Characteristics of U.S. Consumers Reporting Past Year Intake of Raw (Unpasteurized) Milk: Results from the 2016 Food Safety Survey and 2019 Food Safety and Nutrition Survey

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Abstract

Consumption of unpasteurized (raw) milk has been linked to foodborne illness in the United States at higher relative rates than has consumption of pasteurized milk and milk products. Regulation of these products differs by state. Regardless of the risk of consumption, some people still purchase and consume unpasteurized milk. Based on information from the 2016 Food Safety Survey and the 2019 Food Safety and Nutrition Survey conducted by the U.S. Food and Drug Administration, we evaluated prevalence, frequency, and demographic predictors of consumption of raw milk in the U.S. adult population. Results show that 4.4% of U.S. adults reported consuming raw milk at least once in the past year, with 1.6% reporting frequent consumption of raw milk (once per month or more often) and 1.0% reporting consumption once per week or more often. The individuals who consumed raw milk in the previous 12 months were more likely to be younger, living in a rural area, and living in a state in which retail sale of raw milk is legal. These results provide quantitative information on consumption prevalence and frequency and demographic characteristics of individuals who consume unpasteurized milk in the United States.

Keywords

Consumer behavior; Dairy food safety; Food safety; Raw milk; Unpasteurized milk

In 1987, the U.S. Food and Drug Administration (FDA) prohibited the distribution of raw (unpasteurized) milk across state lines for direct sale or distribution to consumers. However, many states allow these products to be sold within the state, and human illnesses and outbreaks associated with consumption of unpasteurized dairy products (including raw fluid milk and cheese made from raw milk) continue to occur (6, 10, 13, 26). According to a 2019 report by the U.S. Department of Agriculture, Economic Research Service (USDA-ERS), as of 2016, retail sales of raw milk from cows, goats, and sheep for human consumption were legal in 13 states, sales on farms or via cow-share agreements were legal in 25 states, and

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sales were not legal in 12 states (16). Costard et al. (5) calculated that raw dairy products are 840 times more likely than pasteurized dairy products to cause illnesses and 45 times more likely to cause hospitalizations from infections with *Campylobacter* spp., *Listeria monocytogenes, Salmonella,* and Shiga toxin–producing *Escherichia coli* when controlling for consumption patterns of these products.

Despite issues associated with raw dairy products, the currently popular movement toward eating local and unprocessed food has fueled increasing interest in and consumption of unpasteurized dairy products (4). A recent analysis from the USDA-ERS revealed that 2% of at-home meal preparers in the United States served raw milk weekly (16). We used pooled data from two U.S. cross-sectional probability surveys, the 2016 Food Safety Survey (FSS) (23) and the 2019 Food Safety and Nutrition Survey (FSANS) (25), to compare the demographic characteristics of individuals who reported consuming unpasteurized milk in the prior year and to describe consumption frequency.

MATERIALS AND METHODS

Sample.

We analyzed data from the FDA 2016 FSS and the 2019 FSANS, which are nationally representative cross-sectional surveys of U.S. adults. The 2016 FSS was a national telephone survey of adults in the 50 states and the District of Columbia. The survey included 4,169 participants and was conducted between October 2015 and January 2016. Respondents were randomly selected from an overlapping dual sampling frame consisting of both landlines and cell phones. Both landline and cell phone numbers were selected using a random digit-dial (RDD) process (GENESYS, Marketing Systems Group, Horsham, PA), which yields an equal probability of selection, single-stage sample of telephone numbers. Regional coverage was controlled to assure the survey could reach a sufficient number of African American and Hispanic consumers. In the landline portion of the survey, the most recent birthday method was used to select the eligible respondent in a household, and for the cellphone survey the adult who answered the phone was selected. A 21% dual-frame response rate was achieved (response rate 3, American Association for Public Opinion Research [AAPOR], Alexandria, VA) with 2,021 landline and 2,148 cell phone interviews. All respondents were asked the questions about raw milk. Each interview averaged 17 min. Sampling weights were calibrated to the Census American Community Survey (ACS) 2016 U.S. adult population estimates (https://www.census.gov/programs-surveys/acs).

Because of declining response rates and increased costs associated with phone surveys, the FSS was transitioned to the FSANS for 2019. To ensure continuity between surveys and allow temporal trend analyses, the 2019 FSANS consisted of both an RDD phone survey version and an address-based "mail—push to Web" survey (ABS) version. The mixed mode approach ensured that comparisons could be made with previous food safety surveys while controlling for any effects of administration mode on survey results. Sampled persons for the phone version of the survey were selected using the dual-frame landline and cell phone RDD sampling scheme. This dual-frame stratified sampling approach allowed for national representation but also oversampled landline telephone numbers in exchanges with higher Hispanic and African American populations. The cell phone sample was not stratified

because cell exchanges are not accurately tied to geographic areas. Before sampling, the researchers agreed to 80% cell phone and 20% landline RDD composition for efficient coverage of the U.S. adult population. The RDD data were collected from 14 October through 22 December 2019, and each respondent was randomly assigned to one of the two versions of the survey: food safety or nutrition. Of the 834 respondents, 415 were randomly assigned to the food safety version and asked the raw milk questions.

The Web and paper surveys utilized the ABS system to obtain a nationally representative sample of households. Before the first survey invitation letter was mailed, each address was randomly designated for inclusion in the nutrition or food safety version of the survey. Within households, respondents were randomly selected using the Hagen-Collier within-household sampling scheme (oldest adult female, youngest adult female, oldest adult male, youngest adult male) to identify one random adult in the household (7). Up to five letters requesting participation in the study were sent to each selected household. The first mailing contained a notification letter on FDA letterhead introducing the study and providing survey access information (the URL and a unique personal identification number [PIN] assigned to each selected household); the letter invited the selected adult to complete the study by visiting an FDA Web site. The first mailing also contained two $1 bills as an incentive to encourage response and maintain data quality. The second mailing was a thank you and reminder postcard, which was sent 3 days after the initial mailing and was followed 6 days later by the third mailing, which was a second reminder letter. The fourth mailing, sent 20 days after the initial mailing to those who had not yet responded, contained a letter, a survey booklet, and a prepaid return envelope. Four days after the fourth mailing, researchers sent the fifth and final mailing, a reminder postcard that also included instructions on how to access the Web version of the survey. Addresses in zip codes with high Hispanic populations (20% Hispanic) according to the U.S. Census received letters in Contacts 1, 3, and 4 with the information in both English and Spanish.

The FDA survey Web page provided commonly asked questions about the study (in English and Spanish) and included a link that routed participants to the survey host site (now defunct). On the host site, respondents could enter their assigned PIN to begin the survey. Survey data were weighted to account for sampling design and non-response. The ABS data were collected from 1 October through 2 November 2019 and yielded a sample of 4,398 respondents, 2,227 of which were randomly assigned to the food safety version and asked the raw milk questions. Sampling weights were calculated separately for the RDD and ABS samples to control for differential probabilities of selection (within household and across sociodemographic groups) and to reduce biases due to non-response. Sampling weights were calibrated to the ACS 2014 to 2018 5-year U.S. adult population estimates. Extreme weights were truncated. The response rate 3 (as defined by the AAPOR) from the 2019 FSANS RDD was 6.6%, and that from the 2019 FSANS ABS was 28.1%.

Questionnaire design.

Prior to the administration of both the 2016 and 2019 surveys, cognitive interviews and pretests were conducted to enhance the survey's understandability and to evaluate the survey

administration plan. For the phone surveys, training was also conducted to familiarize interviewers with the contents of the survey.

Variables.

For both the 2016 and 2019 surveys, all eligible respondents were asked, "In the past 12 months, did you drink any raw milk or milk that was not pasteurized? This type of milk is often sold off-the-farm or door-to-door." The variable "raw milk consumption" was based on this question, and those who answered "yes" were considered "raw milk consumers" and were subsequently asked, "How often do you drink raw milk? Would you say less than once a year, a few times a year, once a month, a few times a month, once a week, two to three times per week, or daily?" Those who said they drank raw milk once per month or more frequently were classified as being "frequent raw milk drinkers."

To capture data on both race and Hispanic ethnicity, a four-level variable combining the two was created. This variable categorized the respondents into non-Hispanic white, non-Hispanic Black, non-Hispanic other, and Hispanic. Respondent ages were aggregated into three groups: 18 to 35 years, 36 to 65 years, and 66 years. Respondent education levels were aggregated into three groups: high school graduate or less, some college or an associate's degree, and college graduate. Respondents were also grouped into regions of the United States: Northeast (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania), Midwest (Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota), South (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington, D.C., West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas), and West (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington). Phone respondents were asked to specify their zip code, and geocodes were developed from the reported zip code. The dichotomous variable "rural" (1 = rural; 0 = urban) was created by appending the respective USDA-ERS Rural Urban Commuting Area codes to the respondents' zip codes. Codes 1 to 3 were classified as urban, and codes 4 to 10 were classified as rural.

To analyze raw milk consumption rates by state based on the legality of the sale of raw milk, each state was categorized as allowing retail store sales within the state (retail), allowing sales on farms or via cow-share agreements (on farm), or as not allowing sale of raw milk for human consumption (sale not legal), as categorized by Rhodes et al. (16).

Statistical analysis.

Data from the 2016 FSS and 2019 FSANS were combined to get a more accurate picture of who was consuming raw milk in the United States. Prior to combining the 2016 and 2019 survey results, the temporal mode effect of survey year and mode (2016 RDD, 2019 RDD, and 2019 ABS) was assessed. Logistic regression was used to assess the effect of survey year and mode on raw milk consumption (yes or no) and on frequent raw milk consumption (weekly or monthly versus none), while adjusting for possible confounding effects of sample compositional differences, and 95% confidence intervals (CIs) around the

model-adjusted percentages for raw milk consumption were estimated where overlapping intervals indicated no significant difference. Confounders included in the model were race, age, gender, income (unimputed), education, and urbanicity. The sampling weights for 2016 and 2019 were composited, applying equal importance to both cycles: $F_{2016} = [n_T(1 - 0.5)]/n_{2016}$, where F_{2016} is the factor applied to the 2016 sampling weights, F_{2019} is the factor applied to the 2019 sampling weights, n_{2016} is the 2016 sample size (4,169), n_{2019} is the 2019 sample size (2,642), and n_T is the total sample size (6,811). The sampling weights for FSANS 2019 were similarly composited prior to combining 2019 FSANS with 2016 FSS (i.e., the sampling weights of 2019 FSANS were a composite of RDD and ABS sampling weights). To estimate population counts, a similar compositing processing was used on the original sampling weights such that these composited weights over both cycles added up to an average yearly U.S. adult population estimate.

Using the composited 2016 and 2019 data, we assessed the demographic characteristics of individuals who reported consuming raw milk in the past 12 months. Characteristics of frequent raw milk consumers (i.e., at least weekly or at least monthly) were compared with those of respondents who did not report consuming raw milk in the past 12 months. Initially, separate bivariate analyses were conducted to evaluate associations between consumption of raw milk and age, gender, race or ethnicity, education, income, region, living in an urban versus rural area, and state legal status of raw milk. Logistic regression was used to assess the effect of each respondent characteristic on raw milk consumption and the concordance statistic (C), which is an estimate of the ability of each characteristic to contribute predictive power to the model, was used to assess predictor importance (9). C statistics are not expected to be high for survey categorical data, and characteristics with C values of 0.52 were then included in the multivariate logistic regression models to identify which characteristics were significant predictors of past year raw milk consumption. Because only 4.4% of the weighted combined sample (227 respondents) consumed raw milk in the past year, the sample size was not sufficient to include interaction terms in the model. Therefore, frequent raw milk drinkers were compared with nonconsumers of raw milk using bivariate logistic regression. SAS 9.4 (2012, SAS Institute, Cary, NC) was used for all data analyses.

Responses of "don't know" or "refused" or that were left blank were treated as missing. Because of the high percentage of missing values for income ($n_{2016} = 640$, 15.4%; $n_{2019} = 404$, 15.3%) and its promising candidacy as a predictor ($C = 0.56$), income was imputed using missing-at-random and nonmonotone missing data pattern assumptions. The multiple imputation procedure was utilized to multiply impute income ($n_{impute} = 5$) using fully conditional specification methods from the number of adults 18 to 59 years old in the household, education level, gender, age (continuous), race, and urbanicity. The quality of the imputations was checked via cross-validation (20% randomly set to missing). A Pearson correlation value of 0.26 ($P = 0.012$) indicated a significant positive correlation between imputed and nonimputed values. Imputed income was aggregated into four annual household income groups: <$25,000, $25,000 to $49,999, $50,000 to $99,999, and $100,000.

RESULTS

Compositing samples.

The model-adjusted percentages of raw milk consumption (95% CIs) were 3.1% (1.8, 5.2%) for 2019 FSANS ABS, 5.5% (3.1, 9.5%) for 2019 FSANS RDD, and 3.5% (2.4, 5.2%) for 2016 FSS RDD. The model-adjusted percentages of weekly raw milk consumers were 0.7% (0.3, 2.0%) for 2019 FSANS ABS, 0.3% (0.04, 1.8%) for 2019 FSANS RDD, and 0.8% (0.4, 1.9%) for 2016 FSS RDD. The model-adjusted percentages of monthly raw milk consumers were 1.0% (0.4, 2.4%) for 2019 FSANS ABS, 1.0% (0.3, 3.4%) for 2019 FSANS RDD, and 1.1% (0.5, 2.3%) for 2016 FSS RDD. Because no significant temporal differences were found among the three surveys, the 2016 and 2019 samples were combined for the demographic analysis (Table 1).

Results show that 4.4% of U.S. adults (approximately 10,698,000 adults) reported consuming raw milk at least once in the past 12 months, 1.6% reported consuming raw milk once per month or more often, and 1.0% reported consuming raw milk once per week or more often. Of the 4.4% who reported drinking raw milk in the past year, 23.2% said they did so once per week or more often (Table 2).

Bivariate analysis of raw milk consumption.

The demographic characteristics of respondents who drank raw milk at least once in the past 12 months, separated into frequent (once per month or more often) versus occasional (less than once per month) raw milk drinkers are presented in Table 3. Age, region, and state legal status of raw milk were the strongest correlates for drinking raw milk. One noteworthy albeit not significant (possibly due to small sample sizes) demographic distinction was found between the frequent and occasional raw milk drinkers: occasional raw milk drinkers tended to have higher levels of education (college graduate).

Multivariate analysis of raw milk consumption.

Of the 6,747 survey participants, 6,075 (90%) respondents with complete data were included in the logistic regression model of raw milk consumption (Table 4). Adjusted odds ratio estimates revealed that after accounting for the demographic characteristics, younger adults (18 to 35 years) were more likely to have consumed raw milk in the previous year than were older adults (66 years). Those living in rural residences and those in higher income groups also were more likely to consume raw milk. Those from states where the retail sale of raw milk for human consumption is legal were more likely to consume raw milk than were those from states where the sale of raw milk is not legal, and those from the Northeast were more likely than those from the South to consume raw milk. Education, gender, and race or ethnicity were not significant predictors of raw milk consumption in the previous year (Table 4).

DISCUSSION

Unpasteurized or "raw" milk is more likely than pasteurized milk to contain pathogens such as *Campylobacter, Salmonella, E. coli, Coxiella burnetii,* and *Listeria,* all of which can cause

serious illnesses and are particularly dangerous for people with weakened immune systems, children, older adults, and pregnant women (13). This study was conducted to determine the demographic characteristics of U.S. adults who reported consuming unpasteurized (raw) milk and to determine the frequency of consumption based on nationally representative survey data from 2016 and 2019. We found that 1.6% of adults reported consumption of raw milk once per month or more frequently, and 1.0% of adults reported consumption of raw milk once per week or more often. These findings are consistent with those of previous work, in which 1.5% of respondents reported having consumed raw milk in the past 7 days (20). In the 2018 to 2019 FoodNet population study, 2% of respondents in the catchment areas (representing about 15% of the U.S. population) reported drinking raw milk in the past 7 days (2). The USDA-ERS found that 2% of at-home meal preparers in the United States used or served raw milk in the past 7 days (16).

We found that those who reported drinking raw milk in the past year were more likely to be younger (18 to 35 years) and to reside in rural areas. Consumption was significantly higher in the Northeast than in the South and was significantly higher in states where the retail sale of raw milk is legal than in states where the sale of raw milk is not legal. Model results indicated that level of education was not a significant predictor of previous year raw milk consumption after accounting for other demographic factors.

Many Internet "health" sites include misleading information and falsely promote raw milk as more nutritious or natural (11, 21). Rahn et al. (15) stated that raw milk advocates have been advancing the argument for reducing legal barriers for the sale of raw milk in terms of consumer choice and support for local farmers in several states. Other research has supported the findings that perceived health benefits and taste are major drivers of raw milk consumption (8, 12).

Our study results expand the literature by elucidating the differences in the demographic characteristics of consumers based on the reported frequency of consumption of raw milk. Although all raw milk drinkers tended to be younger and more likely to live in rural areas or in states where the retail sale of raw milk is legal, occasional raw milk drinkers were more likely to be college educated, and frequent raw milk drinkers tended to have lower levels of formal education. This information is important from a food safety and educational outreach perspective because occasional raw milk drinkers (less than once per month) make up the majority (60%) of raw milk drinkers. Many factors such as the higher price of raw milk (which can be two to three times higher than that of pasteurized milk) (3) and the limited points of purchase for raw milk likely limit the frequency of raw milk consumption among those who would choose to consume raw milk.

Although FDA experts have provided numerous testimonies to state legislators warning them of the risks of unpasteurized milk consumption (17–19), most U.S. adults live in states that have some form of legal access to raw milk. Although prohibiting the sale of raw milk may be an effective legal strategy for reducing consumption overall in a given state, it may be beneficial to couple this prohibition with mechanisms for individual behavior change such as effective public health education campaigns and messages for consumers to increase

their awareness of the risks associated with raw milk. These educational programs could further reduce raw milk consumption and the associated foodborne illnesses.

The overall findings about raw milk drinkers suggest a need to target younger consumers with public health messages designed based on best practices in health communication so that the messages resonate with these consumers. Many, but especially younger, consumers are more likely to access food and nutrition information online and from personal sources such as friends and family (14). Raw milk consumption was significantly higher in the Northeast than in the South. This may be partially because raw milk is more easily accessed in northeastern states because more of these states allow retail sales (16) and interstate travel is easier in this region. We suspect that consumers living in rural areas probably have more access to raw milk because they may live on or near a farm.

Public health messages for occasional raw milk drinkers or even those who are interested in raw milk should be designed specifically to reach them. Occasional raw milk drinkers may be unaware of the risks of raw milk consumption, so targeted messaging informing them about the risks of raw milk is critical. Less frequent drinkers and new potential drinkers may encounter these products for the first time at places such as farm markets and festivals. The risks of raw milk could be presented at the point of sale at farm markets and festivals to inform those who may not know the risks and remind others of risks they may have heard of and may be effective for preventing some consumers from trying raw milk.

Public health messaging about the dangers of raw milk, such as the Centers for Disease Control and Prevention (1) campaign "Real Stories of the Dangers of Raw Milk" that features personal stories about mothers or their children severely sickened by raw milk, have many features (such as focusing on young adults with children and using first-person stories) that likely make them compelling and persuasive even for individuals who already know about the risks. The FDA also has conducted numerous outreach campaigns aimed at educating consumers about the risks of raw milk consumption (22, 24).

The main strengths of the present study include the use of the national sampling frames with large sample sizes, which allowed us to more accurately estimate raw milk consumption. The data from the two surveys conducted 3 years apart allowed us first to test for temporal differences and then, after finding none, to combine the two data sets to increase our sample size. However, this study is limited by the nature of self-reported data, which may not perfectly reflect actual behavior. Information about why respondents chose to drink raw milk would have been helpful for obtaining a better understanding of consumer motivations and for designing public health messages. Although we conducted an analysis looking at the rate of raw milk consumption by state legal status of raw milk as of 2016, state laws continue to change, and this analysis should be updated to reflect these changes. In conclusion, 4.4% of U.S. adults reported consuming raw milk at least once in the past year, 1.6% reported frequent consumption of raw milk (once per month or more often), and 1.0% reported consuming it once per week or more often.

This improved understanding of who is consuming raw milk, particularly at higher and lower frequencies, will contribute to development of more effective public health outreach, education, and prevention strategies to reduce consumption of raw milk.

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HIGHLIGHTS

- Results show that 4.4% of adults consumed raw milk at least once in the past year.

- Consumers usually were younger, from rural areas, and where retail sale of raw milk is legal.

- Most (62%) of all raw milk consumers drink this milk less than once per month.

TABLE 1.

Descriptive statistics for raw milk consumption and consumer sociodemographic variables for the combined 2016 Food Safety Survey and 2019 Food Safety and Nutrition Survey

Variable	Category	n	% (weighted)
Consumed raw milk (n = 6,747)	Yes	227	4.4
	No	6,520	95.6
Age (yr) (n = 6,431)	18–35	1,342	32.5
	36–65	3,261	51.0
	66	1,828	16.6
Education (n = 6,677)	High school graduate or less	1,922	40.0
	Some college or associate's degree	1,805	30.7
	College graduate	2,950	29.2
Gender (n = 6,763)	Male	2,983	48.9
	Female	3,780	51.1
Race, ethnicity (n = 6,653)	Non-Hispanic white	4,549	66.4
	Non-Hispanic Black	689	11.5
	Non-Hispanic other	698	7.0
	Hispanic	717	15.1
Income (n = 5,767) (unimputed)	<$25,000	1,247	22.4
	$25,000–$49,999	1,418	25.6
	$50,000–$99,999	1,727	29.9
	$100,000	1,375	22.1
Region (n = 6,798)	Northeast	1,182	17.5
	Midwest	1,523	22.0
	South	2,477	37.5
	West	1,616	23.1
Urbanicity (n = 6,591)	Rural	1,094	17.0
	Urban	5,497	83.0
Legal status of raw milk (n = 6,757)[a]	Retail	1,996	29.0
	On farm	3,224	47.4
	Sale not legal	1,537	23.5

[a]Rhodes et al. (16).

TABLE 2.

Self-reported frequency of raw milk consumption among those who consumed raw milk in the past 12 months

Frequency	n	Weighted % (95% CI)[a]	No. of U.S. adults (weighted) (95% CI)[b]
<1 time/yr (occasional)	47	23.1 (15, 31.3)	2,416,500 (1,523,600, 3,309,400)
Few times/yr (occasional)	97	36.5 (28.3, 44.7)	3,959,800 (3,139,400, 4,780,100)
1 time/mo (frequent)	17	5.3 (1.8, 8.8)	574,000 (211,200, 936,900)
Few times/mo (frequent)	14	8.1 (2.5, 13.7)	844,100 (268,600, 1,419,600)
1 time/wk (frequent)	8	4.9 (0.1, 9.8)	495,400 (11,900, 978,800)
2–3 times/wk (frequent)	16	8.8 (3.3, 14.3)	990,000 (368,000, 1,612,000)
Daily (frequent)	22	9.5 (4.5, 14.5)	1,018,600 (492,500, 1,544,700)
Don't know, refused to answer, blank	6	3.8 (0, 8.6)	399,600 (0, 884,500)
Total	227	100	10,698,000 (9,461,600, 11,934,300)

[a]Percentages weighted to the U.S. population.

[b]Numbers rounded to nearest 100.

TABLE 3.

Demographic characteristics of those who drank raw milk at least once in the past 12 months, frequently, and occasionally

Characteristic	Category	No consumption		All drinkers			Frequent drinkers			Occasional drinkers		
		n	% (95% CI)[a]	n	% (95% CI)	C	n	% (95% CI)	C[b]	n	% (95% CI)	C[c]
Raw milk consumption		6,520	95.6 (94.8, 96.4)	227	4.4 (3.6, 5.2)		77	1.6 (1.1, 2.2)		144	2.7 (2.1, 3.2)	
Age (yr)	18–35	1,238	31.4 (29.6, 33.1)	83	47.2 (37.9, 56.5)	0.63	26	42.8 (26.8, 58.7)	0.59	54	48.0 (36.9, 59.1)	0.64
	36–65	3,133	51.4 (49.6, 53.2)	103	45.8 (36.6, 55)		29	47.9 (31.6, 64.3)		72	45.9 (34.9, 56.9)	
	66	1,786	17.2 (16.1, 18.3)	29	7.0 (3.8, 10.2)		15	9.3 (3.6, 15)		14	6.1 (1.9, 10.2)	
Education	High school graduate or less	1,841	39.7 (38, 41.5)	57	38.4 (29, 47.8)	0.52	21	46.6 (30.2, 62.9)	0.51	33	31.2 (20.8, 41.5)	0.55
	Some college or associate's degree	1,730	30.9 (29.3, 32.5)	59	28.1 (20.1, 36)		22	29.1 (15.7, 42.6)		35	27.9 (17.8, 38.1)	
	College graduate	2,821	29.4 (28, 30.8)	108	33.5 (25.6, 41.5)		31	24.3 (13.6, 35)		76	40.9 (30.2, 51.6)	
Gender	Male	2,835	48.3 (46.5, 50)	121	58.3 (49.5, 67.1)	0.55	43	59.3 (44.2, 74.5)	0.56	73	55.6 (44.6, 66.5)	0.54
	Female	3,640	51.7 (50, 53.5)	104	41.7 (32.9, 50.5)		33	40.7 (25.5, 55.8)		70	44.4 (33.5, 55.4)	
Race, ethnicity	Non-Hispanic white	4,357	66.6 (64.8, 68.3)	156	69.6 (60.5, 78.6)	0.53	56	81.3 (69.5, 93.1)	0.55	99	66.4 (54.9, 77.8)	0.54
	Non-Hispanic Black	672	11.6 (10.4, 12.8)	11	7.1 (1.2, 13.1)		3	2.8 (0, 6.3)		6	5.8 (0, 11.7)	
	Non-Hispanic other	652	6.7 (5.9, 7.5)	31	7.0 (4, 10)		10	7.3 (2, 12.6)		20	7.1 (3.3, 10.9)	
	Hispanic	689	15.2 (13.7, 16.6)	23	16.3 (8.3, 24.3)		5	8.6 (0, 19.2)		16	20.8 (9.6, 32)	
Income	<$25,000	1,193	22.3 (20.8, 23.9)	40	20.5 (13, 27.9)	0.56[d]	15	14.9 (5.2, 24.7)	0.54[d]	24	23.8 (13.4, 34.2)	0.57[d]
	$25,000–$49,999	1,374	25.9 (24.2, 27.5)	32	15.5 (9.2, 21.8)		13	20.1 (7.4, 32.7)		19	12.8 (6.5, 19.1)	
	$50,000–$99,999	1,647	29.9 (28.2, 31.7)	71	35.6 (26.7, 44.5)		26	40.4 (24.5, 56.4)		44	32.7 (22.3, 43.1)	
	$100,000	1,305	21.8 (20.4, 23.3)	57	28.4 (19.5, 37.3)		15	24.5 (9.1, 40)		41	30.7 (19.7, 41.6)	
Region	Northeast	1,116	17.2 (15.9, 18.4)	53	26.3 (18.1, 34.6)	0.58	20	33.3 (17.4, 49.2)	0.57	32	23.6 (14.4, 32.8)	0.59
	Midwest	1,464	22.4 (21, 23.8)	48	18.7 (12.5, 24.9)		13	14.4 (5.6, 23.2)		33	21.3 (12.8, 29.7)	
	South	2,393	37.6 (35.9, 39.3)	57	26.5 (18, 34.9)		22	22.9 (10.3, 35.5)		32	25.3 (15.2, 35.5)	
	West	1,535	22.8 (21.4, 24.3)	68	28.5 (20.3, 36.7)		21	29.4 (14.8, 43.9)		47	29.8 (19.7, 39.9)	
Urbanicity	Rural	1,037	16.9 (15.6, 18.2)	53	25.2 (17.2, 33.2)	0.54	19	33.8 (17.9, 49.7)	0.54	34	21.4 (13.1, 29.8)	0.54
	Urban	5,268	83.1 (81.8, 84.4)	170	74.8 (66.8, 82.8)		57	66.2 (50.3, 82.1)		108	78.6 (70.2, 86.9)	
Legal status of raw milk	Retail	1,890	28.4 (26.8, 29.9)	88	40.9 (31.9, 49.8)	0.58	29	43.3 (27.6, 58.9)	0.59	59	42.0 (31.0, 53.0)	0.58
	On farm	3,085	47.9 (46.1, 49.6)	111	46.1 (37.1, 55.2)		42	51.5 (35.9, 67.2)		65	43.7 (33.0, 54.7)	
	Sale not legal	1,492	23.7 (22.2, 25.3)	27	13.0 (6.4, 20.0)		6	5.2 (0.3, 10.0)		19	14.3 (6.5, 22.0)	

[a] Percentages weighted to the U.S. population.

[b]Weekly or monthly raw milk drinkers versus respondents who did not consume raw milk in the past 12 months.

[c]Yearly or less frequent raw milk drinkers versus respondents who did not consume raw milk in the past 12 months.

[d]Calculated on imputed income.

TABLE 4.

Associations between demographic characteristics of adults (≥ 18 years) and consumption of raw (unpasteurized) milk in the past 12 months[a]

Characteristic	Comparison		Adjusted odds ratio (95% CI)	P
	Category 1	Category 2		
Age (yr)	18–35	36–65	1.8 (1.2, 2.8)	<0.01
	18–35	≥66	3.7 (2, 6.6)	<0.001
	36–5	≥66	2.0 (1.2, 3.5)	<0.05
Education	High school graduate or less	Some college or associate's degree	1.2 (0.7, 1.9)	
	High school graduate or less	College graduate	1.0 (0.6, 1.8)	
	Some college or associate's degree	College graduate	0.9 (0.5, 1.5)	
Gender	Male	Female	1.4 (0.9, 2)	
Race ethnicity	Non-Hispanic white	Non-Hispanic Black	1.3 (0.5, 3.1)	
	Non-Hispanic white	Non-Hispanic other	1.1 (0.6, 1.8)	
	Non-Hispanic white	Hispanic	1.0 (0.5, 2)	
	Non-Hispanic other	Non-Hispanic Black	1.2 (0.4, 3.2)	
	Non-Hispanic other	Hispanic	0.9 (0.4, 2)	
	Hispanic	Non-Hispanic Black	1.3 (0.4, 3.8)	
Income (imputed)	<$25,000	$25,000–$49,999	1.7 (0.8, 3.5)	
	<$25,000	$50,000–$99,999	0.9 (0.4, 1.8)	
	<$25,000	>$100,000	0.9 (0.4, 1.8)	
	$25,000–$49,999	$50,000–$99,999	0.5 (0.3, 0.9)	<0.05
	$25,000–$49,999	>$100,000	0.5 (0.3, 1)	<0.05
	≥$100,000	$50,000–$99,999	1.0 (0.6, 1.8)	
Region	Northeast	Midwest	1.8 (1, 3.2)	
	Midwest	South	1.1 (0.6, 1.8)	
	Midwest	West	0.9 (0.4, 1.7)	
	Northeast	South	1.9 (1.1, 3.3)	<0.05
	South	West	0.8 (0.4, 1.5)	
	Northeast	West	1.5 (0.9, 2.6)	
Urbanicity	Rural	Urban	1.7 (1.1, 2.8)	<0.05
Legal status of raw milk	Retail	Sale not legal	2.0 (1.1, 3.9)	<0.05

Characteristic	Comparison		Adjusted odds ratio (95% CI)	P
	Category 1	Category 2		
	On farm	Sale not legal	1.5 (0.8, 2.7)	
	Retail	On farm	1.4 (0.8, 2.3)	

[a] National U.S. population estimates, combined 2016 FSS and 2019 FSANS data.