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COVID-19 Working Paper: Obesity Prevalence Among U.S. Adult Subpopulations During the First Year of the COVID-19 Pandemic

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Abstract

Data from the 2011–20 Behavioral Risk Factor Surveillance System were leveraged to estimate obesity disparities prior to the spring 2020 arrival of the Coronavirus (COVID-19) pandemic and during the first year of the pandemic, and then intra-pandemic changes in adult obesity rates were estimated across various population subgroups. Adult obesity was modeled as a function of various demographic and socioeconomic characteristics—household composition, urbanicity, Census region, age, race, gender, income, and education—over pre-pandemic and pandemic periods using a linear regression model estimated by ordinary least squares. The regression coefficients were then used to calculate the pre-pandemic and intra-pandemic obesity rates for the overall population and by subpopulation. Overall U.S. adult obesity prevalence was significantly higher during the first year of the pandemic by 1.3 percentage points (pp). This amounts to an obesity increase of 3.2 percent when compared with an obesity rate of 40.7 percent over the pre-pandemic period from January 1, 2019, to March 12, 2020. The net societal increase in early pandemic obesity rates was not evenly distributed across subpopulations. Obesity rates significantly increased by a larger amount for adults in subgroups with a lower accumulation of long-term human capital (such as education and skills) and greater potential need for institutional and societal support. Intra-pandemic obesity growth rates were significantly higher by 5.6 percent among adults with annual household incomes that qualified for benefits from the Supplemental Nutrition Assistance Program (SNAP) and by 7.3 percent for adults whose education level was below a high school diploma. Higher intra-pandemic growth rates for obesity were also observed for young adults (aged 20–39) (5.6 percent) and adults aged 20 years or older living in the West Census region and west to the Pacific Ocean, which includes all States from Montana, Wyoming, Colorado, and New Mexico (7.6 percent).

Keywords: COVID-19, Coronavirus, pandemic, obesity, rural obesity, urban obesity, household characteristics, race, ethnicity, gender, age, employment, income, education, Behavioral Risk Factor Surveillance System, BRFSS

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What Is the Issue?

From March 2020 to June 2020, nearly 3 million U.S. residents had confirmed cases of COVID-19 and almost 130,000 nationwide had died of COVID-19 (Coronavirus Resource Center, 2022a, 2022b). Early in the pandemic, obesity was identified as a risk factor for medical complications and death from COVID-19 (Centers for Disease Control, 2022b; Sanchis-Gomar et al., 2020). The decades-long rise in adult obesity, from 30.5 percent in 1999–2000 to 42.4 percent in 2017–18, meant a higher percentage of adults faced increased risks from the COVID-19 virus. Public health measures to contain the pandemic altered behavioral, food access, and environmental constraints for millions of people living in the United States. Social pressures, including public health social distancing policies, food supply chain blockages, and workforce labor shortages, modified the day-to-day context of life. Many modifications may have worsened some obesity-related risk factors, such as sedentary behavior and snacking (Almandoz et al., 2022). Still, other pandemic-induced changes, like healthier at-home meal preparation, may have decreased obesity-related risk factors (Flanagan et al., 2020; Okrent and Zeballos, 2022; *The Economist*, 2020).

A nationally representative study shows a 3.0-percent increase in the rate of obesity in the overall adult U.S. population from spring 2019 to spring 2020 (Restrepo, 2022). Pre-pandemic obesity prevalence was not evenly distributed across society—adults in lower resource or marginalized situations tended to bear a higher proportion of the obesity burden (e.g., Befort et al., 2012; Grecu and Rotthoff, 2015). The different daily consequences of the pandemic for people living in the United States may also translate to uneven risks of obesity. As a result, pre-pandemic obesity disparities may have narrowed, remained constant, or widened across certain population subgroups (Belanger et al., 2020). This report measures changes in U.S. adult obesity rates overall and across a wide variety of demographic and socioeconomic subgroups during the first year of the pandemic—March 2020 to March 2021.

What Did the Study Find?

The first year of the COVID-19 pandemic compounded some pre-pandemic obesity prevalence disparities. The pandemic shock affected obesity rates differently across distinct population subgroups. While the U.S. obesity rate significantly increased from 40.7 percent to 42.0 percent ($p<0.05$) or by 1.3 percentage points (pp) in the overall adult population during the first year of the pandemic, certain adult subpopulations experienced larger statistically significant increases in obesity rates. Adults whose annual household income was eligible for benefits from the Supplemental Nutrition Assistance Program (SNAP) had a 2.5 percentage point obesity increase during this time. Pronounced increases also occurred among younger adults aged 20–39 (2.0 pp), adults residing in the West Census region (2.8 pp) (Bureau of the Census, 2022), and adults with less than a high school diploma (3.3 pp). Only one subgroup examined in this study experienced a decline in obesity prevalence—adults living in the Northeast Census region—who reported a 1.1 pp decrease in obesity prevalence in the first year of the pandemic.

How Was the Study Conducted?

The data are from the 2011–20 annual waves of the Behavioral Risk Factor Surveillance System (BRFSS) from the Centers for Disease Control. After accounting for the BRFSS survey design, weighted BRFSS data are nationally representative of adults living in the United States (Centers for Disease Control, 2013). Self-reported Body Mass Index (BMI) was used to classify adults 20 years or older as having obesity (BMI≥30). BMI was corrected for self-reporting bias with data from the 2011–2012 to 2019–March 2020 cycles of the National Health and Nutrition Examination Survey (NHANES). The period from January 1, 2019, to March 12, 2020, is the baseline pre-pandemic period upon which intra-pandemic shifts in obesity rates were estimated.

Introduction

As COVID-19 emerged in the spring of 2020, it was soon known that obese individuals had a higher risk of severe adverse health outcomes, including death, from a COVID-19 infection than non-obese individuals (Centers for Disease Control, 2022b; Onyeaka et al., 2021; Sanchis-Gomar et al., 2020; Stefan et al., 2021). From March 2020 to June 2020, nearly 3 million U.S. residents had confirmed cases of COVID-19 and almost 130,000 had died of the disease (Coronavirus Resource Center, 2022a, 2022b). To prevent widespread death among such individuals and other at-risk U.S. residents (including elderly and immunocompromised individuals), local, State, and national authorities implemented public health measures (e.g., social distancing, schooling-at-home, and business closures) to limit the spread of infections and COVID-19 deaths beginning in March 2020 (Onyeaka et al., 2021).

These measures modified the day-to-day context of life in the United States (Centers for Disease Control, 2022a; Matthews et al., 2022). For some, daily modifications such as sedentary behavior and social isolation may have worsened obesity-related risk factors (Flanagan et al., 2020). At the same time, some adults reported new lifestyle activities, such as healthy at-home meal preparation and daily exercise. These activities may have decreased the risk of obesity among such adults (Flanagan et al., 2020; Okrent and Zeballos, 2022; Onyeaka et al., 2021; *The Economist*, 2020). However, overall adult obesity rates grew higher in the United States by the end of the first year of the COVID-19 pandemic (Restrepo, 2022).

The question remains whether the overall increase in adult obesity accelerated obesity-related health disparities during this time. Pre-pandemic obesity prevalence and growth rate differences arose across social, demographic, and economically defined groups (e.g., Hales et al., 2020a; Ogden et al., 2017). Certain population subgroups defined by employment status, household composition, urbanicity, Census region, age, race, gender, income, and education were more likely to suffer from obesity than the general population (e.g., Chen et al., 2018; Fryar et al., 2020; Ogden et al., 2017).

The authors measured changes in U.S. adult obesity rates across demographic and socioeconomic subgroups during the first year of the COVID-19 pandemic—March 2020 to March 2021. They analyzed pooled cross-sectional data from the 2011–20 Behavioral Risk Factor Surveillance System (BRFSS) to measure obesity rate changes. The nationally representative estimates were derived from a weighted cross-section of U.S. adults with data from before and during the first year of the pandemic (National Center for Chronic Disease Prevention and Health Promotion, 2022a). The data were analyzed using linear probability models to estimate changes in obesity rates across a wide variety of adult subpopulations.

The first year of the pandemic compounded some pre-existing obesity prevalence disparities. The pandemic shock affected obesity rates differently across distinct population subgroups. The authors found that large and statistically significant disparities arose across a wide variety of subgroups, including vulnerable segments of the population such as adults in households with children, those with annual household incomes that qualify for SNAP benefits, and those without a high school diploma.

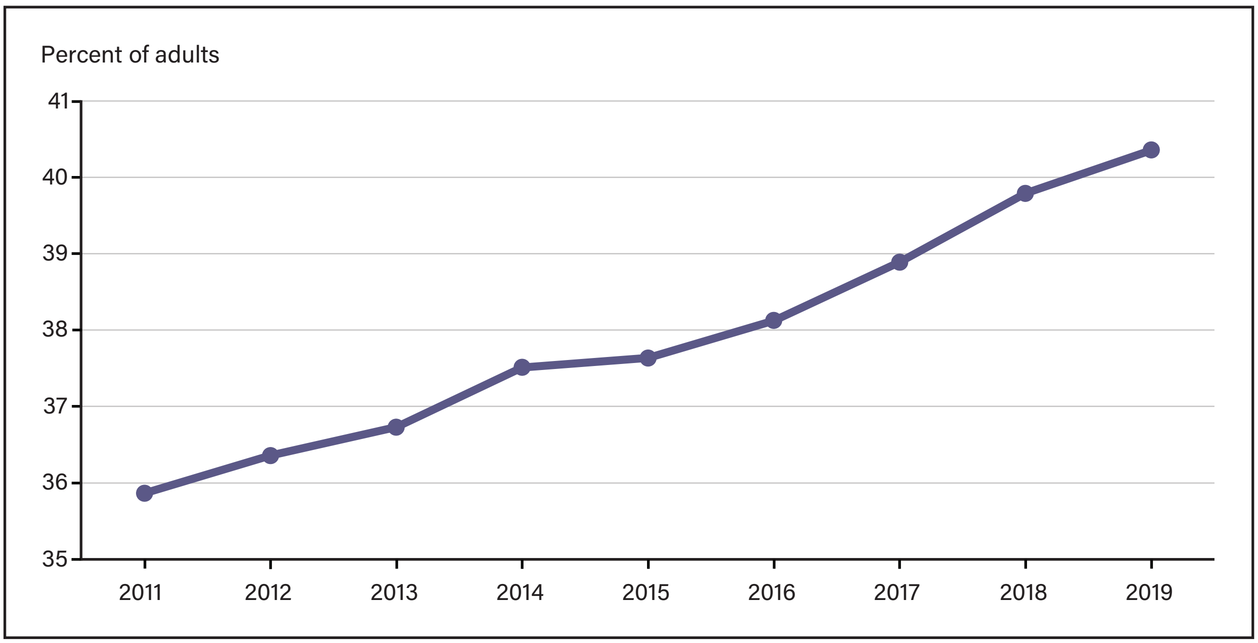
This report serves to inform USDA's efforts to support food and nutrition security, which are essential elements to reduce the risk of obesity (U, S. Department of Agriculture, 2022). The results support efforts to improve nutritional education and counseling to reduce obesity and improve health equity (The White House, 2022).

Background

The World Health Organization defines obesity and overweight as abnormal or excessive fat accumulation that may impair health (World Health Organization, 2022). In the United States, obesity status for adults 20 and older can be determined by the Body Mass Index (BMI).[1] If an adult's BMI is between 18.5 and 25, they are classified as having a healthy weight. Adults with a BMI between 25 and 30 are classified as overweight (but not obese). Adults who have a BMI of 30 or higher are classified as obese (Centers for Disease Control and Prevention, 2022a). Adult obesity trends are of concern not only for adults but all Americans as obesity is associated with higher medical care costs, lower military readiness, and lower worker productivity (Centers for Disease Control and Prevention, 2009; Centers for Disease Control and Prevention, 2022b; National Center for Chronic Disease Prevention and Health Promotion, 2022b).

Before the pandemic, the rate of adult obesity grew from 35.9 percent in 2011 to 40.4 percent in 2019, an increase of 4.5 percentage points (pp) over 8 years (figure 1). The adult obesity trendline generally increased over the entire pre-pandemic period, with an average year-over-year increase of 0.6 pp. However, the authors found that obesity rates increased at variable rates over time. For example, from 2014 to 2015, the obesity growth rate (0.1 pp) was much smaller compared with the increase from 2013 to 2014 (0.8 pp).

Figure 1
Overall U.S. adult obesity rates before the COVID-19 pandemic, 2011–2019



Source: USDA, Economic Research Service calculations using weighted data from the 2011–2019 Behavioral Risk Factor Surveillance System.

Adult obesity trends are of concern because they translate to lower life expectancy (Almandoz et al., 2022). Obesity-related chronic diseases such as type 2 diabetes decrease the quality of life for many people living in the United States. Additionally, obesity-related conditions such as depression and reduced physical mobility increase medical and public health costs (Centers for Disease Control and Prevention, 2009; National Center for Chronic Disease Prevention and Health Promotion, 2022b).

[1] The BMI is the ratio of a person's weight in kilograms (kg.) relative to the square of their height in meters (m^2). Using weight in pounds (lb.) relative to height in inches (in), the formula is weight (lb.) / [height (in)]^2 x 703.

In 2020, the COVID-19 pandemic arrived amidst sustained increases in obesity prevalence in the United States (Sanchis-Gomar et al., 2020). The pandemic induced unprecedented changes to community, household, and individual life from March 2020 to March 2021 (Centers for Disease Control, 2022a; Onyeaka et al., 2021; Thompson et al., 2020). Early on, public health researchers identified obesity as a risk factor for suffering from extensive illness and mortality from COVID-19 (Centers for Disease Control, 2022b; Sanchis-Gomar et al., 2020). As the pandemic evolved, varying obesity outcomes across the U.S. population were reported. Using data from emergency room and ambulatory care visits for individuals pre- and post-pandemic, Freedman et al. (2022) found a small average increase in weight (0.1 kg. or 0.2 lbs.) during the first year of the pandemic. However, researchers noted their sample was not nationally representative of the U.S. population. Restrepo (2022) used nationally representative Behavioral Risk Factor Surveillance System (BRFSS) data or self-reported cross-sectional surveillance data from the first year of the pandemic and found that the proportion of obese adults in the United States rose by 1.1 pp or 3.0 percent. These findings aligned with other research reports of rising adult obesity levels amidst the pandemic (Almandoz et al., 2022).

These discrepancies in findings suggest overall outcomes may not be representative of subgroup disparity trends. Within the population, certain groups may have had increased exposure to obesity risk that outweighed reductions in weight gain for other groups. For example, while Freedman et al. (2022) found a small average increase in weight across the population, they also found that women gained more weight than men and that young adults gained more weight relative to older adults. These findings suggest overall pandemic weight changes were not equally distributed across subpopulations. Such findings were consistent with long-term trends suggesting the obesity burden is not equally borne by U.S. residents.

In studies conducted prior to the pandemic, researchers found obesity is not evenly distributed across demographic, socioeconomic, and geographic segments of U.S. adults (Hales et al., 2020b; Ogden et al., 2017). Previous research on adult obesity-related health disparities points to a need to understand the possible differences in experiences across several demographic, socioeconomic, and geographic dimensions. The social determinants of health framework offers one approach to identify the most important demographic and socioeconomic characteristics affecting health status, including physical health as measured by obesity (Solar and Irwin, 2010) (see box, “Social Determinants of Health Framework and Heterogeneous Risks of Obesity Across Adult Subpopulations”).

Social Determinants of Health Framework and Heterogeneous Risks of Obesity Across Adult Subpopulations

Social determinants of health (SDH) are nonmedical factors that affect a wide range of health risks and outcomes, including one's place in society. In the SDH framework, health inequities are a function of structural and contextual mechanisms. Contextual mechanisms are those elements of society that create, organize, and maintain social behaviors that underlie health status. Structural mechanisms define social stratification and social class. The SDH framework may be used to identify complex drivers of health outcomes, including obesity (Solar and Irwin, 2010). SDH includes the socioeconomic, psychosocial, and institutional drivers of health outcomes. According to the SDH framework, the emergence and perpetuation of health disparities depend on socioeconomic and political contextual factors. Factors include economic policies and systems, social norms, social policies, political systems, and public assistance policies (e.g., the Supplemental Nutrition Assistance Program or SNAP). These factors may reinforce or alleviate structural drivers of health disparities that are related to sociodemographic characteristics (e.g., age, gender, income, education, race, and ethnicity) (Medvedyuk et al., 2018; Solar and Irwin, 2010).

Health disparities may arise due to historical structural mechanisms, such as gendered roles concerning food, childcare, and fitness; generational changes in diet patterns and food environments; or racial and ethnically defined circumstances (Solar and Irwin, 2010). Prior to the pandemic, the SDH were shown across multiple studies to play a significant role in obesity prevalence (e.g., Bell et al., 2021; Li et al., 2021; Singh et al., 2021). Even though many individual studies showed how obesity rates differ across subgroups, research is limited on how obesity rates differ across subgroups defined by different SDH, especially during the most tumultuous part of the pandemic.

Societal modifications to slow the spread of COVID-19 in the first year of the pandemic may have worsened SDH for some people, while improving SDH for others (Belanger et al., 2020). Across the country, food system accessibility and physical activity were altered as grocery supply chains were squeezed and public spaces were closed. As some U.S. residents became remote workers and had less commute time, they had more time to cook food at home—decreasing their intake of higher calorie food away from home—and to exercise outdoors (Flanagan et al., 2020; Okrent and Zeballos, 2022). A wide range of other SDH were affected by the pandemic, including health care operations and accessibility, employment, education, and Government program administration.

Employment is a primary source of income and plays a key role in reducing health inequities (Solar and Irwin, 2010). Extensive research finds associations between obesity and employment. Obese adults tend to earn lower wages and have a lower likelihood of employment. These differences may be related to decreased productivity due to poorer health among adults with obesity (Cawley et al., 2021) as well as discrimination against women with obesity (Biener et al., 2018). Chen et al. (2018) used computer-based modeling to simulate the effects of employment, unemployment, and reemployment on adult obesity. They reported a higher prevalence of obesity following disruptive labor events or increased unemployment rates. Their model predicts lower obesity rates when a high rate of reemployment follows unemployment and people are employed in higher wage jobs. This modeling suggests strong relationships between employment and obesity where steady employment in higher income professions leads to more healthy weight adults. Due to the strong associations between employment and obesity, differences in obesity outcomes may be seen across the population during the first year of the pandemic, as employment opportunities were affected differently during the early months of the pandemic.

Research on household composition and adult obesity indicates that household roles and composition significantly affect adult obesity outcomes. Early research in this area suggested married adults were at higher risk of obesity than single adults (Sobal et al., 1992). The presence of children in the household may serve as one mechanism by which marital status can influence adult obesity since parents may have less time for exercise and may be exposed to more calorie-dense snack foods (Sobal et al., 1992).

Geographic location—rural versus urban or northern versus southern—may affect the risk of obesity since location shapes food availability, housing and clothing needs, and logistical access to affordable food (Solar and Irwin, 2010). For two decades prior to the pandemic, obesity rates were higher in rural U.S. regions (counties with fewer than 50,000 residents) (Befort et al., 2012; Lundeen et al., 2018). In 2016, obesity prevalence was significantly higher for those living in nonmetropolitan counties (34 percent) than for those living in metropolitan counties (29 percent) (Jackson et al., 2005; Lundeen et al., 2018). Adult obesity rates also vary by Census region. Koh et al. (2018) showed that although obesity prevalence increased in all States from 2000 to 2010, counties in southern States, especially along the Mississippi River and Appalachian Mountains, had higher obesity rates than other U.S. counties. Similarly, Wang et al. (2020) found large regional differences in adult obesity rates over 2011 to 2016, with the South having the highest rates of obesity.

One's age and stage in life are primary determinants of health status. Across the lifespan, obesity rates generally increase the most among middle-aged adults. In 2017–18, U.S. adults aged 20 to 39 had the lowest obesity rate at 40.0 percent; those aged 40 to 59 had the highest, 44.8 percent; and 42.8 percent of adults 60 and older were obese (Hales et al., 2020b). Obesity rates typically peak for adults at age 60. Past this point, an increase in body fat may be masked by increasing sarcopenia, or age-related muscle deterioration, in the elderly adult population (Kirwan et al., 2020).[2]

Obesity prevalence is not equally distributed across racial and ethnic groups or by gender. According to BMI measurements, non-Hispanic Black adults had a higher incidence of obesity (49.6 percent) in 2017–18 (Hales et al., 2020). At the same time, the lowest obesity prevalence was among Asian-American adults (17.4 percent), three times lower than non-Hispanic Blacks. The obesity rates of non-Hispanic White adults and Hispanic adults were 42.2 percent and 44.8 percent, respectively. Using BMI measures, adult women are more likely than men to suffer from obesity, a risk that starts at an earlier point in adulthood (Fryar et al., 2020). Researchers found that women globally are typically 150 percent more likely to have obesity than men (Wells et al., 2012).

Income is a proximate indicator of standard of living (Solar and Irwin, 2010), measured by annual household income in the BRFSS dataset (National Center for Chronic Disease Prevention and Health Promotion, 2022a). Obesity is often found to be inversely related to income—as personal income increases, people are less likely to be obese (Chen et al., 2018; Ver Ploeg et al., 2007). The United States has food assistance programs to reduce individual and household food insecurity, including the Supplemental Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Research on the role of food assistance for low-income adults has shown that food assistance recipients (mainly SNAP) were more likely to be obese than non-participating low-income adults. Those SNAP recipients were also more likely to be obese than middle- and high-income adults (Chen and Wang, 2021). Additional exploration of the food assistance-obesity relationship indicates such findings are sensitive to temporal and social determinant factors. Ver Ploeg et al. (2007) found that food assistance recipients (including both WIC and SNAP recipients) were neither more nor less likely to be obese than their non-participating low-income peers. Also, as Almanda and Tchernis (2018) emphasized, the strength of the food assistance-to-obesity link may vary by the amount of food assistance benefits. Parents from families that had expanded food assistance benefits experienced lower obesity rates than food assistance participants who did not.

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[2] After age 60, adults may not gain more weight but are at greater risk of converting lean muscle mass to fat or developing the condition known as sarcopenia (T.S. Han et al., (2011)). See "Obesity and Weight Management in the Elderly," *British Medical Bulletin*, *97*, 169–196.

Education is a measure that reflects both the material and intellectual resources of one's parents and community, as well as an individual's ability in transitions toward employment and income. Education is often associated with improved health, as it advances one's ability to retain and use health information (Solar and Irwin, 2010). Research focusing solely on educational attainment and obesity, however, is limited. It is difficult to parse out educational attainment from income (Cohen et al., 2013). An early propensity toward obesity may also reduce the educational attainment of children and young adults if there are associated health problems that limit school attendance, creating a challenge to understand the causality of education in obesity outcomes. Research that did not control for the myriad of contextual factors affecting education found that college graduates had lower obesity rates than adults with lower levels of education, both among men and women (Ogden et al., 2017). Other researchers, however, who controlled for confounding factors such as food insecurity did not find a similar association (McMillian and Thorpe, 2021).

Data

The Behavioral Risk Factor Surveillance System (BRFSS) is an annual cross-sectional survey sponsored by the Centers for Disease Control and Prevention that collects data about U.S. residents from all 50 States, Washington, D.C., and 3 U.S. territories regarding their health-related risk behaviors and chronic health conditions. Methodologic changes were made in BRFSS in 2011, which makes it difficult to compare data collected before and after 2011. Therefore, this analysis begins with the 2011 annual data and ends with the latest data available in 2020. This report uses only public-use de-identified data from BRFSS respondents aged 20 and older residing in the 50 U.S. States and Washington, D.C. The BRFSS is the largest continuously conducted health survey system in the world and is based on more than 400,000 adult interviews annually, making it one of the most suitable datasets to perform health-related analyses for adult subpopulations.[3]

Beginning with the 2011 BRFSS survey period, "raking" or iterative proportional fitting has been used as the statistical weighting method to generate nationally representative estimates from survey data. In contrast to poststratification, which is the standard method for weighting survey data and the approach used in earlier years of BRFSS data, the raking statistical weighting (RSW) method is more sophisticated. The RSW method permits more demographic variables and adjusts for each variable individually in a series of data processing–intensive iterations. These advances result in reduced potential for bias and increased representativeness of estimates from BRFSS data (Pierannunzi et al., 2012).

BRFSS interviews for a given year *t* typically span that year (*t*) and the year after (*t+1*). For example, data from the 2020 BRFSS file were collected from BRFSS respondents in interviews conducted from January 1, 2020, to March 18, 2021. Therefore, the authors were able to examine how obesity rates changed from the onset of the COVID-19 pandemic in the United States (March 13, 2020) until about 1 year later (March 18, 2021).

The underlying dependent variable of interest, Body Mass Index (BMI), is derived from the self-reported height and weight of adults aged 20 and older. Height and especially weight are often misreported by survey respondents, with the degree of weight underreporting tending to increase with weight (Cawley et al., 2015). Thus, self-reported height and weight data from the BRFSS are adjusted for measurement error using a percentile-rank-based correction method (Courtemanche et al., 2015) with data from another nationally representative health survey that contains both self-reported and measured height and weight information: the 2011–2012 to 2019–March 2020 cycles of the National Health and Nutrition Examination Survey (NHANES). The corrections are designed to ensure that adjusted height and weight data better align with

[3] Analyses of very small subgroups can lead to unreliable estimates, especially when the unweighted number of respondents is under 50 (Centers for Disease Control and Prevention, 2013b). For every subgroup analyzed in this study, the intra-pandemic sample sizes are far greater than 50 respondents. For example, 64,996 respondents in the analytical sample were non-Hispanic American Indians, Alaskan Natives, or Pacific Islanders. Although they form the smallest subgroup analyzed in the study, 5,114 of them were interviewed during the intra-pandemic period.

precise body measurements taken by health professionals, such as those obtained by NHANES personnel. The authors took the adjusted height and weight data and applied the BMI formula (adjusted weight (kg.) ÷ [adjusted height (meters)]^2) to compute an adjusted BMI measure. A respondent with an adjusted BMI ≥ 30 is classified as having obesity.

Methods

Following a closely related study (Restrepo, 2022) to estimate intra-pandemic changes in adjusted obesity rates in the overall adult population and by adult subpopulation, the following linear regression model was estimated by ordinary least squares:

$$Y_{it} = \alpha + X'_{it}\beta + \gamma_j \sum_{j=2011}^{2018} Interview\ Year_{it} + \delta COVID\ Pandemic_{it} + \varepsilon_{it}, \quad (1)$$

where Y_{it} is the adjusted obesity indicator variable (adjusted BMI ≥30) for individual i at time t; X_{it} is a vector of demographic and socioeconomic characteristics—age group, gender, race/ethnicity, education, annual household income, marital status, number of children, and geographic location—that could affect body weight or obesity risk; ∑ *Interview Year* represents eight indicator variables equal to 1 if the survey respondent was interviewed in a pre-pandemic year 2011, 2012, …, 2018 and 0 otherwise; *COVID Pandemic* is an indicator variable equal to 1 if the survey respondent was interviewed after the President of the United States declared the spread of the novel coronavirus a public health emergency on March 13, 2020, and 0 otherwise; and ε_{it} is a random error term.

In this stratified analysis, the authors began by dividing the sample by subgroup and then estimating the regression model shown in equation 1. However, to avoid small sub-sample sizes, the authors did not analyze all possible combinations of the subgroups (e.g., young adults aged 20–39, women, men, young adult men aged 20–39, and young adult women aged 20–39). Since equation 1 is estimated for each subgroup, when young adults aged 20–39 were analyzed as a standalone subgroup, a gender variable was included as a control variable. And when women were analyzed as a standalone subgroup, an indicator for young adults aged 20–39 was included as a control variable. The same was applied to other subgroups.

All interview period coefficient estimates were estimated relative to an omitted time category—the pre-pandemic period from January 1, 2019, to March 12, 2020. Hereafter this is referred to as the baseline pre-pandemic period. Unless otherwise noted, in all analyses discussed below, the asterisks shown in the figures denote the statistical significance of the linear regression coefficient estimates associated with the COVID-19 pandemic period (i.e., *p<0.10, **p<0.05, and ***p<0.01). However, to facilitate the presentation of the results and accompanying discussion, regression-adjusted means before and during the pandemic are shown instead of the linear regression coefficient estimates associated with the pandemic period. Specifically, after each linear regression model was estimated, the regression coefficient estimates were used to calculate predicted values for the adjusted obesity rates, one for the baseline pre-pandemic period $Y^0_{it} = \hat{\alpha} + X'_{it}\hat{\beta} + \hat{\gamma}_j \sum_{j=2011}^{2018} Interview\ Year_{it}$) and another for the intra-pandemic period ($Y^1_{it} = \hat{\alpha} + X'_{it}\hat{\beta} + \hat{\gamma}_j \sum_{j=2011}^{2018} Interview\ Year_{it} + \hat{\delta}$), where $\hat{a}$, $\hat{\beta}$, and $\hat{\gamma}_j$ are the estimated regression coefficients from equation 1. Regression-adjusted mean values for the baseline pre-pandemic and intra-pandemic periods—i.e., mean values of Y^0_{it} and Y^1_{it}, respectively—are presented in the figures discussed below.

All analyses were conducted using Stata version 17. To account for the complex survey design of the BRFSS and produce nationally representative estimates, BRFSS sampling weights, strata, and primary sampling units were applied using Stata's estimation commands for survey data.

Results

Summary Statistics

Table 1 contains the summary statistics for the dependent and independent variables used in the analysis for the overall sample of adults 20 years and older. The analytical sample consists of a total of 3,494,695 respondents, with 3,255,619 from the pre-pandemic period and 239,076 from the intra-pandemic period.

BRFSS respondents reported an average weight of 82.1 kg. (181.0 lbs.). However, once corrected for reporting error, the authors found a mean adjusted weight of 84.3 kg. (185.9 lbs.), indicating that BRFSS respondents underestimated their weight by an average of almost 3 percent. Consequently, adjusted BMI and obesity prevalence were higher than unadjusted BMI and obesity prevalence, respectively. The mean adjusted BMI was 29.3 (σ=7.0), or about 1 unit higher than the mean self-reported BMI of 28.1 (σ=6.4). An average adjusted BMI value of 29.3 relates to a sample-wide adjusted obesity rate of 38.2 percent of the respondents. That is, pooling all data from 2011 to 2021, close to 4 in 10 respondents had obesity. This is 7.5 pp higher than the obesity rate based on the self-reported rate of 30.7 percent of the sample.

The household composition varied across the sample. Over half (58.3 percent) of the respondents were married or coupled but unmarried. The second largest household subgroup (21.1 percent) of respondents were never married. The household composition subgroups also included 11.5 percent of respondents who were divorced, 6.5 percent of respondents who were widowed, and 2.6 percent of respondents who were separated.

Over 6 in 10 respondents (62.8 percent) did not have children below 18 years of age in the household. Households with 1 or 2 children included 28.3 percent of respondents. Under 1 in 10 or 8.9 percent of respondents reported having more than 2 children in their households.

The respondents were temporally and geographically diverse. The annual data were well balanced across time, typically accounting for at least 9 percent of the full sample, except for the final year. Respondents from the observable COVID-19 pandemic period—March 13, 2020, to March 18, 2021—accounted for 8.2 percent of the analysis sample. The highest percentage (37.1 percent) of respondents were in the South Census region.[4] Close to one quarter or 24 percent of respondents were in the West Census region. The Midwest was home to 21.8 percent of respondents. Only 17.0 percent of respondents were in the Northeast. Among the respondents with information on whether they resided in an urban or rural area (2018 and beyond), the vast majority reported residing in an urban area (93.4 percent).

On average, BRFSS respondents interviewed from 2011 to 2021 were 48 years of age. Most adults were middle-aged (36.4 percent), followed by young adults aged 20–39 (35.6 percent), and then by adults aged 60 and over (28.0 percent). The sample was evenly balanced between genders—49.4 percent of respondents were female, and 50.6 percent of respondents were male.

Almost 2 in 3 (65.7 percent) respondents were non-Hispanic White. Hispanic adults made up the second largest subgroup or 14.8 percent of the sample. Non-Hispanic Blacks made up 11.7 percent of the sample and were the largest non-Hispanic racial or ethnic minority group. Their representation was followed by 4.7 percent of respondents who were non-Hispanic Asian, 1.8 percent who were non-Hispanic other, and 1.2 percent who were non-Hispanic American Indians, Alaskan Natives, or Pacific Islanders.

[4] The South Region includes Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

Approximately 60.1 percent of respondents reported being employed. About 72.6 percent of respondents reported having an annual household income of at least $25,000. The largest economic subgroup or 33.1 percent of the sample reported a household income of over $75,000 per year. Just over 1 in 4 (27.4 percent) respondents had an annual household income of less than $25,000. Using the annual household income categories and household size in combination with poverty guidelines, the authors determined if respondents' annual household income made them eligible for SNAP (i.e., gross monthly income is ≤ 130% of the Federal poverty line). About 1 in 5 (22.7 percent) of the sample was eligible according to the criterion for SNAP benefits. A majority (60.9 percent) of respondents reported some college (31.5 percent of respondents) or had a college degree or higher (29.4 percent). Formal schooling to grade 12 or the GED was the terminal educational attainment for 26.8 percent of the respondents. Only 8.2 percent indicated partial high school education and 3.9 percent of respondents' highest education attainment was the 8th grade or lower. A tiny share of respondents (0.2 percent of the sample) reported not attending school or only kindergarten.

Table 1

Summary statistics for the full analytic sample, 2011–20 Behavioral Risk Factor Surveillance System

Variable	Sample size	Weighted mean or percent	Standard deviation
Height in meters (self-reported, unadjusted)	3,494,695	1.7	0.1
Height in meters (self-reported, adjusted)	3,494,695	1.7	0.1
Weight in kilograms (self-reported, unadjusted)	3,494,695	82.1	20.8
Weight in kilograms (self-reported, adjusted)	3,494,695	84.8	22.1
Body Mass Index (self-reported, unadjusted)	3,494,695	28.1	6.4
Body Mass Index (self-reported, adjusted)	3,494,695	29.3	7.0
Has obesity (self-reported, unadjusted)	3,494,695	30.7	N/A
Has obesity (self-reported, adjusted)	3,494,695	38.2	N/A
Adult age groups	**Sample size**	**Percent**	
Age 20–39	132,613	35.6	N/A
Age 40–59	1,429,140	36.4	N/A
Age 60+	1,932,942	28.0	N/A
Sex	**Sample size**	**Percent**	**N/A**
Female	1,921,918	49.4	N/A
Male	1,572,777	50.6	N/A
Racial/ethnic group	**Sample size**	**Percent**	
Non-Hispanic American Indian/Alaskan Native/Pacific Islander	64,996	1.2	N/A
Non-Hispanic Asian	69,474	4.7	N/A
Non-Hispanic Black	280,110	11.7	N/A
Non-Hispanic Other	87,401	1.8	N/A
Non-Hispanic White	2,764,218	65.7	N/A
Hispanic	228,496	14.8	N/A
Educational attainment	**Sample size**	**Percent**	
Never attended school or only kindergarten	2,936	0.2	N/A
Grades 1 through 8 (elementary)	69,516	3.9	N/A
Grades 9 to 11 (some high school)	163,973	8.2	N/A
Grade 12 or General Educational Development (high school graduate)	939,739	26.8	N/A
College 1 year to 3 years (some college)	968,449	31.5	N/A
College 4 years or more (college graduate)	1,350,082	29.4	N/A

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Employment status	Sample size	Percent	
Employed	1,643,641	60.1	N/A
Not employed	1,840,392	39.9	N/A
Annual household income	**Sample size**	**Percent**	
Less than $10,000	164,881	5.6	N/A
$10,000 to less than $15,000	187,761	5.2	N/A
$15,000 to less than $20,000	257,025	7.5	N/A
$20,000 to less than $25,000	321,210	9.1	N/A
$25,000 to less than $35,000	382,865	10.5	N/A
$35,000 to less than $50,000	505,113	13.6	N/A
$50,000 to less than $75,000	565,598	15.3	N/A
$75,000 or more	1,110,242	33.1	N/A
Annual household income eligible for SNAP	**Sample size**	**Percent**	
Yes	579,713	22.7	N/A
No	2,618,041	77.3	N/A
Marital status	**Sample size**	**Percent**	
Married or a member of an unmarried couple	1,993,345	58.3	N/A
Divorced	509,452	11.5	N/A
Widowed	414,229	6.5	N/A
Separated	73,974	2.6	N/A
Never married	503,695	21.1	N/A
Number of children under 18 years of age in the household	**Sample size**	**Percent**	
0	2,541,078	62.8	N/A
1	383,000	14.9	N/A
2	343,043	13.5	N/A
3	148,128	5.8	N/A
4	52,980	2.0	N/A
5+	26,466	1.0	N/A
Veteran status	**Sample size**	**Percent**	
Veteran	482,879	11.7	N/A
Not a veteran	3,010,204	88.3	N/A
Urbanicity	**Sample size**	**Percent**	
Urban area	783,229	93.4	N/A
Rural area	140,942	6.6	N/A
Census region	**Sample size**	**Percent**	
Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont	650,252	17.0	N/A
Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin	958,917	21.8	N/A
South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia	1,056,614	37.1	N/A
West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming	828,912	24.0	N/A

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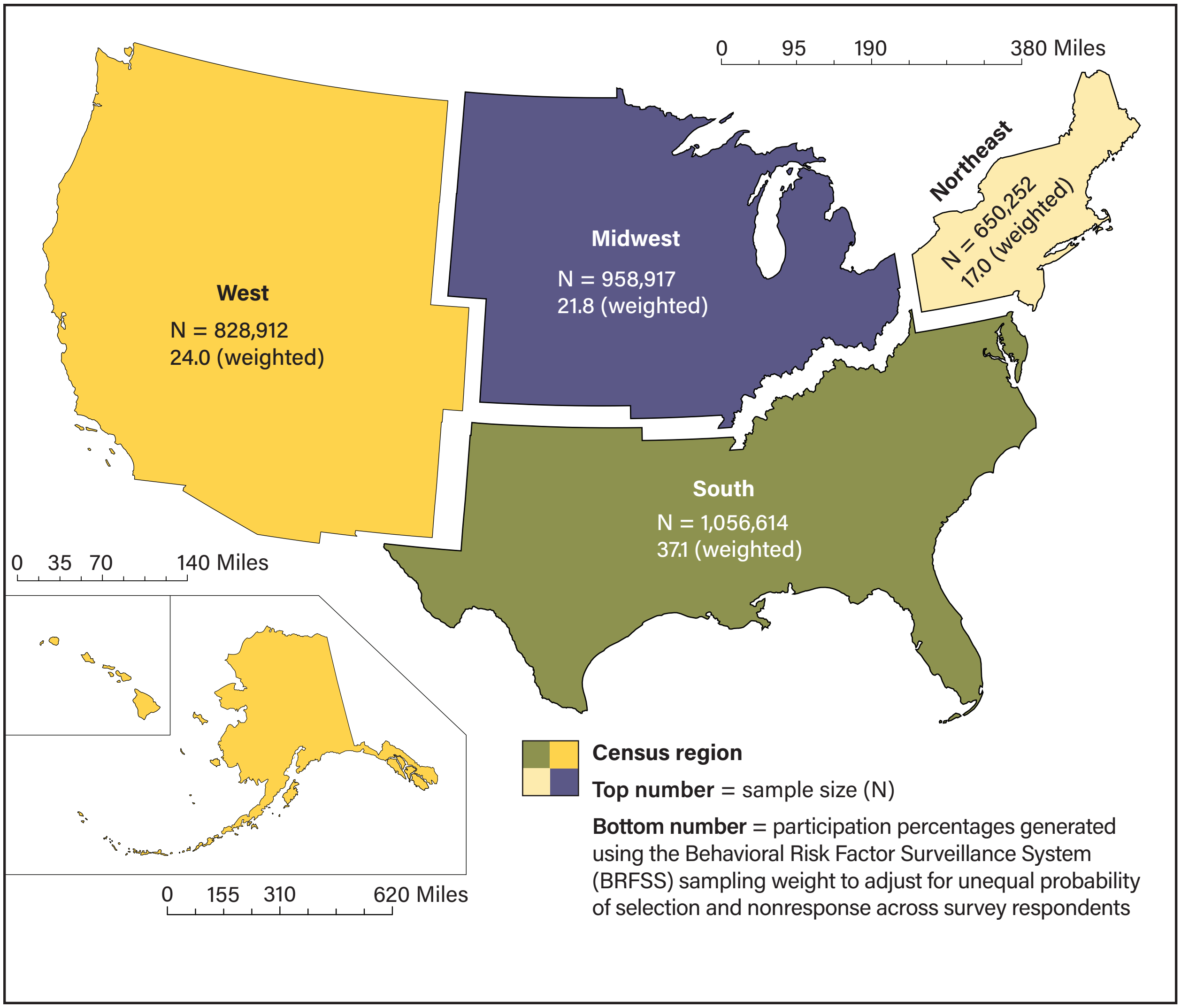
Time period	Sample size	Percent	
Year 2011	398,928	9.9	N/A
Year 2012	377,758	10.2	N/A
Year 2013	386,961	10.1	N/A
Year 2014	362,851	10.0	N/A
Year 2015	325,880	9.7	N/A
Year 2016	365,606	10.1	N/A
Year 2017	343,937	10.2	N/A
Year 2018	325,197	9.8	N/A
Year 2019 to March 12, 2020	368,501	11.7	N/A
March 13, 2020, to March 18, 2021	239,076	8.2	N/A

N/A = Not applicable. SNAP = Supplemental Nutrition Assistance Program.

Note: Behavioral Risk Factor Surveillance System sampling weights were used to calculate these summary statistics. Information on whether the respondent resided in an urban or rural area is available only from 2018 and beyond, which explains the much smaller sample sizes by urbanicity than by other categories.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Figure 2
Sample size (N) and participation percentages in the Behavioral Risk Factor Surveillance System (BRFSS) survey for each Census region in the United States, 2011–20



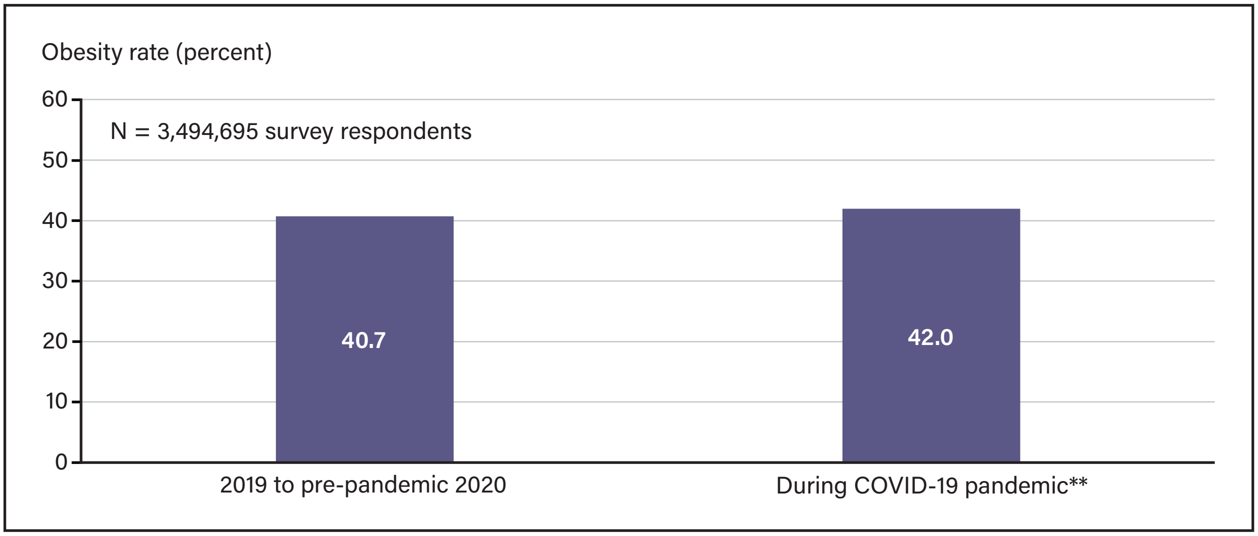
Source: USDA, Economic Research Service based on data collected by the Behavioral Risk Factor Surveillance System and U.S. Department of Commerce, Bureau of the Census.

Main Findings

Overall Adult Population

Figure 3 shows that the share of U.S. adults aged 20 and older with obesity significantly increased ($p<0.05$) from 40.7 percent in the baseline pre-pandemic period to 42.0 percent during the first year of the COVID-19 pandemic (from March 13, 2020, to March 18, 2021).[5] This statistically significant increase of 1.3 pp is not trivial when divided into the baseline pre-pandemic period obesity rate (1.3/40.7 = 3.2 percent).[6]

Figure 3
Obesity prevalence in the overall U.S. adult population, before and during the COVID-19 pandemic



Note: Statistical significance is indicated by **$p<0.05$.

Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

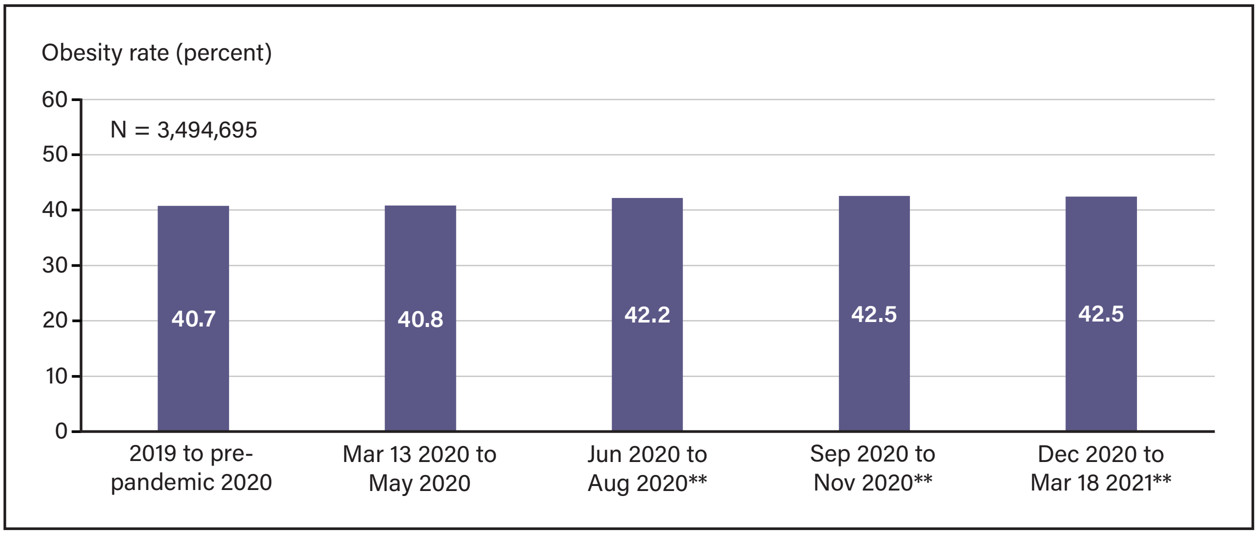
Relative to the obesity rate in the baseline pre-pandemic period, the obesity rate was statistically indistinguishable over the first 3 months of the pandemic (March 2020 to May 2020) (40.8 percent) (figure 4). However, relative to the baseline pre-pandemic period, there were statistically significant increases in future pandemic periods ($p<0.05$). Over the June 2020 to August 2020 period, approximately 3 months following the imposition of the initial pandemic restrictions, obesity prevalence significantly increased by 1.5 pp to 42.2 percent. Obesity prevalence remained at this elevated level, slightly increasing to 42.5 percent or 1.8 pp higher than the baseline pre-pandemic period from September 2020 to November 2020 and held steady at that level from December 2020 to March 2021.

[5] In this analysis, the first year of the pandemic spans from March 13, 2020, to March 18, 2021.

[6] This estimate slightly differs from Restrepo (2022) because that study used data from all U.S. areas, including U.S. territories, whereas this working paper uses data from the 50 U.S. States and Washington, D.C.

Figure 4

Obesity prevalence in the overall U.S. adult population, before and during stages of the COVID-19 pandemic



Note: Statistical significance is indicated by **p<0.05.

Asterisks indicate the level of significance of the difference between the baseline pandemic period and the given pandemic period.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

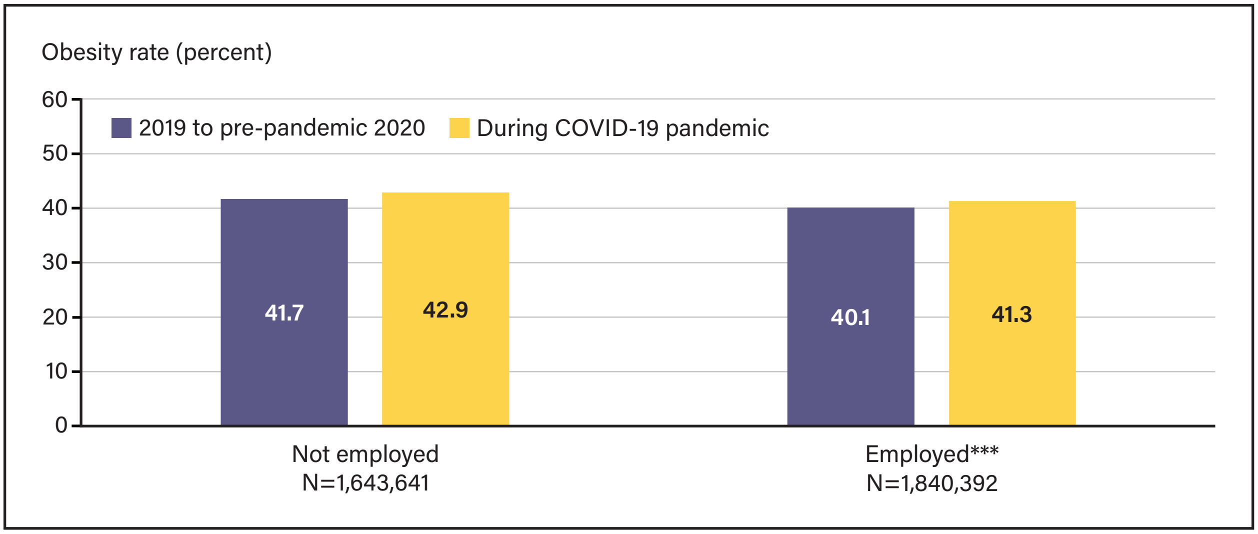
The above-mentioned changes are for the overall adult population. However, given the heterogeneity in obesity rates before the pandemic, varying obesity growth rates across different demographic characteristics, socioeconomic status, and geography may be expected. Therefore, the authors used the variables listed in table 1 to break down changes in obesity prevalence across a wide variety of adult subpopulations.

Employment Status

Prior to the pandemic, relative to employed respondents, obesity prevalence was slightly higher among those not employed (e.g., retired, unemployed, or stay-at-home parents) (figure 5). The obesity rate of employed respondents significantly increased by 1.2 pp (p<0.01) or from a baseline pre-pandemic prevalence of 40.1 percent to 41.3 percent during the pandemic. The obesity rate of respondents who were not employed also increased by 1.2 pp, from 41.7 percent to 42.9 percent, but the change was not statistically significant.

Figure 5

Obesity prevalence in the U.S. by employment status, before and during the COVID-19 pandemic



Note: Statistical significance is indicated by ***p<0.01.

Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

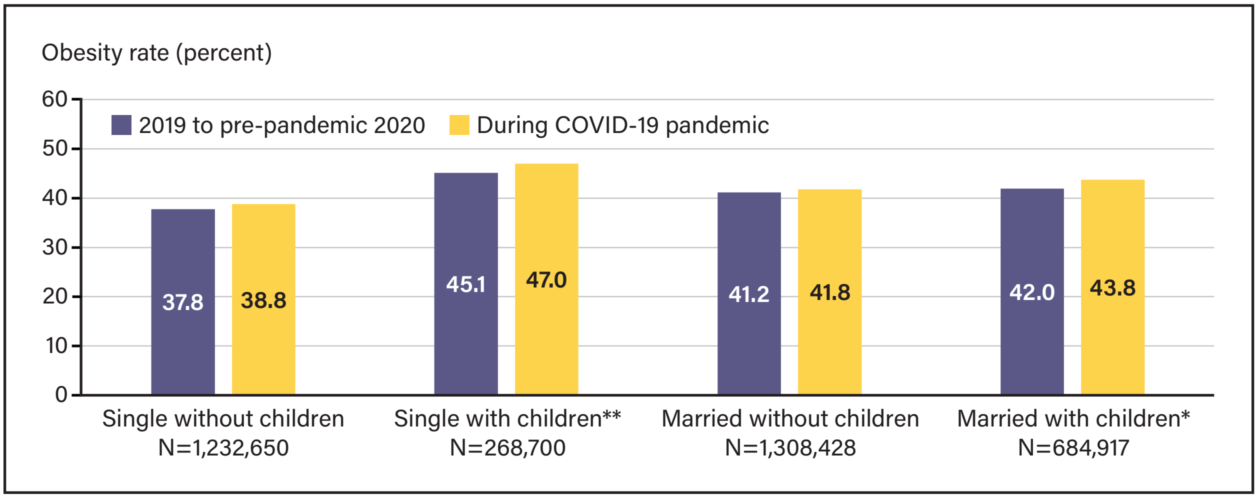
Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Household Composition

Obesity rate changes also varied across groups according to marital status and whether there were children under 18 years of age in the household. Unmarried respondents without children reported a statistically insignificant obesity rate increase of 1 pp from 37.8 percent prior to the pandemic to 38.8 percent from March 2020 to March 2021 (figure 6). By contrast, single respondents with children reported an increase in their obesity rate that was almost twice as large (1.9 pp), which was statistically significant ($p<0.05$). Married respondents without children reported one of the smallest obesity rate changes, with their obesity rate insignificantly rising from 41.2 percent to 41.8 percent. Conversely, married respondents with children reported a statistically significant increase ($p<0.10$) in their obesity rate from 42.0 percent to 43.8 percent or 1.8 pp.

Figure 6

Obesity prevalence in the U.S. by household composition, before and during the COVID-19 pandemic



Note: Statistical significance is indicated by *p<0.10 or **p<0.05.

Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

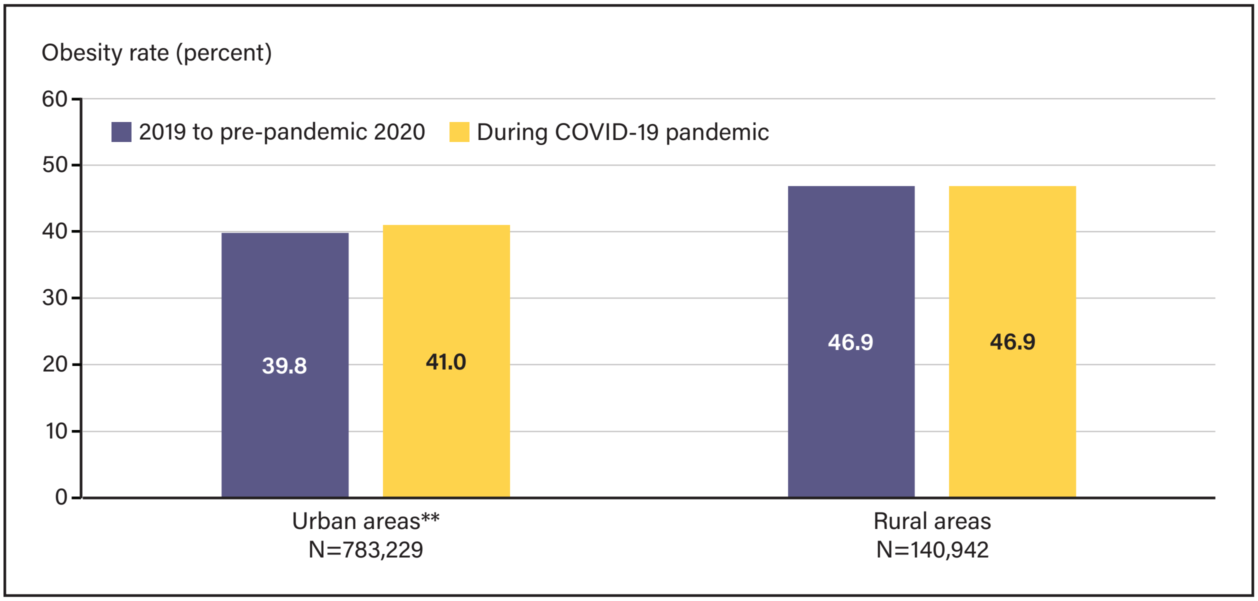
Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Urbanicity/Rurality

Information on whether the respondent resided in an urban or rural area is available only from 2018 and later. Despite the smaller sample sizes by urbanicity, the authors were still able to estimate the baseline pre-pandemic period (2019 to pre-pandemic 2020) to the pandemic period change (figure 7).

Rural respondents' reported obesity rate was higher before the pandemic (46.9 percent) and held steady at that level during the first pandemic year. Urban respondents, however, started with a lower pre-pandemic obesity rate of 39.8 percent, which rose to 41.0 percent during the first year of the pandemic. The overall 1.2 pp rise in obesity rates among urbanites was statistically significant ($p<0.05$).

Figure 7
Obesity prevalence in the U.S. by urbanicity/rurality before and during the COVID-19 pandemic



Note: Statistical significance is indicated by **p<0.05.

Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

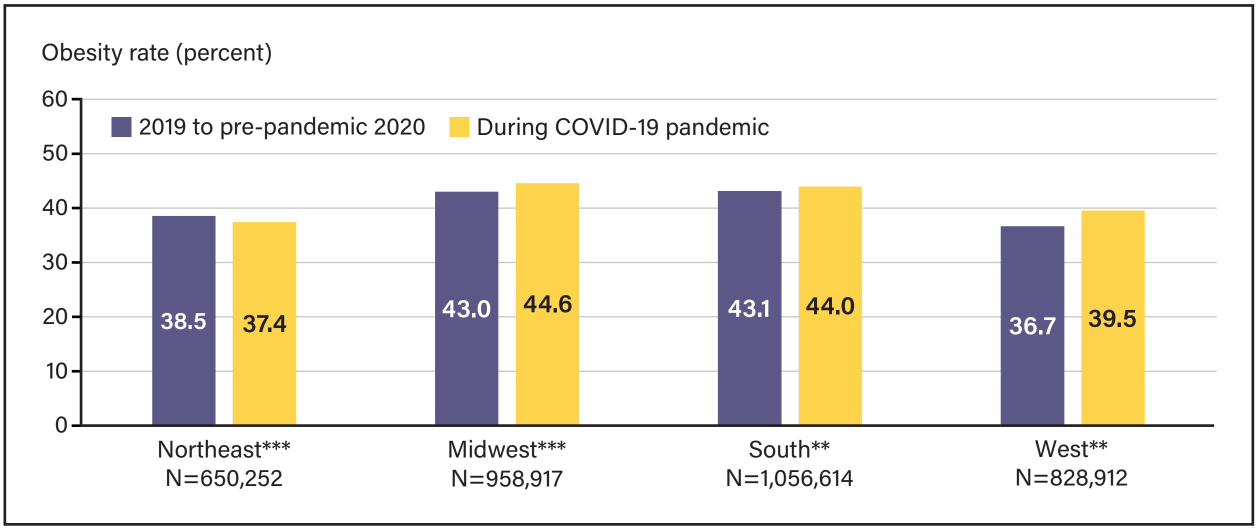
Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Census Region

The patterns by Census region were heterogeneous (figure 8). Interestingly, residents of the generally urbanized Northeast census region reported a small drop in obesity prevalence during the pandemic.[7] Prior to the pandemic, the Northeast region respondents' obesity rate was 38.5 percent. From March 2020 to March 2021, the analysis indicates a 1.1 pp decrease in obesity prevalence for this group (37.4 percent). This change was statistically significant (p<0.01). Respondents in all other geographic regions reported statistically significant obesity rate increases. The largest obesity rate increase was in the West, which is also generally urbanized, where the obesity rate across respondents increased from 36.7 percent to 39.5 percent (p<0.05) or an increase of 2.8 pp. The two regions with the highest baseline pre-pandemic obesity rates were the Midwest and South. The baseline pre-pandemic obesity rate in the Midwest was 43.0 percent and 43.1 percent in the South. In the Midwest, respondents' reported weight increases translated into a 1.6 pp increase in the obesity rate during the pandemic (44.6 percent) (p<0.01). This increase is about twice the size of the increase experienced in the South. There, respondents reported a 0.9 pp increase in the obesity rate from 43.1 to 44.0 percent (p<0.01).

[7] In our analytical sample with information on urbanicity/rurality (2018 and beyond), the share of respondents living in rural counties is 3.2 percent in the Northeast, 10.1 percent in the Midwest, 8.2 percent in the South, and 3.1 percent in the West.

Figure 8
Obesity prevalence by U.S. census region, before and during the COVID-19 pandemic



Note: Statistical significance is indicated by **p<0.05 or ***p<0.01.

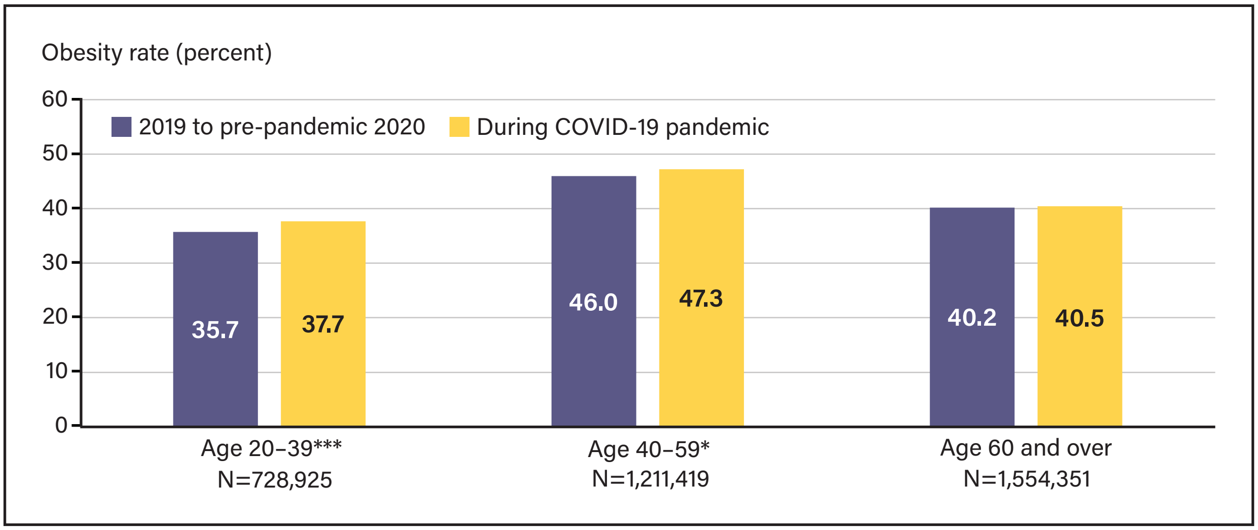
Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Age Group

Figure 9 shows that the youngest adult age group examined had the largest obesity rate increase and was statistically significant. Relative to the baseline pre-pandemic period, obesity prevalence significantly increased by 2 pp among respondents 20 to 39 years old during the COVID-19 pandemic. This increase is over 1.5 times larger than the significant increase of 1.2 pp among respondents aged 40 to 59 years. The change in the obesity rate for people aged 60 years and older was even smaller and not statistically significant.

Figure 9
Obesity prevalence in the U.S. by age group before and during the COVID-19 pandemic



Note: Statistical significance is indicated by *p<0.10 or ***p<0.01. Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

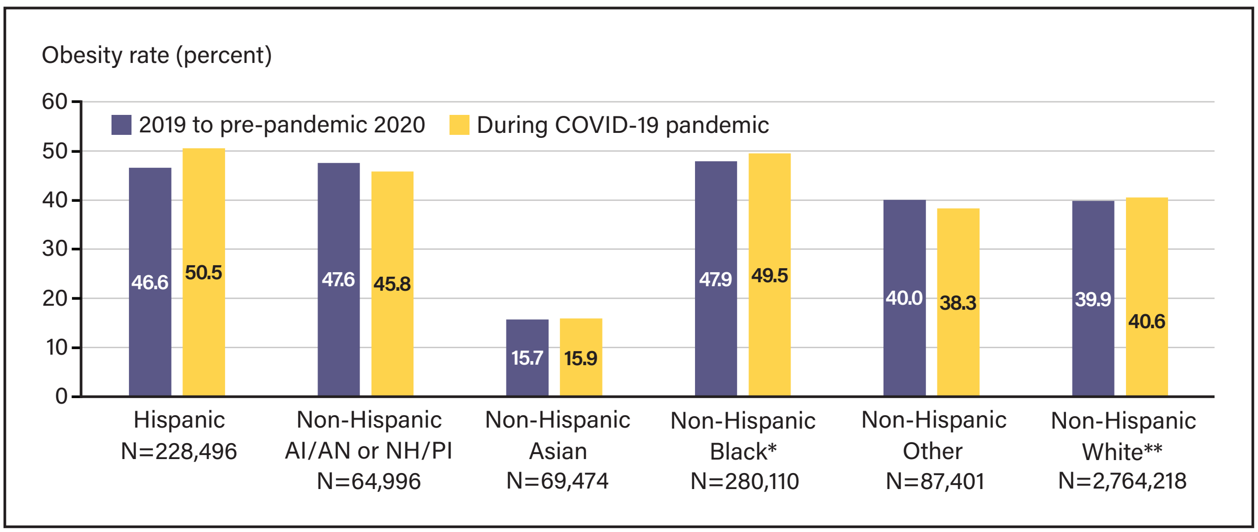
Race and Ethnicity

The variability in baseline obesity rates across racial and ethnic groups is very noticeable in figure 10. Prior to the pandemic, authors' estimates indicate that non-Hispanic Black respondents had the highest obesity rate at 47.9 percent or 7.2 pp above the full sample baseline pre-pandemic rate of 40.7 percent. American Indians, Alaskan Natives, and Native Hawaiian respondents' obesity rate of 47.6 percent was 6.9 pp above the full sample baseline pre-pandemic rate. Hispanic respondents' obesity rate was 46.6 percent or 5.9 pp higher than the full sample baseline pre-pandemic rate.

The non-Hispanic Asian subgroup was the racial minority with the lowest obesity rate prior to the pandemic. According to the survey respondent responses, the obesity rate of this group was 15.7 percent before the pandemic. The next lowest obesity rate, the non-Hispanic White subgroup, was nearly 3 times that of non-Hispanic Asians at 39.9 percent. This was just below the obesity rate of those of non-Hispanic Other races (40.0 percent).

After the first year of the pandemic, some racial groups' obesity rates were significantly higher. Specifically, non-Hispanic Black and White respondents reported statistically significant higher obesity rates relative to the baseline pre-pandemic period. Among non-Hispanic Black respondents, the obesity rate increased from 47.9 percent in the baseline pre-pandemic period to 49.5 percent in the first year of the pandemic, a statistically significant rise of 1.6 pp ($p<0.10$). There was also a statistically significant 0.7 pp rise in non-Hispanic White participants' obesity rate. Among these respondents, the obesity rate increased significantly ($p<0.05$) from 39.9 percent to 40.6 percent. Other racial and ethnic subgroups did not show statistically significant changes in their obesity rate, which may, in part, be due to their smaller sample sizes.

Figure 10
Obesity prevalence in the U.S. by race/ethnicity before and during the COVID-19 pandemic



AI/AN = American Indian or Alaskan Native and NH/PI = Native Hawaiian or other Pacific Islander.

Note: Statistical significance is indicated by *p<0.10 or **p<0.05.

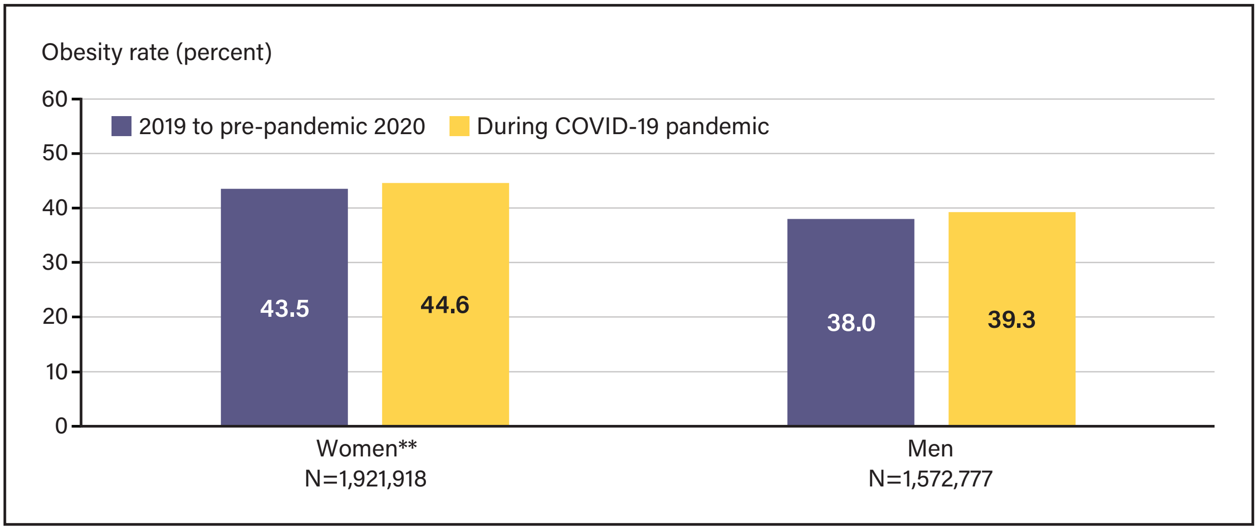
Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Gender

Obesity rates significantly increased among women during the pandemic compared to the baseline pre-pandemic period (figure 11). The obesity rate of women increased from 43.5 percent to 44.6 percent or by 1.1 pp ($p<0.05$). Although the obesity rate increase among men was slightly larger at 1.3 pp, the estimate fell just outside the threshold of statistical significance ($p = 0.110$).

Figure 11
Obesity prevalence in the U.S. by gender before and during the COVID-19 pandemic



Note: Statistical significance is indicated by **p<0.05.

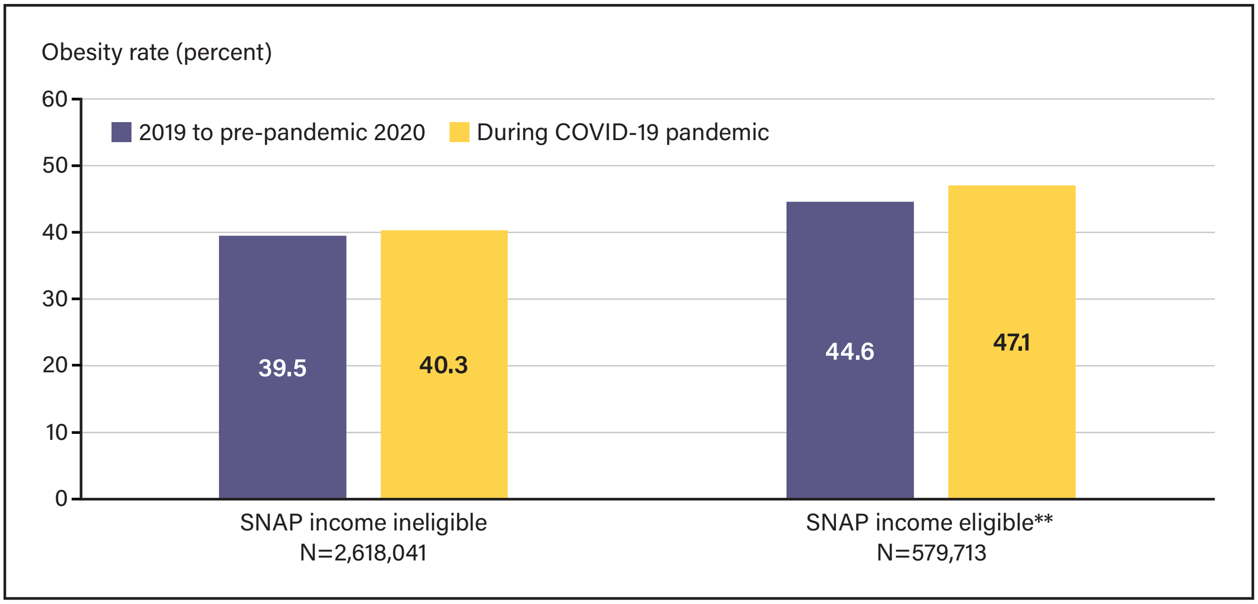
Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Income Eligibility for SNAP

Given that respondents came from households that varied by household size, estimates by annual household income alone are challenging to interpret. The authors used information on annual household income categories and household size in combination with poverty guidelines to determine whether respondents' annual household income made them eligible for SNAP. Three interesting patterns emerge. First, respondents whose income was not eligible for SNAP benefits had much lower baseline pre-pandemic obesity rates than respondents who were income eligible (figure 12). Second, while there was a 0.8 pp increase in the obesity rate among respondents whose income made them ineligible for SNAP benefits, the increase was not statistically significant. Third, by contrast, the increase in the obesity rate among respondents who were income-eligible for SNAP benefits was over twice the size (2.5 pp) and statistically significant ($p<0.05$).

Figure 12
Obesity prevalence in the U.S. by SNAP (income) eligibility, before and during the COVID-19 pandemic



Note: Statistical significance is indicated by **p<0.05.

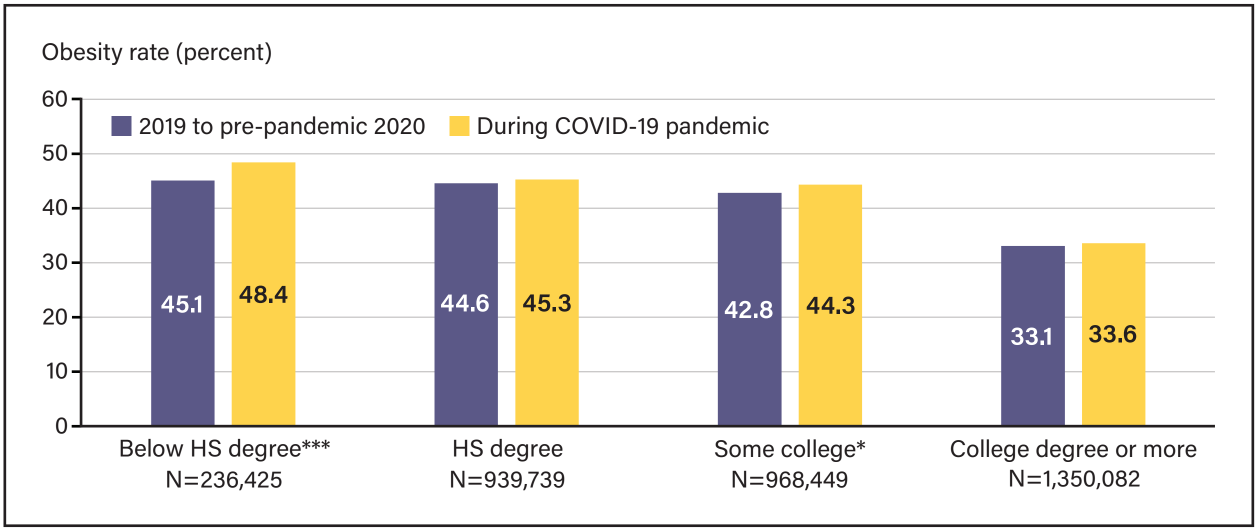
Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Educational Attainment

Across educational subgroups, the low education subgroup (those who attained below a high school diploma) reported the highest obesity rate increase (figure 13). Their pre-pandemic obesity rate was 45.1 percent. This rose by 3.3 pp or to an obesity rate of 48.4 percent during March 2020 to March 2021 ($p<0.01$). The educational subgroup with some college education also had a significant 1.5 pp ($p<0.10$) increase in their obesity rate from 42.8 percent to 44.3 percent over the same periods. Other educational subgroup respondents did not show a significant change in obesity rates.

Figure 13
Obesity prevalence in the U.S. by education attainment, before and during the COVID-19 pandemic



HS = high school.

Note: Statistical significance is indicated by *p<0.10 or ***p<0.01.

Asterisks indicate the level of significance of the difference between the baseline pandemic period and the first year of the pandemic.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Discussion

Given the health risks associated with obesity (National Center for Chronic Disease Prevention and Health Promotion, 2022b), every statistically significant increase in obesity within a subgroup during the pandemic is concerning. The authors performed seemingly unrelated regressions (SUR) to compare the estimated change in the prevalence of obesity in the overall adult population—an increase of 1.3 pp—to each of the estimated obesity rate changes among each of the previously analyzed subgroups. After the SUR estimations, Wald tests of equality of regression coefficients indicated that the following subgroups exhibited obesity rate changes that were larger as well as statistically distinguishable from the obesity rate change in the overall adult population, with p-values under 0.10:

- Young adults aged 20–39 (estimated intra-pandemic increase = 2 pp)
- Adults living in the West Census region (estimated intra-pandemic increase = 2.8 pp)
- Adults in households with an annual income that was eligible for SNAP benefits (estimated intra-pandemic increase = 2.5 pp)
- Adults with below a high school diploma (estimated intra-pandemic increase = 3.3 pp)

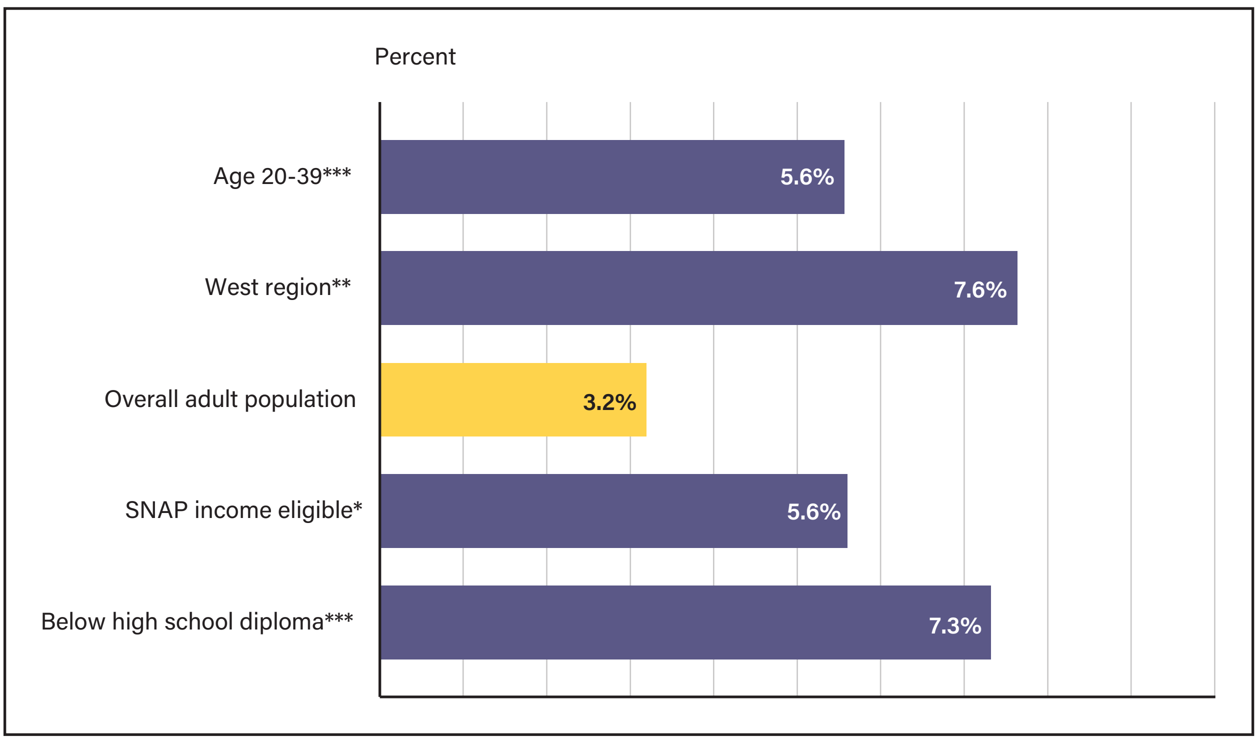
One way to get a sense of the size of these increases is to compare them to average year-over-year (YOY) changes from 2011 to 2019. Using the full adult sample, the average pre-pandemic YOY change was 0.6 pp, so the intra-pandemic increase of 1.3 pp in the overall adult population was over twice as large as the earlier overall average YOY change. Homing in on the adult subgroups listed above, the subgroup-specific average pre-pandemic YOY changes are as follows:

- Young adults aged 20–39 (average pre-pandemic YOY change = 0.5 pp)
    - Estimated intra-pandemic increase was $2/0.5$ or about 4 times larger
- Adults living in the West Census region (average pre-pandemic YOY change = 0.6 pp)
    - Estimated intra-pandemic increase was $2.8/0.6$ or about 5 times larger
- Adults in households with an annual income that was eligible for SNAP benefits (average pre-pandemic YOY change = 1.3 pp)
    - Estimated intra-pandemic increase was $2.5/1.3$ or about 2 times larger
- Adults with below a high school diploma (average pre-pandemic YOY change = 1 pp)
    - Estimated intra-pandemic increase was $3.3/1.0$ or about 3 times larger

Therefore, the increases from the baseline pre-pandemic period to the first year of the COVID-19 pandemic were significant, ranging from about two times the size to about five times the size of the earlier average YOY changes.

In figure 14, each of the statistically significant increases ($p<0.10$) is expressed as a share of each subgroup's baseline pre-pandemic obesity rate, and the increases are then sorted by baseline pre-pandemic obesity rate in ascending order. Young adults aged 20–39 had the smallest baseline pre-pandemic obesity rate (35.7 percent), and adults with below a high school diploma had the largest baseline pre-pandemic obesity rate (45.1 percent).

Figure 14
Estimated percent changes in obesity in the U.S. during the COVID-19 pandemic



SNAP = Supplemental Nutrition Program.

Note: Expressed as shares of pre-pandemic obesity rates, ranked from least to greatest pre-pandemic prevalence. Statistical significance is indicated by *p<0.10, **p<0.05, or ***p<0.01. Asterisks indicate the level of significance of the difference between that subgroup and overall adult population from a Wald test of equality of regression coefficients.

Source: USDA, Economic Research Service based on data collected by Behavioral Risk Factor Surveillance System.

Although young adults aged 20 to 39 years old started from a relatively low pre-pandemic rate of obesity, the prevalence of obesity increased by a substantial amount, which may, in turn, raise the risk of obesity and obesity-linked health effects in later adulthood (Poobalan and Aucott, 2016). These young adults reported a 2 pp intra-pandemic increase in obesity prevalence, or a 5.6-percent increase relative to the baseline pre-pandemic level. Most of these young adults are in their prime working years and have a stronger attachment to the labor force than older adults (Bureau of Labor Statistics, 2020). Compared with employed people who have a healthy weight, those with obesity are significantly more likely to miss work due to injuries or illnesses (Cawley et al., 2021).

In the baseline pre-pandemic period, those living in the West Census region had a lower prevalence of obesity than the three other Census regions (figure 8). However, during the first year of the pandemic, obesity prevalence in the West increased by 2.8 pp or 7.6 percent higher than the rate during the baseline pre-pandemic period. Together with a drop in obesity prevalence in the Northeast Census region, the West Census region's rank in obesity prevalence fell from the lowest (pre-pandemic) to the second lowest during the first year of the pandemic. Many potential causes exist for geographic differences in adult obesity rates, including spatial differences in the food and physical activity environments. For example, Wende et al. (2021) showed that the South had significantly lower food and physical activity environment scores than other regions. Michimi and Wimberly (2015) reported a higher concentration of convenience store and fast-food workers in the South and Midwest. Higher concentrations of convenience store and fast-food workers are associated with higher community obesity rates compared to communities with larger concentrations of supermarket and full-service restaurant workers.

Conclusion

During the first year of the COVID-19 pandemic in the United States, obesity rates increased across the overall adult population, but there were not significant changes among every adult subgroup examined. Some subgroups experienced substantive increases in obesity growth rates, especially younger adults, low-education adults, those in low-income SNAP-eligible households, and adults living in the West Census region.

Previous reports showed that unemployment is typically associated with higher obesity rates (e.g., Biener et al., 2018; Cawley, 2004), but the authors found that obesity among the unemployed was unchanged during the first year of the pandemic. However, the small increase in obesity among employed individuals corresponded with the simulated predictions of Chen et al. (2018). They reported that reemployment could lead to an increase in the prevalence of population-wide obesity through a reduction in leisure time. Geographic trends also deviated from pre-pandemic trajectories. The West Census region experienced the greatest increase in obesity. These findings contrasted with long-term trends of greater obesity rate increases in rural areas of the United States and the South (Befort et al., 2012; Lundeen et al., 2018). Finally, although middle-aged adults had the highest rate of obesity before the pandemic (Hales et al., 2020b), young adults reported the highest obesity growth rates during the pandemic. This finding is consistent with that of Freedman et al. (2022), who found that young adults gained more weight than older adults during the pandemic. The pandemic disruption shifted increased weight accumulation from middle-aged to younger adults during the early months of the pandemic.

Other intra-pandemic obesity patterns were more closely predicted by pre-pandemic trends. Findings within racial and ethnic categories suggest that pre-pandemic obesity rate disparities were perpetuated during the first year of the pandemic. Like earlier trends (e.g., Hicken et al., 2018), non-Hispanic Black adults were more susceptible to obesity from 2019 to 2020. The higher obesity rate among women was consistent with pandemicera findings that women gained more weight than men during the first year of the pandemic (Freedman et al., 2022). Findings were also consistent with prior reports that the presence of children in the household during the pandemic decreased physical activity, especially among women (e.g., Matthews et al., 2022), and exposed adults to greater obesity risk. The increased obesity rates among low-income adults were accordant with previous research identifying low income as a possible obesity-related risk factor (Grecu and Rotthoff, 2015). Finally, the inverse relationship between educational attainment and obesity growth rates during the pandemic was consistent with pre-pandemic findings from developed economies (Cohen et al., 2013).

Groups with the most limited resources were less likely to contain obesity rate growth during the first year of the pandemic. Younger adults and those with limited income and education were most at risk of increased obesity.

The research was limited to the demographic and socioeconomic characteristics available in the BRFSS dataset, and data measuring food-related mechanisms were unavailable. The authors were also limited to comparisons between categorically defined groups. The analysis did not have groups defined by multiple categories to allow for intersectional comparisons (e.g., low-income females compared to high-income female obesity growth rates). Due to the lack of data on food-related mechanisms during the pandemic, the authors were not able to explore whether and how much increases in obesity were fueled by changes in access to healthy foods or shifts in demand toward calorie-dense foods. Evidence suggests food spending changed by food retail type (e.g., grocery retail versus foodservice retail) and across food categories during the first year of the pandemic (Okrent and Zeballos, 2022). For example, steep declines in food-away-from-home spending were mostly offset by food-at-home spending, with protein foods, desserts, prepared meals, and snacks contributing most to the increase in the food-at-home budget share (Okrent and Zeballos, 2022). However, the authors were unable to link actual food consumption to weight outcomes because pandemic restrictions did not permit in-person dietary interviews or anthropometric measurements that would have otherwise been collected as part of the National Health and Nutrition Examination Survey (NHANES) (Centers for Disease Control and Prevention, 2022b). There were also additional society- and economy-wide shifts during the first year of the COVID-19 pandemic. These included expanded unemployment insurance or food distribution disruptions that were not considered in the analysis. Despite these limitations, this study identifies dynamic changes in obesity outcomes across population sub-groups during the first year of the pandemic. The information about subgroup differences may inform differentiated analysis moving forward.

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