3–4 months followed by mixed breastfeeding and complementary feeding is associated with increased risk for gastrointestinal infection and slower maternal weight loss after birth (*6*). Further, limited evidence also suggests introduction to complementary foods before age 4 months might increase later overweight and obesity risk (*3*).

Health care providers can help increase awareness of recommended timing of introduction of complementary foods by employing consistent messaging in accordance with AAP recommendations and stressing the importance of developmental readiness when discussing complementary feeding with families (*1*). Resources are available to help health care providers engage with and educate families to better navigate the transition from milk feeds to family foods (*7*). Further, given the higher prevalence of early introduction of complementary foods among infants receiving formula, targeted education to parents and caregivers of those receiving infant formula might be particularly helpful. Similar efforts by others who could influence infant feeding practices such as peer educators, early care and education staff members, and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) staff members might also help reduce early introduction.

Another nationally representative study of U.S. children, the 2009–2014 National Health and Nutrition Examination Surveys (NHANES), found a ~~lower~~ similar prevalence of early introduction (16.3%) ~~than the estimate from NSCH participants (31.9%)~~; ~~however~~ in addition, similar patterns in early introduction by sociodemographic and infant feeding status characteristics were seen across both studies (*8*). The questions used to identify timing of complementary feeding introduction were the same for both studies. ~~Some of the discrepancy might be explained by inherent differences in the surveys including representativeness of participants and response rates or by the different age ranges of studied children (6–36 months in NHANES compared with 1–5 years in NSCH). Differences might also reflect changes over time in parental attitudes toward complementary feeding or health care provider advice because participants included in the NHANES and NSCH analyses were born during 2006–2014 and 2010–2018, respectively. Over the past decade, there has been growing awareness of the benefits of not delaying introduction of allergenic foods among children at high risk for food allergies to prevent the development of food allergies (*9*).~~ These findings, that most infants are not introduced to complementary foods early, ~~Results from both NHANES and NSCH~~ might indicate that ~~It is possible that research might have been misinterpreted by~~ parents, caregivers, and health care providers have been receptive to early food introduction recommendations. Continued education and clear communication on appropriate timing is important. ~~; leading to increases in early introduction to complementary foods in recent years. Further education on correct timing of introduction of allergenic foods and identification of children at high risk for food allergies might be needed to improve adherence to feeding recommendations.~~

The findings in this report are subject to at least five~~four~~ limitations. First, an unexpected clustering of reported month of introduction at exactly 12 months was observed. Approximately 7.4% of the sample reported 12 months versus 1.2% at 11 months and 0.5% at 13 months. It was hypothesized that the clustering might be rounding from nearby categories

but that respondents likely introduced complementary foods late in the first year. A sensitivity analysis excluded those who reported ≥12 months from the denominator, because of the potential implausibility of these responses, and found the prevalence of early introduction increased by 1.2 percentage points. Second, data might be affected by information bias. Though maternal recall of breastfeeding has been shown to have high validity and reliability, recall of solid and other liquid feeding might not be as reliable (~~10~~9). However, participants with implausible feeding patterns were removed from the sample to account for potential misreporting of infant feeding information. Third,~~Second,~~ although multiply imputed, household FPL data might be misclassified. Fourth,~~Third,~~ data do not allow for analysis of types, amounts, or frequency of complementary foods offered; these are important markers of early child nutrition. Finally, small sample sizes limited the ability to conduct further sociodemographic analyses at the state level.

Introduction of complementary foods at the recommended time could help improve infant health and might play a role in prevention of overweight and obesity; however, nearly one ~~third~~ in six~~of~~ infants are introduced to complementary foods too early. Early introduction also varies geographically and across sociodemographic and infant feeding characteristics, placing some infants, such as Black infants and infants of mothers and households of lower socioeconomic status, at increased risk for potential poor health outcomes related to early introduction of complementary foods. Increased education on complementary feeding recommendations, including the possible effects of early introduction and signs of developmental readiness, might help decrease the number of infants who are introduced to complementary foods too early.

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Summary

What is already known about this topic?
The American Academy of Pediatrics recommends introducing complementary foods at approximately age 6 months. Introduction before age 4 months is too early because infants are not developmentally ready for complementary foods. Early introduction prevents infants from reaching the recommended 6 months of exclusive breastfeeding.

What is added by this report?
Nearly one in three six infants is introduced to complementary foods before age 4 months; prevalence of early introduction varies geographically and across sociodemographic and infant feeding characteristics.

What are the implications for public health practice?
Increasing awareness of and adherence to feeding recommendations could help reduce early introduction. Health care providers and others who might influence infant feeding practices should educate families on recommended timing of introduction of complementary foods.

TABLE. Percentage of infants introduced to complementary foods before age 4 months, by sociodemographic characteristics, infant milk feeding status at age 4 months, and region among children aged 1–5 years — National Survey of Children's Health, United States, 2016–2018

Characteristic	Total no.*	% Introduced early†	95% CI†
Total	23,743 ~~23,927~~	15.6% ~~31.9~~	(14.6-16.6) ~~(30.6–33.2)~~
Race/Ethnicity§			
Hispanic	2,605 ~~2,626~~	15.0 ~~29.9~~	(12.4-18.0) ~~(26.3–33.7)~~
White, non-Hispanic	16,721 ~~16,853~~	13.8 ~~31.5~~	(12.9-14.8) ~~(30.2–32.9)~~
Black, non-Hispanic	1,206 ~~1,211~~	25.2 ~~40.5~~	(21.2-29.6) ~~(35.7–45.4)~~
Asian, non-Hispanic	1,115 ~~1,125~~	14.4 ~~23.8~~	(10.7-19.2) ~~(19.1–29.1)~~
Other/Multiracial, non-Hispanic	2,096 ~~2,112~~	16.7 ~~33.2~~	(13.8-20.1) ~~(29.5–37.1)~~
Maternal age group (yrs)¶,**			
18–29	4,604 ~~4,634~~	15.8 ~~34.0~~	(13.8-17.9) ~~(31.1–37.1)~~
30–39	14,099 ~~14,201~~	12.4 ~~28.8~~	(11.2-13.6) ~~(27.3–30.5)~~
≥40	3,390 ~~3,412~~	17.4 ~~33.3~~	(14.8-20.3) ~~(30.0–36.8)~~
Maternal highest education level¶,††			
High school diploma or less	2,526 ~~2,544~~	18.4 ~~34.3~~	(15.6-21.5) ~~(30.6–38.1)~~
Some college	5,920 ~~5,962~~	15.8 ~~33.4~~	(14.0-17.8) ~~(30.8–36.1)~~
Bachelor's degree or more	13,569 ~~13,664~~	10.9 ~~27.7~~	(9.9-12.0) ~~(26.3–29.1)~~
Household income§§			
<100% FPL	2,405 ~~2,429~~	19.8 ~~35.2~~	(16.8-23.2) ~~(31.0–39.6)~~
100%–199% FPL	3,719 ~~3,745~~	18.2 ~~34.3~~	(15.4-21.4) ~~(30.9–37.8)~~
200%–399% FPL	7,608 ~~7,662~~	14.8 ~~31.7~~	(13.0-16.7) ~~(29.4–34.0)~~
≥400% FPL	10,012 ~~10,091~~	12.1 ~~28.5~~	(10.8-13.4) ~~(26.7–30.4)~~
Infant milk feeding status at age 4 mos¶¶			
Breast milk feeding only	9,109 ~~9,085~~	5.6 ~~18.5~~	(4.7-6.8) ~~(16.9–20.2)~~
Infant formula feeding only	8,667 ~~9,567~~	23.7 ~~41.6~~	(21.9-25.6) ~~(39.5–43.8)~~
Mixed breast milk and infant formula feeding	5,750 ~~4,863~~	14.8 ~~32.1~~	(12.8-17.1) ~~(29.1–35.2)~~
Region*,†††			
Northeast	4,066 ~~4,093~~	16.7 ~~33.8~~	(14.3-19.4) ~~(30.8–36.8)~~
Midwest	6,020 ~~6,063~~	15.2 ~~32.3~~	(13.6-16.9) ~~(30.2–34.4)~~
South	7,613 ~~7,675~~	17.8 ~~34.8~~	(16.2-19.7) ~~(32.6–37.0)~~
West	6,044 ~~6,096~~	11.6 ~~25.7~~	(9.8-13.8) ~~(23.0–28.7)~~

Abbreviations: CI = confidence interval, FPL = federal poverty level.

* Denominators might not sum to total because of missing maternal sociodemographic or infant milk feeding status data.

† Percentages are weighted to account for complex survey design.

§ The percentage of infants introduced to complementary foods before age 4 months among non-Hispanic black children is significantly different from that of non-Hispanic White ~~Black~~ children. ~~. The percentage introduced early among non-Hispanic White children is significantly different from that of non-Hispanic Black and~~ non-Hispanic Asian children, Hispanic children, and . ~~The percentage introduced early among non-Hispanic Black children is significantly different from that of all other racial/ethnic groups. The percent introduced early among non-Hispanic Asian children is significantly different from that of non-Hispanic White, non-Hispanic Black, and~~ non-Hispanic other/multiracial children. ~~The percentage introduced early among non-Hispanic other/multiracial children is significantly different from that of non-Hispanic Black and non-Hispanic Asian children.~~

¶ Maternal sociodemographic data might be missing because no mother was reported in the child's household or because information was not reported by respondent.

** The percentage of infants introduced to complementary foods before age 4 months among children of mothers aged 30–39 years is significantly different from that of children of mothers aged 18–29 and ≥40 years.

†† The percentage of infants introduced to complementary foods before 4 months among children of mothers with bachelor's degrees or higher is significantly different from that of children of mothers of all other highest education levels.

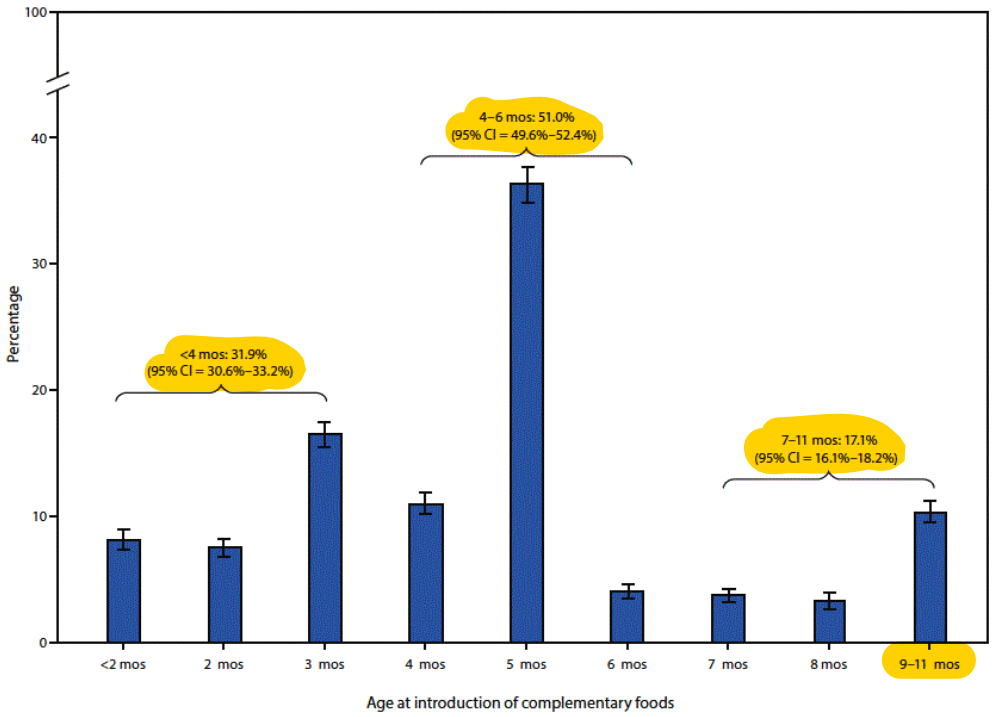
§§ The percentage of infants introduced to complementary foods before 4 months among children living at ≥400% FPL is significantly different from that of children living at all other household income levels. The percentage of infants introduced early among children living at <100% FPL is significantly different from that of children living at 200%–399% FPL and ≥400% FPL.

¶¶ The percentage of infants introduced to complementary foods before age 4 months among children receiving only breast milk for milk feeds at age 4 months is significantly different from that of children receiving all other types of nutrition for milk feeds at age 4 months. The percentage introduced early among children receiving only infant formula for milk feeds at age 4 months is significantly different from that of children receiving all other types of nutrition for milk feeds at age 4 months. The percentage introduced early among children receiving both breast milk and infant formula for milk feeds at age 4 months is significantly different from that of children receiving all other types of nutrition for milk feeds at age 4 months.

*** U.S. Census Bureau classifications for regions.

††† The percentage of children introduced to complementary foods before age 4 months among children living in the West is significantly different from that of children living in all other regions. The percentage of children introduced early among children living in the Midwest is significantly different from that of children living in the South and the West.

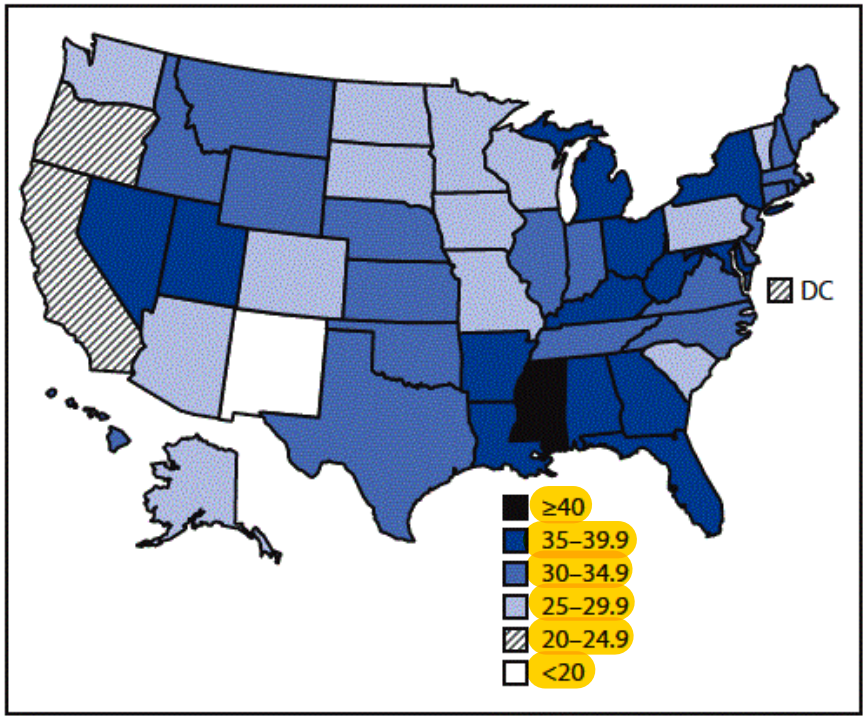
FIGURE 1. Age at introduction of complementary foods among children aged 1–5 years* — National Survey of Children's Health. United States. 2016–2018



Abbreviation: CI = confidence interval.
* 95% confidence intervals are indicated by error bars.

Alt Text: The figure is a bar graph showing the distribution of age at introduction of complementary foods among children aged 1–5 years in the United States during 2016–2018 according to the National Survey of Children's Health. Introduction of complementary foods at age <4 months was 15.6% (95% CI = 14.6%–16.6%), at age 4–6 months was 63.3% (62.0%–64.7%), and at age 7–12 months was 21.1% (19.9%–22.3%).

FIGURE 2. Percentage of children introduced to complementary foods before age 4 months among children aged 1–5 years — National Survey of Children's Health, United States, 2016–2018



Abbreviation: DC = District of Columbia.

Alt Text: The figure is a map of the United States showing the percentage of children introduced to complementary foods before age 4 months among children aged 1–5 years in the United States during 2016–2018 according to the National Survey of Children's Health.

Supplementary Table. Percentage of children introduced to complementary foods before age 4 months by state among children 1–5 years – National Survey of Children's Health, United States, 2016–2018.

	Total no.	Percentage introduced early (%)*	95% CI (%)*
Alabama	431~~432~~	24.3~~38.7~~	(19.3, 30.2)~~(32.8, 44.8)~~
Alaska	472~~475~~	12.8~~28.9~~	(9.5, 17.0)~~(24.0, 34.4)~~
Arizona	421~~422~~	15.0~~28.8~~	(10.5, 21.0)~~(23.2, 35.1)~~
Arkansas	449~~452~~	19.6~~39.3~~	(15.1, 25.2)~~(32.6, 46.3)~~
California	416~~417~~	10.7~~23.0~~	(7.5, 14.9)~~(18.1, 28.8)~~
Colorado	482~~486~~	9.3~~26.6~~	(6.6, 13.1)~~(21.5, 32.4)~~
Connecticut	441~~443~~	16.5~~31.5~~	(12.3, 21.9)~~(25.8, 37.9)~~
Delaware	692~~451~~	12.8~~33.9~~	(9.1, 17.7)~~(28.0, 40.3)~~
District of Columbia	450~~699~~	17.4~~24.9~~	(13.0, 22.8)~~(20.2, 30.3)~~
Florida	414~~417~~	16.5~~35.2~~	(11.7, 22.7)~~(28.5, 42.5)~~
Georgia	394~~398~~	17.3~~37.9~~	(12.9, 22.8)~~(31.6, 44.6)~~
Hawaii	481~~488~~	14.6~~30.9~~	(11.0, 19.2)~~(25.9, 36.4)~~
Idaho	490~~492~~	13.4~~32.6~~	(10.0, 17.7)~~(27.7, 38.0)~~
Illinois	502~~502~~	14.1~~31.4~~	(10.1, 19.3)~~(25.7, 37.6)~~
Indiana	433~~437~~	19.4~~34.8~~	(14.8, 25.1)~~(29.2, 41.0)~~
Iowa	466~~469~~	12.0~~29.0~~	(8.7, 16.4)~~(23.7, 35.1)~~
Kansas	498~~503~~	16.2~~30.3~~	(11.5, 22.3)~~(24.6, 36.6)~~
Kentucky	458~~459~~	22.8~~35.8~~	(17.9, 28.6)~~(30.1, 42.0)~~
Louisiana	390~~391~~	21.2~~35.9~~	(16.1, 27.5)~~(29.9, 42.4)~~
Maine	445~~448~~	13.2~~32.2~~	(9.4, 18.2)~~(26.6, 38.4)~~
Maryland	452~~454~~	19.3~~35.0~~	(14.3, 25.5)~~(29.0, 41.4)~~
Massachusetts	495~~500~~	15.1~~33.6~~	(10.5, 21.1)~~(27.7, 39.9)~~
Michigan	483~~486~~	14.3~~36.3~~	(10.3, 19.5)~~(30.3, 42.9)~~
Minnesota	591~~595~~	12.1~~26.1~~	(8.1, 17.7)~~(21.0, 31.9)~~
Mississippi	415~~416~~	34.4~~49.0~~	(28.2, 41.1)~~(42.5, 55.5)~~
Missouri	479~~481~~	17.0~~28.5~~	(12.6, 22.7)~~(23.4, 34.3)~~
Montana	478~~481~~	13.8~~32.8~~	(9.7, 19.1)~~(27.0, 39.2)~~
Nebraska	549~~550~~	14.5~~31.2~~	(10.8, 19.1)~~(25.7, 37.3)~~
Nevada	426~~427~~	17.1~~35.1~~	(12.5, 22.9)~~(28.8, 41.9)~~
New Hampshire	423~~426~~	12.3~~30.9~~	(8.5, 17.5)~~(25.3, 37.1)~~
New Jersey	435~~435~~	15.9~~34.4~~	(11.7, 21.3)~~(28.4, 41.0)~~
New Mexico	381~~382~~	7.6~~18.0~~	(5.3, 10.7)~~(13.9, 23.1)~~
New York	441~~446~~	18.2~~37.3~~	(13.1, 24.7)~~(30.9, 44.2)~~
North Carolina	439~~442~~	19.6~~34.9~~	(14.2, 26.3)~~(28.4, 41.9)~~
North Dakota	524~~525~~	12.9~~28.1~~	(9.4, 17.4)~~(22.8, 34.2)~~
Ohio	471~~474~~	18.0~~38.4~~	(13.4, 23.8)~~(32.3, 44.9)~~
Oklahoma	453~~458~~	14.5~~32.6~~	(10.2, 20.3)~~(26.9, 38.9)~~
Oregon	487~~491~~	13.2~~22.6~~	(8.6, 19.6)~~(16.9, 29.5)~~
Pennsylvania	476~~477~~	17.0~~29.5~~	(12.6, 22.5)~~(24.1, 35.5)~~
Rhode Island	438~~440~~	16.5~~32.5~~	(12.4, 21.6)~~(27.1, 38.5)~~
South Carolina	472~~475~~	17.2~~29.1~~	(12.5, 23.3)~~(23.5, 35.3)~~
South Dakota	521~~527~~	15.0~~28.8~~	(10.9, 20.2)~~(23.7, 34.5)~~
Tennessee	436~~444~~	15.9~~33.3~~	(12.0, 20.7)~~(27.7, 39.4)~~
Texas	408~~413~~	15.5~~33.1~~	(11.2, 21.2)~~(27.1, 39.7)~~
Utah	545~~552~~	12.1~~36.7~~	(8.7, 16.5)~~(31.6, 42.2)~~
Vermont	477~~478~~	9.7~~28.0~~	(6.8, 13.6)~~(22.6, 34.1)~~

Virginia	471~~473~~	15.6~~32.2~~	(11.9, 20.2)~~(26.6, 38.3)~~
Washington	513~~517~~	11.0~~25.1~~	(7.5, 15.8)~~(20.1, 30.8)~~
West Virginia	399~~401~~	17.0~~36.3~~	(12.6, 22.5)~~(29.9, 43.2)~~
Wisconsin	512~~514~~	11.3~~27.7~~	(7.9, 16.0)~~(22.4, 33.7)~~
Wyoming	460~~466~~	14.1~~30.3~~	(10.6, 18.5)~~(25.4, 35.7)~~

Abbreviations: CI = confidence interval.

*Percentages are weighted to account for complex survey design.