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Change in testing for blood glucose during the COVID-19 pandemic, United States 2019–2021

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Abstract

Aim: This study assessed changes in testing for blood glucose in the United States (US) from 2019 to 2021.

Methods: We conducted a serial cross-sectional analysis of the 2019–2021 National Health Interview Survey by including adults aged ≥ 18 years without reported diagnosed diabetes. We estimated the prevalence of testing for blood glucose within 12 months and the difference in the testing prevalence between 2019 and 2021.

Results: The study sample included 82,594 respondents without diabetes in 2019—2021, with a mean age between 46.4 and 46.8 years. Overall, the prevalence of testing for blood glucose decreased significantly from 64.2 % (95 % confidence interval [CI] 63.3 %, 65.1 %) in 2019 to 60.0 % (95 % CI 59.1 %, 60.9 %) in 2021. Among adults who met the United States Preventive Services Task Force's 2015 screening recommendation, the prevalence decreased from 73.4 % (95 % CI 72.2 %, 74.6 %) to 69.5 % (95 % CI 68.3 %, 70.6 %). Although decreases in testing were observed in most groups, the extent of the decline differed by subgroups.

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Declaration of Competing Interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.diabres.2023.110985.

Conclusions: Testing for blood glucose decreased in the US during the COVID-19 pandemic. This may have delayed diagnosis and treatment of prediabetes and diabetes, underscoring the importance of continued access to diabetes screening during pandemics.

Keywords

Diabetes; Prediabetes; Screening; Testing; COVID-19

1. Introduction

Diabetes and prediabetes affect 13 % and 34.5 % of U.S. adults, respectively [1]. Testing adults' blood glucose levels to screen for prediabetes or diabetes is important for early detection and subsequent management. Regular screening of asymptomatic individuals is vital to achieve the Healthy People 2030 objectives: reduce the number of diabetes cases diagnosed yearly — D-01; and reduce the proportion of adults who don't know they have prediabetes — D-02 [2]. The U.S. Preventive Services Task Force (USPSTF) guideline in 2015 recommended screening for prediabetes and type 2 diabetes in adults aged 40–70 years who are overweight or obese [3]. In 2021, the USPSTF updated the recommendation by lowering that age criteria for screening from 40 to 35 years for earlier detection [4].

The COVID-19 pandemic has negatively impacted preventive health services, and identification and management of chronic diseases [5]. Previous research showed that people delayed or avoided routine medical care during the pandemic [6]. Reports from Europe and the United Kingdom (U.K.) showed the COVID-19 pandemic adversely affected testing for glycated hemoglobin in people with or at risk for diabetes, delaying delivery of diabetes care [7,8]. One U.S. report showed that preventive health screenings for cardiometabolic diseases—including diabetes— and cancers declined in 2021 relative to 2019, with variation by educational attainment and race and ethnicity [9].

However, among adults without diagnosed diabetes, no study has assessed how changes in blood glucose testing differed by demographic factors and geographic locations. We hypothesized that disparities in demographic characteristics and geographic locations exist in blood glucose testing among adults without diagnosed diabetes. Capturing changes in preventive screening uptake is important, as its consequences may extend long after the pandemic, and it can inform future pandemic readiness. Therefore, we used the National Health Interview Survey (NHIS), 2019–2021, to investigate the prevalence of blood glucose testing among U.S. adults without diagnosed diabetes—overall and by selected sociodemographic characteristics.

2. Methods

2.1. Data source

NHIS is a nationally representative survey of the U.S. civilian noninstitutionalized population conducted by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS). NHIS collects information on health status, health-related behaviors, and accessibility to health care [10]. From before the COVID-19 pandemic until

March 2020, interviews were conducted in respondents' homes (following regular survey interviewing procedures). From April to June 2020, due to the COVID-19 pandemic, all interviews were conducted by telephone. From July 2020 to April 2021, contact with household members was attempted first via telephone, with subsequent home visits. After May 2021, interviewers returned to regular survey interviewing procedures. Households were sampled using a geographically clustered method. From each selected household, a sample adult was randomly selected to complete a more detailed interview about their health. The sample adult response rate was 59.1 %, 49.9 %, and 50.9 % in 2019, 2020, and 2021, respectively. We did not include data from NHIS prior to 2019 due to a major questionnaire redesign including change in some items and the sampling weights for nonresponse [10–12].

2.2. Study population

The study population included non-pregnant adults aged ≥ 18 years who did not have self-reported diagnosed diabetes. We estimated the prevalence of respondents who received blood glucose testing within the previous 12 months based on the following question: "When was the last time you had a blood test for high blood sugar or diabetes by a doctor, nurse, or other health professional?". In 2019 and 2020, the question was asked of all adults while in 2021 it was asked only among adults who reported not having diagnosed diabetes. Therefore, we restricted the study sample to those without self-reported diagnosed diabetes across years, to obtain comparable populations. Respondents in 2019 had a 1-year look-back period from January 2018 to December 2019, the period before the COVID-19 pandemic. Respondents interviewed in 2021 had a 1-year look-back from January 2020 to December 2021, corresponding with the initial occurrence of the pandemic, which was declared a Public Health Emergency of International Concern by the World Health Organization on January 30, 2020. We assumed that the difference in the prevalence of testing between 2019 and 2021 reflects the epidemic's possible impact on testing.

2.3. Statistical analysis

Between 2019 and 2021, descriptive statistics of the study population and the distribution of sociodemographic and clinical characteristics were compared using chi-squared test [13]. Prevalence of blood glucose testing with 95 % confidence intervals (CI) by year for sociodemographic and clinical characteristics were estimated using the Korn and Graubard method for complex survey design [14]. The 2013 NCHS urban–rural classification scheme was used for counties: large central metro, large fringe metro, medium and small metro, and non-metropolitan [15]. Missing of income was imputed by NCHS for each year. Family income was assessed as the ratio of imputed household income to the federal poverty level (FPL), and categorized as < 100 %, 100–300 %, or ≥ 300 % based on the distribution of the data. FPL published by the US Census Bureau depends on family size and the number of related children under 18 years [16,17]. A ratio of 100 % of FPL represents a family's income equal to the FPL and higher values correspond to higher income. Age-adjusted absolute and relative changes of testing prevalence were estimated using logistic regression and predictive marginal prevalence for each subgroup. In addition, we estimated the absolute and relative changes in prevalence after adjusting for all variables using a multivariable logistic regression model. We also repeated the analysis among adults who fulfilled the

USPSTF 2015 screening recommendation for prediabetes or type 2 diabetes: adults aged 40–70 years who have overweight or obesity based on self-reported weight and height [3]. All results were weighted to account for the complex survey design and to produce nationally representative estimates. For statistical analyses we used SAS callable SUDAAN version 11 (SAS Institute Inc, Cary, NC; RTI International, Research Triangle Park, NC).

3. Results

The study sample included 82,594 respondents without diabetes in 2019–2021, with a mean age of 46.4–46.8 years (48.4 %–48.7 % were men). Population characteristics by survey year are shown in Table 1. Most demographic features showed similar distributions over the 3 years. However, compared with adults in 2019, those in 2021 were on average older, more likely to report diagnosed prediabetes, living in large central metro areas, having health insurance, reporting higher income, and having a college degree or greater.

Overall, the prevalence of adults without diagnosed diabetes who received blood glucose testing within 12 months was 64.2 % (95 % CI 63.3 %, 65.1 %) in 2019 and 60.0 % (95 % CI 59.1 %, 60.9 %) in 2021. These findings are equivalent to an absolute change in percentage points of −4.2 (95 % CI −5.3, −3.1) and a relative change of −6.6 % (95 % CI, −8.2 %,−4.9 %). Among the adults who fulfilled the USPSTF 2015 recommendation for screening of prediabetes and type 2 diabetes, the absolute and relative change in prevalence from 2019 to 2021 was −3.9 (95 % CI, −5.6, −2.3) and –5.4 % (95 % CI, −7.5 %, −3.2 %), respectively. Fig. 1 shows the age-adjusted prevalence of adults who received testing for blood glucose within 12 months by year, overall and for those meeting USPSTF 2015 recommendation.

Fig. 2 shows age-adjusted absolute and relative change in testing prevalence from 2019 to 2021, and Supplemental Table 1 also shows crude prevalence of adults who received blood glucose testing for the 3 years by selected characteristics. Significantly lower testing was observed for almost every demographic and geographic subgroup except non-Hispanic (NH) American Indian and Alaska Native adults, other single or multiple race adults, those with underweight, and those with family income < 100 % of FPL.

In 2019, prevalence of blood glucose testing within 12 months was lowest among adults without health insurance and in the youngest age group. The highest testing prevalence both in 2019 and 2021 was observed among adults aged 40–64 years and ≥ 65 years, NH Black adults, and those with self-reported prediabetes.

The largest age-adjusted decline in testing prevalence, in both absolute and relative terms, was observed in NH Asian adults (−10.0 and − 14.8 %, respectively), the West region (−7.2 and − 12.0 %, respectively), large central metro areas (−6.9 and − 10.5 %, respectively), those without health insurance (−6.3 and − 17.3 %, respectively), and the youngest age group (−5.0, − 10.3 %, respectively). Notably, among racial and ethnic groups, Hispanic adults experienced the second-largest decline in testing, from 60.7 % in 2019 to 54.7 % in 2021 (−6.1 % absolute and − 10.0 % relative change).

More frequent testing in 2021 than 2019 was observed among NH American Indian and Alaska Native adults, other single or multiple race adults, and those with BMI < 18.5 kg/m^2. However, these changes were not statistically significant, and the 51.9 %–61.4 % testing prevalence attained in 2021 remained at the lower end of the overall prevalence distribution.

Supplemental Table 2 showed multivariable-adjusted change in prevalence between 2019 and 2021 where similar trends to age-adjusted change were observed.

4. Discussion

In a nationally representative sample of US adults without diabetes, the prevalence of those who received blood glucose testing within 12 months was significantly lower in 2021 than in 2019, suggesting that screening for prediabetes or type 2 diabetes was negatively impacted during the COVID-19 pandemic. Lower testing prevalence from 2019 to 2021 was observed particularly in young adults, non-Hispanic Asian and Hispanic populations, those without health insurance, adults living in central metropolitan areas and adults living in the West. Although testing was consistently higher among adults meeting the 2015 USPSTF criteria, it declined over time in a manner similar to that of the general population without diagnosed diabetes.

Reduced use of preventive health services such as screening during the pandemic was consistently observed in our study and in reports from various countries, including the US [9,18], the UK [7,19], Canada [20], and Israel [21]. Because 31.5 % of US adults refrained from routine care during the pandemic due to reduced accessibility, decreased availability of public transportation or fear of exposure to COVID-19 [6, 22], it is not surprising that people delayed or avoided blood glucose testing as well.

The low prevalence of blood glucose testing in the youngest population (aged 18–39 years) before the COVID-19 pandemic and that group’s further 10 % reduction during the pandemic reflects the generally low prevalence of preventive care in young adults [23] and a decreased usage of preventive care services [24]. This finding is concerning for at least two reasons. First, approximately 32 million people aged 18–44 years have prediabetes [25], and they are less likely to be aware of their prediabetes status than older adults [26]. The observed delay in blood glucose testing might lead to more undetected prediabetes cases and a rise in type 2 diabetes incidence after 2021, as suggested by other population-based studies [27]. Secondly, national data indicate a resurgence in the incidence of diabetes complications among young and middle-aged adults after 2015 [28], suggesting that early detection and treatment of diabetes is critical in this population [29]. It remains to be seen if lowering the age for prediabetes and diabetes screening from 40 to 35 years, as recommended by the USPSTF [4], will encourage higher rates of blood glucose testing to screen for prediabetes or type 2 diabetes in this segment of the population.

The racial and ethnic heterogeneity in testing for blood glucose persisted during the COVID-19 pandemic, with the highest testing prevalence among NH Black adults and the lowest in Hispanic adults and those of other single or multiple races. The largest attrition in testing frequency occurring among NH Asian adults is consistent with one previous report which included only adults aged 40–75 [9]. NH Asian adults had relatively high testing prevalence in 2019; also they were on average less likely to be in the lower income bracket, or to lack health care access or health insurance than other non-White racial and ethnic groups. A combination of potential factors may have prevailed in this population, including its larger concentration in the West—where testing was consistently lower than in other regions—experiences of discrimination [30], language barriers [31], and possibly stricter adoption of isolation practices for COVID-19 prevention [32].

The increasing trend in testing uptake from 2019 to 2021 was unexpected in some groups such as NH American Indian and Alaska Native adults although the differences were not statistically significant, possibly due to the low sample numbers. Use of remote technology in the Indian Health Service might partly explain this population's increase in health care visits and subsequent testing uptake [33]. One study from a single integrated academic health system in the Upper Midwest showed that American Indian and Alaska Native adults were more likely to use a video or audio visit vs. in-person visits, compared with other race and ethnicity groups in 2020, during the early months of the COVID-19 pandemic [34]. It may be worth considering further research about the effects of telemedicine on testing during the pandemic.

Change in testing is linked to locality. People living in large central metro areas may have been more affected by the pandemic, possibly due to enforcement of quarantine measures. In addition, the higher proportion of younger people in urban areas may partly explain the lower testing rates [35]. Consistently lower testing rates in rural areas may be explained by disparities in health care access linked to financial constraints [36,37], in addition to demographics (e.g., rural residents were more likely to be NH White and older).

We acknowledge several limitations. NHIS collected self-reported data, which are subject to recall biases. There was also a change to phone interviews during 2020 due to the pandemic, with a lower response rate that may reflect selection bias. Due to a major questionnaire redesign in 2019, we could not assess trends in blood glucose testing to compare frequency before and after 2019.

5. Conclusions

Testing for blood glucose decreased in the US during the COVID-19 pandemic, with differences by socio-demographic, clinical, and geographic characteristics. Delayed blood glucose testing could result in a higher burden of diabetes management in the post-pandemic era. The study findings reveal the need to encourage diabetes screenings post-pandemic and subsequently, as well as awareness and management of diabetes—especially among people who are at increased risk for diabetes. In addition, our findings may be helpful in preparing for a potential pandemic in the future. Routine blood glucose testing among adults without diagnosed diabetes may be an important first step in the cascade of appropriate care for people with diabetes and developing resilient screening systems is warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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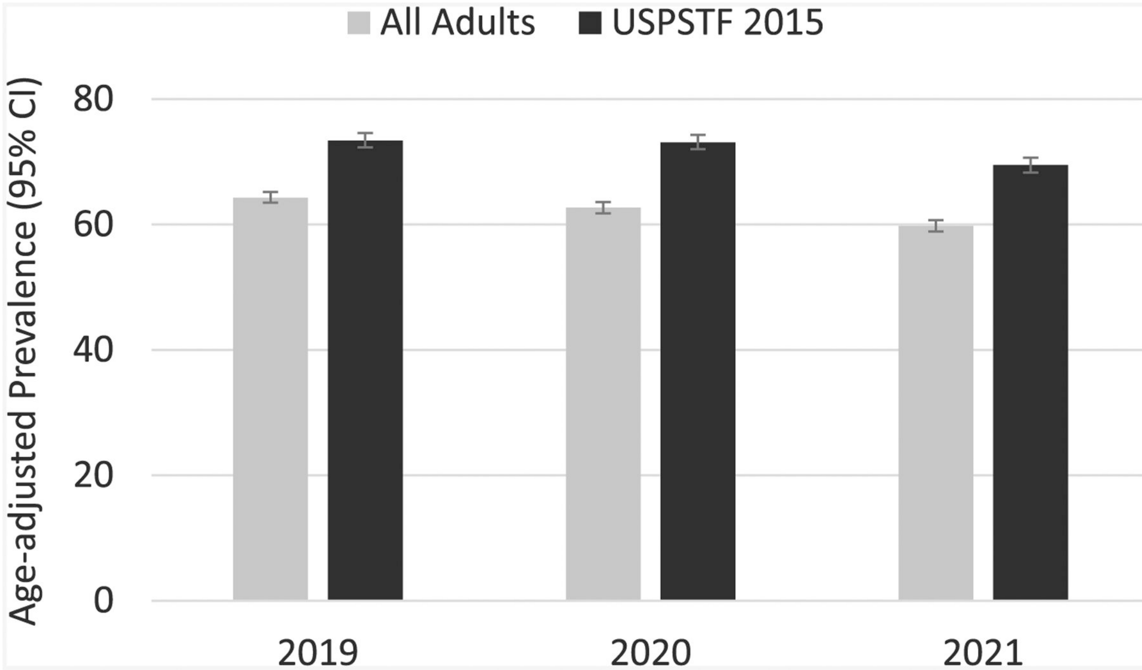

Fig. 1.

Age-adjusted prevalence of adults without diagnosed diabetes who received testing for blood glucose in the past 12 months, by year: National Health Interview Survey, United States, 2019 – 2021. Abbreviations: CI, confidence interval; USPSF, The U.S. Preventive Services Task Force. All adults represent US adults ≥ 18 years old; USPSTF 2015 represents US adults who met USPSTF 2015 screening recommendation for prediabetes and type 2 diabetes (age 40 to 70 years and BMI ≥ 25 kg/m^2).

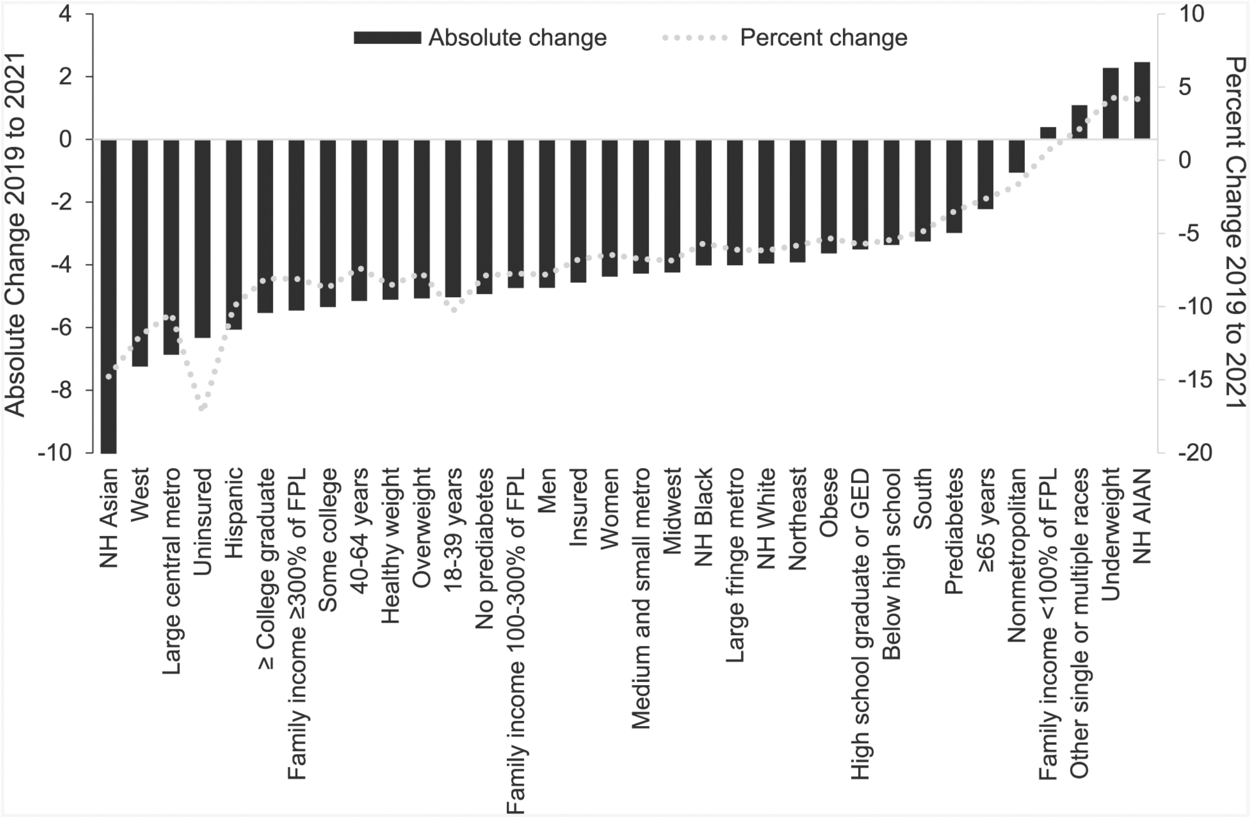

Fig. 2.

Age-adjusted absolute and relative change in the prevalence of adults without diagnosed diabetes who received testing for blood glucose in the past 12 months, National Health Interview Survey, United States. Abbreviations: AIAN, American Indian and Alaska Native; CI, confidence interval; GED, General Educational Development; NH, non-Hispanic; The negative age-adjusted absolute or relative change indicates a lower prevalence of tested adults in 2021 than 2019; a positive change indicates higher prevalence of tested adults in 2021 than 2019.

Table 1

Characteristics of adults aged ≥ 18 years without diagnosed diabetes: National Health Interview Survey, United States, 2019 – 2021.

	2019		2020		2021		
	Respondents Sample	Percent (SE)	Respondents Sample	Percent (SE)	Respondents Sample	Percent (SE)	P value *
Age groups, years							<0.01
18–39	9,259	40.7 (0.4)	8,224	40.3 (0.5)	8,253	40.0 (0.5)	
40–64	11,549	40.6 (0.4)	11,642	40.7 (0.4)	10,571	40.0 (0.4)	
≥65	7,524	18.7 (0.3)	8,104	19.1 (0.3)	7,242	19.9 (0.3)	
Sex							0.56
Men	13,115	48.7 (0.4)	12,885	48.4 (0.4)	11,855	48.4 (0.4)	
Women	15,295	51.3 (0.4)	15,150	51.6 (0.4)	14,288	51.6 (0.4)	
Race and ethnicity							0.88
Hispanic	3,674	16.5 (0.7)	3,375	16.6 (0.7)	3,582	16.7 (0.7)	
NH White	19,626	63.7 (0.8)	19,813	63.5 (0.8)	17,644	63.5 (0.8)	
NH Black	2,941	11.4 (0.4)	2,678	11.2 (0.5)	2,621	11.1 (0.5)	
NH Asian	1,495	5.9 (0.3)	1,517	5.9 (0.3)	1,627	6.0 (0.3)	
NH AIAN	372	1.3 (0.2)	362	1.4 (0.2)	335	1.3 (0.2)	
Other single or multiple races	305	1.2 (0.1)	291	1.2 (0.1)	336	1.4 (0.1)	
Weight Status **							0.13
Underweight	496	1.8 (0.1)	439	1.7 (0.1)	446	1.9 (0.1)	
Healthy weight	9,402	34.1 (0.4)	9,146	32.9 (0.4)	8,600	33.1 (0.4)	
Overweight	9,553	34.2 (0.4)	9,705	34.5 (0.4)	8,872	34.2 (0.4)	
Obese	8,193	29.9 (0.4)	8,102	30.9 (0.4)	7,586	30.8 (0.4)	
Diagnosed Prediabetes	2,355	7.5 (0.2)	2,636	8.5 (0.2)	2,558	8.9 (0.2)	<0.01
Rural-urban classification							0.04
Large central metro	8,382	30.9 (1.2)	8,370	31.1 (1.2)	8,032	32.2 (1.1)	
Large fringe metro	6,651	25.0 (1.2)	6,709	25.1 (1.2)	6,221	24.2 (1.1)	
Medium and small metro	9,035	30.2 (1.5)	8,879	30.1 (1.5)	8,210	30.6 (1.4)	
Non-metropolitan	4,345	13.8 (0.6)	4,078	13.7 (0.6)	3,682	13.1 (0.6)	
U.S. Census Bureau region							0.72
Northeast	4,876	18.0 (0.6)	5,014	17.7 (0.6)	4,302	17.7 (0.6)	

	2019			2020		2021	
Midwest	6,315	21.1 (0.7)	6,402	21.1 (0.7)	5,567	20.7 (0.7)	
South	10,162	37.1 (0.9)	9,491	37.3 (0.9)	9,378	37.5 (0.8)	
West	7,060	23.8 (0.9)	7,129	24.0 (1.0)	6,898	24.1 (0.8)	
Health insurance (yes)	26,211	90.2 (0.3)	26,136	90.6 (0.3)	24,270	91.1 (0.3)	0.01
Educational attainment							<0.01
Below high school	2,378	11.5 (0.3)	2,004	11.1 (0.4)	2,052	8.7 (0.3)	
High school graduate or GED	7,177	27.3 (0.4)	6,516	28.3 (0.4)	6,261	27.8 (0.5)	
Some college	4,605	17.9 (0.3)	4,372	17.5 (0.3)	3,913	15.2 (0.3)	
≥ College graduate	14,100	43.3 (0.5)	15,020	43.2 (0.5)	13,787	48.3 (0.5)	
Family income, %							<0.01
<100 FPL	2,943	10.7 (0.3)	2,339	9.5 (0.3)	2,438	9.5 (0.3)	
100–300 FPL	9,534	34.9 (0.5)	8,729	34.1 (0.5)	8,496	32.8 (0.4)	
≥300 FPL	15,936	54.5 (0.6)	16,968	56.4 (0.6)	15,211	57.7 (0.6)	

Abbreviations: AIAN, American Indian and Alaska Native; BMI, body mass index; FPL, Federal Poverty Level; GED, General Educational Development; NH, non-Hispanic; SE, standard error.

* Reflects comparisons between 2019 and 2021.

** Categories are defined by BMI (kg/m^2): underweight < 18.5, healthy weight 18.5 to 25, overweight 25 to 30, and obese ≥ 30.