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# Frequency and Time of Day That Americans Eat: A Comparison of Data From the American Time Use Survey and the National Health and Nutrition Examination Survey

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# Frequency and Time of Day That Americans Eat: A Comparison of Data From the American Time Use Survey and the National Health and Nutrition Examination Survey

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## Abstract

Since 2003, the American Time Use Survey (ATUS) has collected detailed information about how Americans spend their time by asking respondents to identify primary or main activities they were engaged in over a full 24-hour period, including eating. This means that the ATUS misses “secondary” eating occasions that occur while an individual is otherwise occupied doing something else that is considered to be primary, such as working or watching TV. The Eating & Health Module (EHM) was designed to collect these secondary eating occasions and was included as a supplement to the ATUS during 2006-08 and again in 2014-16. This report compares the number and timing of eating occasions reported in the 2014-16 ATUS-EHM to those reported in the dietary intake component of the 2013-16 National Health and Nutrition Examination Survey (NHANES), which is considered to contain the best available data for estimating average daily dietary intake among the U.S. population. Findings show that the EHM reduces the gap between the ATUS and NHANES with respect to the total number of eating occasions during the day, as well as the share of people reporting eating during each hour of the day, but overall the ATUS-EHM does not capture as many eating occasions as NHANES. When the analysis excludes more easily forgotten eating occasions—that is, drinks and snacks—from the NHANES data, the ATUS-EHM data capture 93.1 percent of all eating occasions reported in NHANES.

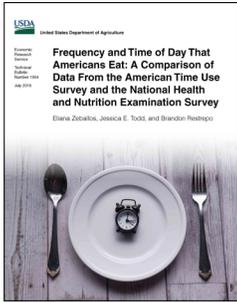
**Keywords:** American Time Use Survey, ATUS, Eating and Health Module, EHM, National Health and Nutrition Examination Survey, NHANES, dietary intake, eating occasions, time of day, eating patterns, time use, time-use survey.

## Acknowledgments

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# Frequency and Time of Day That Americans Eat: A Comparison of Data From the American Time Use Survey and the National Health and Nutrition Examination Survey

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## What Is the Issue?

The American Time Use Survey (ATUS) collects detailed information about how Americans age 15 and older spend their time. Time is particularly important with respect to dietary and diet-related health outcomes. With rising constraints on time, many Americans eat on the go or while working; however, the ATUS does not capture these “secondary” eating occasions, which are defined as eating while engaged in another activity considered primary by the individual. To fill this gap, ERS partnered with USDA’s Food and Nutrition Service and the National Cancer Institute to design the Eating & Health Module (EHM), a supplement to the ATUS that collected information on secondary eating between 2006 and 2008 and again between 2014 and 2016.

Previous studies have shown that the EHM data on eating occasions were not otherwise captured by the ATUS. However, no study has compared the EHM data on secondary eating with similar data collected in other high-quality national surveys to evaluate how well the ATUS and the EHM (ATUS-EHM) do at collecting information associated with time-related eating patterns. This study compares the time of day and the number of eating occasions of U.S. adults as reported in the ATUS-EHM to those in the dietary intake data in the National Health and Nutrition Examination Survey (NHANES), which are currently the best available data for estimating average daily dietary intake among Americans. Findings may help lead to more appropriate use of the data to study the factors that affect eating behaviors and diet-related outcomes of the U.S. population.

## What Did the Study Find?

While the general pattern of eating throughout the day is similar in the ATUS-EHM data and the NHANES data, the ATUS-EHM systematically underestimates eating occasions throughout the day. In particular, the ATUS-EHM estimates are less than those of NHANES for each hour of the day, which is likely due to differences in data collection methods used in the two surveys.

ERS is a primary source of economic research and analysis from the U.S. Department of Agriculture, providing timely information on economic and policy issues related to agriculture, food, the environment, and rural America.

- On average, the ATUS data alone capture only 35.1 percent of all daily eating occasions reported in NHANES. The addition of the supplementary EHM data increases the average to 47.4 percent.
- Corresponding to the greater number of daily eating occasions captured in NHANES, the mean time between eating occasions is shorter in NHANES than in the ATUS-EHM (186.9 minutes versus 322.5 minutes).
- The share of respondents reporting four or more eating occasions per day is much higher for NHANES (89.6 percent) than for ATUS-EHM (22.0 percent).

When the analysis excludes more easily forgotten eating occasions—that is, drinks and snacks—from the NHANES data, the gap between the NHANES and ATUS-EHM estimates decreases.

- The ATUS-EHM data capture 93.1 percent of all main eating occasions reported in NHANES.
- The mean time between meals in NHANES increases to 335.3 minutes, which is only 12.8 minutes more than the mean time in the ATUS-EHM.
- Similarly, the share of NHANES respondents who report eating four or more times in a day falls to 17 percent, which is 5 percentage points lower than the estimated share of ATUS-EHM respondents.

These results suggest that the ATUS-EHM probably captures main meals best and is more likely to miss smaller eating occasions, such as snacks and beverages. Researchers who are interested in estimating eating activity should be aware that even when using the EHM data together with the ATUS data to capture primary as well as secondary eating occasions, eating activity will be underestimated. The results also suggest that incorporating a multiple-pass method of dietary recall, such as the one used in NHANES, into the ATUS-EHM might increase the number of eating occasions captured.

## **How Was the Study Conducted?**

This study used data from the 2014-16 ATUS and the EHM as well as data from the 2013-16 NHANES. The ATUS is sponsored by the U.S. Bureau of Labor Statistics and conducted by the U.S. Census Bureau. NHANES is conducted by the Centers for Disease Control and Prevention. ERS researchers counted the number of times in a day that eating a meal or snack was reported to be a main activity in ATUS (primary eating) and the number of times eating occurred while respondents were also doing something else (secondary eating), as reported in the EHM. These data were compared to similar measures in NHANES. In addition, researchers compared the time of day when eating occurred in both surveys. Differences between the two surveys were compared using a Monte Carlo simulation to calculate confidence intervals in the estimated means and proportions.

# Frequency and Time of Day That Americans Eat: A Comparison of Data From the American Time Use Survey and the National Health and Nutrition Examination Survey

## Introduction

Individuals face time constraints and must choose how to allocate their time between work, personal care, home-related activities, and leisure time. Their choices have implications for health outcomes, income and wealth, as well as overall economic activity. Time is particularly important with respect to dietary and diet-related health outcomes. For example, food prepared at home, which is generally more healthful than food prepared outside the home, takes time to prepare, while food prepared outside the home generally takes less time but costs more and tends to be less healthful. Thus, understanding how Americans allocate time to food-related activities to meet their dietary needs and preferences can provide insights into behaviors associated with nutrition and diet-related health.

The analysis of decisions made under constraints—in this case, time—can also provide insights for the design of both nutrition and food assistance policies and programs because how individuals usually make use of 24 hours in a day has short- and long-run implications for income and earnings, health, and well-being generally. Americans' food-related time use is a basic input in the development of their diets, and a better understanding of this time use may inform consumer education initiatives, food assistance programs, and other policies and programs aimed at improving overall nutrition and reducing overweight and obesity.

Since 2003, the American Time Use Survey (ATUS) has collected detailed information about how Americans age 15 and older spend their time. Respondents are asked to identify activities that they engaged in over a full 24-hour period and to choose the primary or main activity if they were engaged in more than one activity at a given time. Eating activity is captured in the ATUS but only if it was considered a primary activity by the respondent at some point during the 24-hour recall period. In particular, the ATUS is not designed to capture eating occasions that occurred while an individual was otherwise occupied doing something else that is considered primary by the respondent, such as working, watching TV, or socializing with others.

With rising constraints on time (Escoto et al., 2012; Jabs and Devine, 2006; Welch et al., 2009), many Americans are eating on the go or while working, making secondary eating—which is defined as eating while engaged in another activity considered primary by the individual—a nontrivial activity. For example, many Americans turn to fast food to save time, and evidence shows that those who purchase fast food on a given day are more likely to eat at work or while driving than those not purchasing fast food (Hamrick and Okrent, 2014). Since a core mission of USDA is to enhance the understanding of economic issues related to nutrition and diet-related health, including the impact

of time constraints on how people accommodate their dietary needs, it is important to capture time-use data on multitasking eating behavior. To gather information on eating occasions that were not captured in the main ATUS, ERS partnered with USDA's Food and Nutrition Service and the National Cancer Institute to design the Eating & Health Module (EHM), which collected information on secondary eating activity between 2006 and 2008 and again between 2014 and 2016.

Previous studies have shown that, as intended, the EHM captures eating occasions that were not captured by the core ATUS (Zeballos and Restrepo, 2018; Hamrick et al., 2011; Hamrick and McClelland, 2016). However, no study has compared the EHM data with similar data from other high-quality national surveys to evaluate how well the ATUS-EHM does at collecting information related to time-related eating-patterns. This study aims to fill that gap by comparing data on the number of eating occasions, the length of time between eating occasions, and the hour-by-hour distribution of eating occasions of American adults as reported in the ATUS-EHM to those in the dietary intake data collected in the National Health and Nutrition Examination Survey (NHANES), currently the best available data for estimating average daily dietary intake among Americans. The study's findings may lead to a better understanding of the features of the ATUS data for research on food-related time use, which will enable one to more appropriately use the data to analyze the factors that affect eating behaviors and diet-related outcomes of the U.S. population.

## Data, Measures, and Methods

The ATUS-EHM and NHANES are both complex, nationally representative surveys. The EHM is a supplementary questionnaire to the ATUS.

### The American Time Use Survey and the Eating & Health Module

The ATUS is funded by the U.S. Bureau of Labor Statistics and conducted by the U.S. Census Bureau via telephone interviews. The survey samples individuals age 15 and older and draws this sample from households that completed the eighth and final month of the Current Population Survey (CPS). Census Bureau interviewers ask respondents to identify their primary activity (if they were engaged in more than one activity at a time) from 4 a.m. the day before the interview to 4 a.m. of the interview day, the location from which they performed some of the activities, and the individuals who were present when those activities were performed. The respondent, and not the interviewer, decides which activity was the primary activity when the individual was engaged in two or more activities concurrently. Interviews are conducted mainly in English but can be conducted in Spanish when the designated respondent speaks only Spanish or is more comfortable responding in that language. The ATUS also collects data on demographic characteristics, labor force participation, and household information, such as eldercare and number of children. Some of this information was gathered previously through the CPS and is updated during the phone interview (e.g., labor force participation).

The EHM is conducted as part of the ATUS interview, immediately after the core ATUS data have been collected.<sup>1</sup> EHM interviewers ask respondents to report any secondary eating occasions, which are defined as eating while engaged in another activity considered primary by the individual and therefore not captured in the core ATUS interview. The EHM was fielded over two periods of 3 consecutive years, in 2006-08 and then again in 2014-16. This study uses data from the most recent period, 2014-16.

We count the number of times that an individual reported eating as a primary or secondary activity (i.e., an eating occasion). We also estimate the share of individuals who report a primary or secondary eating occasion in each hour of the day. Since survey respondents are asked to report the start and end times for each activity, in the time-of-day analysis, we use the start (not the duration) of each occasion for primary eating and drinking. For secondary eating, we calculate the start of the activity as the midpoint of the primary activity minus half the duration of the secondary eating. In both cases, we look at each 60-minute interval (e.g., 12:00 p.m. until 12:59 p.m.) and calculate the percentage of the population that started an eating occasion during that interval. According to the core ATUS data, respondents averaged 2.0 primary *eating and drinking* occasions on an average day in 2014-16 (appendix table 1). We would like to point out that, in the ATUS activity lexicon, the activity is technically called *eating and drinking* and cannot be separated into *eating* versus *drinking* as a primary or main activity. It is likely that there may be fewer instances in which respondents were engaged in *drinking*—but not *eating*—as a primary activity. For this reason and for brevity, we refer to this activity as *primary eating* hereafter.

We find that the secondary eating reported in the EHM adds an average of 0.7 eating occasions per day to the day's total eating occasions and that these additional eating occasions are mainly distrib-

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<sup>1</sup> The EHM data can be found on the USDA, ERS website under Data Products, Eating and Health Module (ATUS).

uted between 9 a.m. and 10 p.m. (appendix fig. 1). Secondary eating also shifts the distribution in the number of daily eating occasions to the right, increasing the modal number of eating occasions from 2.0 to 2.7 eating occasions per day in 2014-16 (appendix table 1). Our main analysis, therefore, is focused on the *total* number of eating occasions as reported in both the core ATUS and EHM, which we refer to as the ATUS-EHM data throughout the remainder of this study.

## National Health and Nutrition Examination Survey

NHANES is a nationally representative survey of adults and children in the United States that collects a wide range of health-related information. NHANES is a major program of the National Center for Health Statistics (NCHS) that is part of the Centers for Disease Control and Prevention (CDC). The survey is unique in that it combines interviews and physical examinations. The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiological measurements, as well as laboratory tests administered by highly trained medical personnel. The survey is continuous, but data are released to the public for analysis in 2-year cycles, and single years of the public-use data cannot be analyzed separately. Since 2003-04, the survey has included a dietary component that collects food intake data from 2 nonconsecutive days (24-hour periods, midnight to midnight prior to the interview). The first day of intake information is collected in person, at the time of a physical exam in the survey's Mobile Examination Center, while information on the second day is collected over the phone during a followup interview. NHANES day 2 produces a lower estimate of mean daily caloric intake, longer time between eating occasions, and slightly fewer total eating occasions per day than NHANES day 1 (appendix table 2). Previous research has documented that mean energy intake is higher when estimated using day 1 data than when using day 2 data (Mancino et al., 2009), and we find similar evidence.

The NHANES intake data are collected using USDA's Automated Multiple-Pass Method (AMPM), which employs five steps (or passes) designed to achieve a complete and accurate food recall (Raper et al., 2004; Moshfegh et al., 2008a). First, respondents are asked to provide a quick list of the day's intake. Second, the interviewer asks if any foods may have been left off of this quick list, as respondents frequently forget such foods. Third, the respondent is then asked to report the time when he or she began eating and to name the eating occasion (whether the food was part of a specific meal or a snack) for each food. Respondents can also report that an occasion was a drink or "extended consumption." Extended consumption refers to occasions that do not have distinct periods of consumption, such as sipping cups of coffee throughout the day, and where the respondent can more easily report on the total amount consumed rather than smaller amounts throughout the day (CDC, 2016, p. 5-29). We find that beverages account for most food items (92.8 percent) reported to be part of extended consumption. Fourth, the respondent is asked to provide a detailed description of each food and the amount eaten. The interviewer also reviews the named eating occasions and the time of each eating occasion and makes changes as directed by the respondent, in this step. Lastly, the interviewer asks the respondent to verify that all foods consumed have been reported and revises the records if any additional foods consumed are reported in this step. Despite this detailed process, the NHANES intake data have been found to suffer from underreporting (Rumpler et al., 2008; Moshfegh et al., 2008b). Still, they are considered to be the best data with which to estimate population-level and subgroup dietary intake (Subar et al., 2015).

For the comparison, this study uses the two cycles of NHANES data (2013-14 and 2015-16) that best correspond to the 2014-16 ATUS data. This means we have 1 additional year of NHANES data

than we have of ATUS data. Finally, given that day 1 provides the best available data for estimating individual dietary intake, our main comparison is day 1 data for ATUS-EHM and day 1 data for NHANES. The appendix compares day 2 data for ATUS-EHM and for NHANES (see appendix figure 2).

## Constructing Similar Measures of Eating Occasions for Comparison

In addition to the differences in interview modes (phone survey for ATUS and in-person survey for day 1 intake in NHANES), the ATUS and NHANES employ different methods in collecting data. As described earlier, NHANES employs a five-step process to collect each day's dietary intake data (AMPM), providing respondents with multiple opportunities to remember and report their intake. In contrast, the ATUS interview employs at most two passes over the day's activities—first through the core ATUS interview and a second pass via the EHM.

Table 1 presents weighted means of some basic demographic characteristics in both surveys with standard errors that take into account the complex sampling design in each survey and that were estimated according to instructions provided in each survey's user guide. Because not all ATUS respondents completed the EHM, we use the EHM weights when analyzing the ATUS data. We use the day 1 dietary intake weights when analyzing the NHANES day 1 intake data. Given the complex sampling design of each survey, we use a Monte Carlo simulation to test whether estimated means and proportions between the two surveys are statistically significantly different from each other. The Monte Carlo simulation allows us to compare if two means are statistically different from each other by generating random samples using the weighted means and standard errors that are separately calculated. Once the random samples are generated, we can test if these two samples are statistically different from each other by looking at the confidence interval of the difference between the two random samples.

In both surveys, we look at the civilian, noninstitutionalized adult (age 18 and over) population. We use self-reported weight and height in both datasets to calculate the body mass index (BMI) so that BMIs are comparable across surveys. We classify adults age 20 and older into three groups according to their BMI calculated from self-reported height and weight for adults age 20 and older, following the Centers for Disease Control and Prevention (CDC) definitions: normal weight (BMI of less than 24.9); overweight but not obese (BMI of 25-29.9); and obese (BMI of 30 or above).<sup>2</sup> Following the U.S. Census Bureau, we present mean educational attainment for Americans age 25 and older (Ryan and Bauman, 2016).

There are few differences between the two datasets. A smaller share of NHANES respondents have income above 185 percent of the Federal poverty line. This may be due to differences in how income information is collected or in how the household (in the case of ATUS) or family (in the case of NHANES) unit is considered. Another difference between the survey results is that a larger share of adults are classified as obese in NHANES than in ATUS-EHM. This may be due in part to NHANES interviews being conducted in person. Since individuals tend to overestimate their height and underestimate their weight (Maukonen et al. 2018), which reduces estimated BMI, an in-person interview may encourage more accurate reporting. In addition, heights and weights are clinically measured later in the NHANES interview process, which may nudge respondents to self-report these measures more accurately.

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<sup>2</sup> Body mass index for adults age 20 and older is calculated as: (weight in pounds)/(height in inches)<sup>2</sup> x 703. We include underweight individuals (BMI < 18.5) in our normal weight group. See CDC website for more information on adult BMI.

Table 1

**Summary statistics: ATUS-EHM 2014-16 and NHANES 2013-16, age 18 and older (percentages)**

		ATUS-EHM	NHANES	Difference (ATUS - NHANES)
Gender	Male	48.4 (0.067)	48.9 (0.528)	-0.50
	Female	51.6 (0.067)	51.1 (0.528)	0.50
Age (years)	18-24	12.0 (0.102)	12.2 (0.492)	-0.20
	25-64	68.6 (0.080)	68.4 (0.782)	0.20
	65 and older	19.4 (0.026)	19.4 (0.720)	0.00
Ethnicity	Hispanic	15.4 (0.094)	15.2 (1.723)	0.20
	Non-Hispanic White	66.7 (0.217)	64.6 (2.442)	2.10
	Non-Hispanic Black	11.8 (0.069)	11.3 (1.339)	0.50
Education level	Lower than high school degree	10.4 (0.212)	14.3 (1.153)	<b>-3.90</b>
	High school degree or GED	29.9 (0.269)	21.1 (0.830)	<b>8.80</b>
	Some college or associate's degree	24.8 (0.308)	31.6 (0.869)	<b>-6.80</b>
	Bachelor's degree or higher	34.9 (0.306)	32.9 (1.897)	2.00
Income	> 185% poverty line	33.9 (0.304)	36.2 (1.617)	-2.30
	<= 185% poverty line	64.1 (0.307)	58.6 (1.664)	<b>5.50</b>
Body weight category	Normal weight	30.8 (0.315)	28.1 (0.911)	<b>2.70</b>
	Overweight	34.9 (0.363)	33.1 (0.660)	<b>1.80</b>
	Obese	30.0 (0.350)	37.0 (0.969)	<b>-7.00</b>

Notes: GED = General Educational Development. Weighted means reported, using the NHANES dietary day 1 sample weights and EHM survey sampling weights. Standard errors in parentheses account for complex survey design. Differences are bolded if they are statistically different from zero. Body weight categories calculated for those age 20 and older, and education levels calculated for those age 25 and older. The body mass index (BMI) values associated with the body weight categories are normal weight, BMI of less than 24.9; overweight but not obese, BMI of 25-29.9; obese, BMI of 30 or above.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and from the 2014-16 American Time Use Survey (ATUS) and the Eating & Health Module (EHM).

## Results

### Overall, the ATUS Underestimates Frequency of Eating

As a result of the multiple-pass method of dietary recall used in NHANES, NHANES data capture more eating occasions throughout the day than do ATUS-EHM data. In the NHANES data, respondents averaged 5.7 eating occasions per day in 2014-16 (table 2). It was most common for respondents to have four or more eating occasions on an average day (89.6 percent of NHANES respondents), followed by three eating occasions per day (8.5 percent of respondents), and then two eating occasions per day (1.7 percent of respondents).

Table 2

#### Minutes between eating occasions and number of eating occasions on an average day in 2014-16 (ATUS-EHM) and 2013-16 (NHANES – day 1), age 18 and older

	Full EHM-ATUS	NHANES day 1	NHANES without drinks and extended consumption	NHANES without drinks, extended consumption, and snacks
Minutes between eating occasions	322.5 (1.05)	186.9 (2.16)	231.5 (2.15)	335.3 (2.09)
Average number of eating occasions per day	2.7 (0.01)	5.7 (0.06)	4.4 (0.04)	2.9 (0.02)
Percentage of Americans who engaged in:				
Zero eating occasions	0.9 (0.08)	0 (0.00)	0 (0.00)	0 (0.00)
One eating occasion	11.8 (0.24)	0.2 (0.05)	1.1 (0.16)	4.7 (0.30)
Two eating occasions	29.5 (0.33)	1.7 (0.20)	5.9 (0.35)	23.1 (0.60)
Three eating occasions	35.7 (0.37)	8.5 (0.57)	21.3 (0.65)	55.2 (0.80)
Four or more eating occasions	22 (0.32)	89.6 (0.70)	71.7 (0.88)	17 (0.77)
Calories	-- --	2,116.5 (13.76)	2,001.9 (11.90)	1,638.7 (11.26)

Notes: -- = not available. Weighted means reported, using the NHANES dietary day 1 sample weights and EHM survey sampling weights. Standard errors in parentheses account for complex survey design.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and from the 2014-16 American Time Use Survey (ATUS) and the Eating & Health Module (EHM).

The core ATUS captures only 35.1 percent of the eating occasions reported in NHANES (2.0 versus 5.7 eating occasions) (appendix table 1). Once the secondary eating occasions from the EHM are considered, the gap between the estimated eating occasions in ATUS-EHM and NHANES is reduced by 12.3 percentage points, capturing 47.4 percent of the eating occasions reported in NHANES (2.7

versus 5.7 eating occasions). Moreover, compared with shares of NHANES respondents, the shares of ATUS-EHM respondents reporting zero, one, two, or three eating occasions were much higher while the share of ATUS-EHM respondents reporting four or more eating occasions was much smaller. Corresponding to the greater number of eating occasions captured in NHANES, the mean time between eating occasions is shorter in NHANES than in ATUS-EHM (186.9 minutes versus 322.5 minutes).

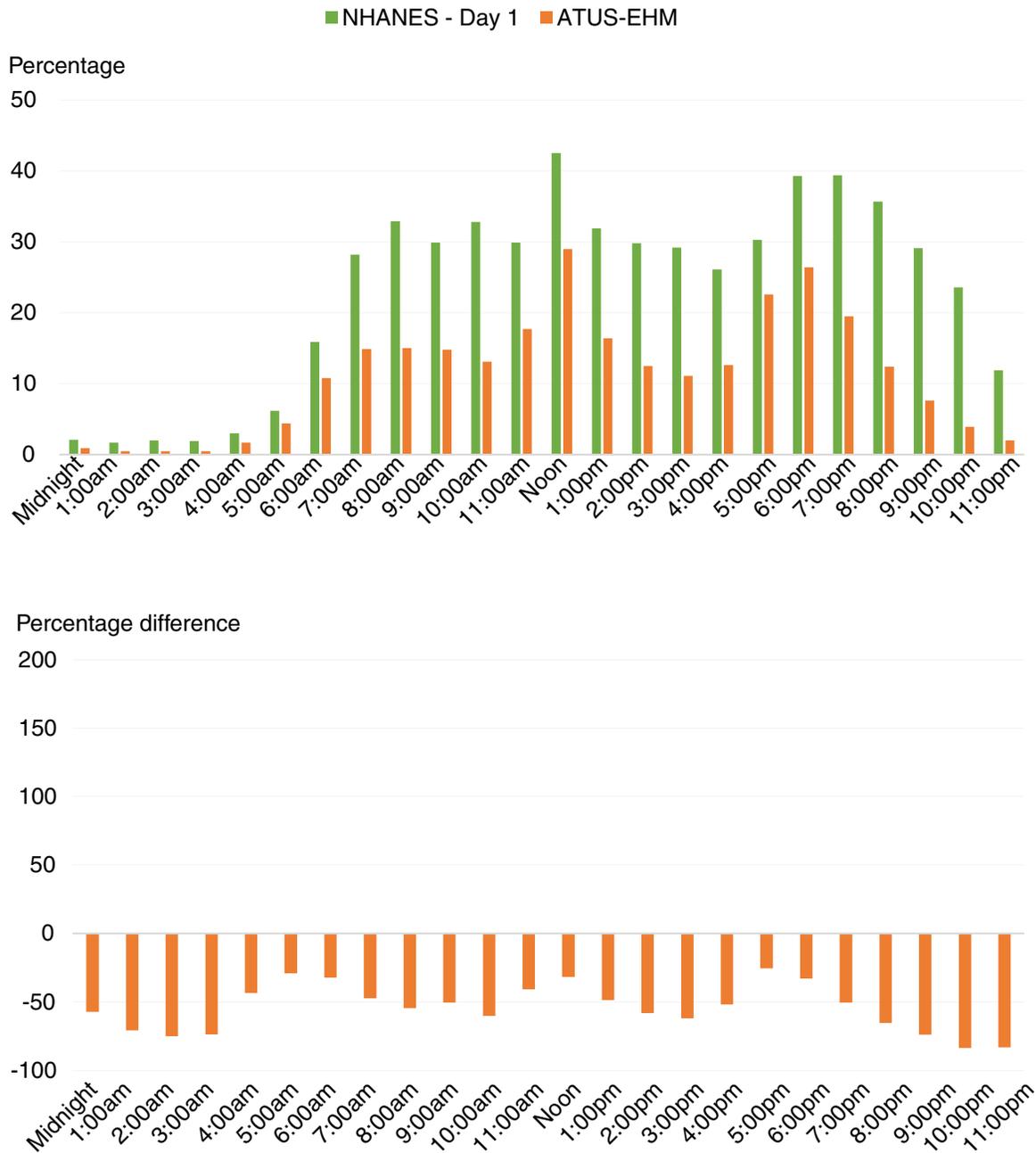
We also considered whether for some U.S. subgroups (defined by gender, age, race/ethnicity, educational attainment, income, and body weight), the ATUS-EHM is either less or more successful at capturing eating occasions than is NHANES (see appendix table 4). In both datasets, the number of reported eating occasions is slightly larger (i) among females than among males; (ii) among non-Hispanic Whites than among other ethnic groups; (iii) among households at/below than above 185 percent of the poverty line than among households at other income levels; and (iv) among those interviewed during a weekend than among those interviewed during a weekday. Also, in both the ATUS-EHM and NHANES, the number of eating occasions increases as a respondent's level of education increases, and decreases as a respondent's BMI increases. By and large, we find that the estimated number of eating occasions for the overall population and a wide variety of subgroups in the datasets are very similar. The differences between ATUS and NHANES, although different in magnitude, are similar as a share of NHANES reported occasions. Once the drinks, extended consumption, and snacks are removed, there are very small differences between the data in ATUS and NHANES.

We can also compare data from the two surveys according to the time of day when eating is reported to begin. The top half of figure 1 compares the shares of NHANES and ATUS-EHM respondents that report beginning to eat during each hour of the day. The bottom half presents the difference between the ATUS-EHM and NHANES estimates as a percent of the NHANES estimate. When the difference between the two surveys is not statistically significant, the corresponding bars in the table are blue.

As shown in the figure, the distribution of data throughout the day is similar in NHANES and ATUS-EHM. Second, the ATUS-EHM estimates are always lower than those of NHANES. The ATUS-EHM systematically underestimates eating occasions throughout the day.

Figure 1

**Percentage of Americans who engaged in eating and percentage change between ATUS-EHM versus NHANES, by time of day, on an average day in 2014-16 and 2013-16, age 18 and older**



Notes: Weighted means reported, using the NHANES Dietary Day 1 sample weights and EHM survey sampling weights.  
 Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and the 2014-16 American Time Use Survey (ATUS) and Eating & Health Module (EHM).

## Improving the Match Between ATUS and NHANES Reduces the Gap Between the Two Survey Estimates

One reason that ATUS-EHM may capture fewer eating occasions than NHANES is that ATUS-EHM respondents were not asked about secondary drinking. Also, while NHANES respondents were asked multiple times about their consumption from the previous day, ATUS respondents were asked only one additional time in the EHM after responding to the core ATUS survey questions. We estimate that the three main meals (breakfast, lunch, and dinner) account for about 1 in 2 eating occasions reported in NHANES and almost 8 in 10 daily calories (see box “Classifying Meals and Snacks in the NHANES Data”). These are eating occasions that people likely recall without much difficulty and are thus probably well accounted for in both the NHANES and ATUS-EHM data. By contrast, eating occasions that consist of a drink only, a snack, or extended consumption are harder to recall and thus more likely to be missed in the ATUS-EHM data collection. For example, while NHANES dietary recall interviewers asked about consumption of items such as beverages, sweets, savory snacks, fruit and vegetables and cheeses, and breads and rolls, ATUS-EHM interviewers did not. For this reason, we expect that ATUS respondents are more likely than NHANES respondents to forget smaller eating occasions, such as snacks.

When we eliminate all eating occasions that were named to be a drink or extended consumption by NHANES respondents, we exclude an average of 1.3 drinking or eating occasions from the NHANES data. As expected, this increases the mean time between eating occasions from 187 minutes to 232 (table 2, column 3). When we also exclude snacks from the NHANES data, the average number of eating occasions per day falls from 4.4 to 2.9 (table 2, column 4). This is only 0.2 occasions greater than the average number of eating occasions estimated using the ATUS-EHM data. Correspondingly, the average amount of time between eating occasions increases to 335 minutes in NHANES, which is 12 minutes greater than the estimate using ATUS-EHM data (323 minutes).

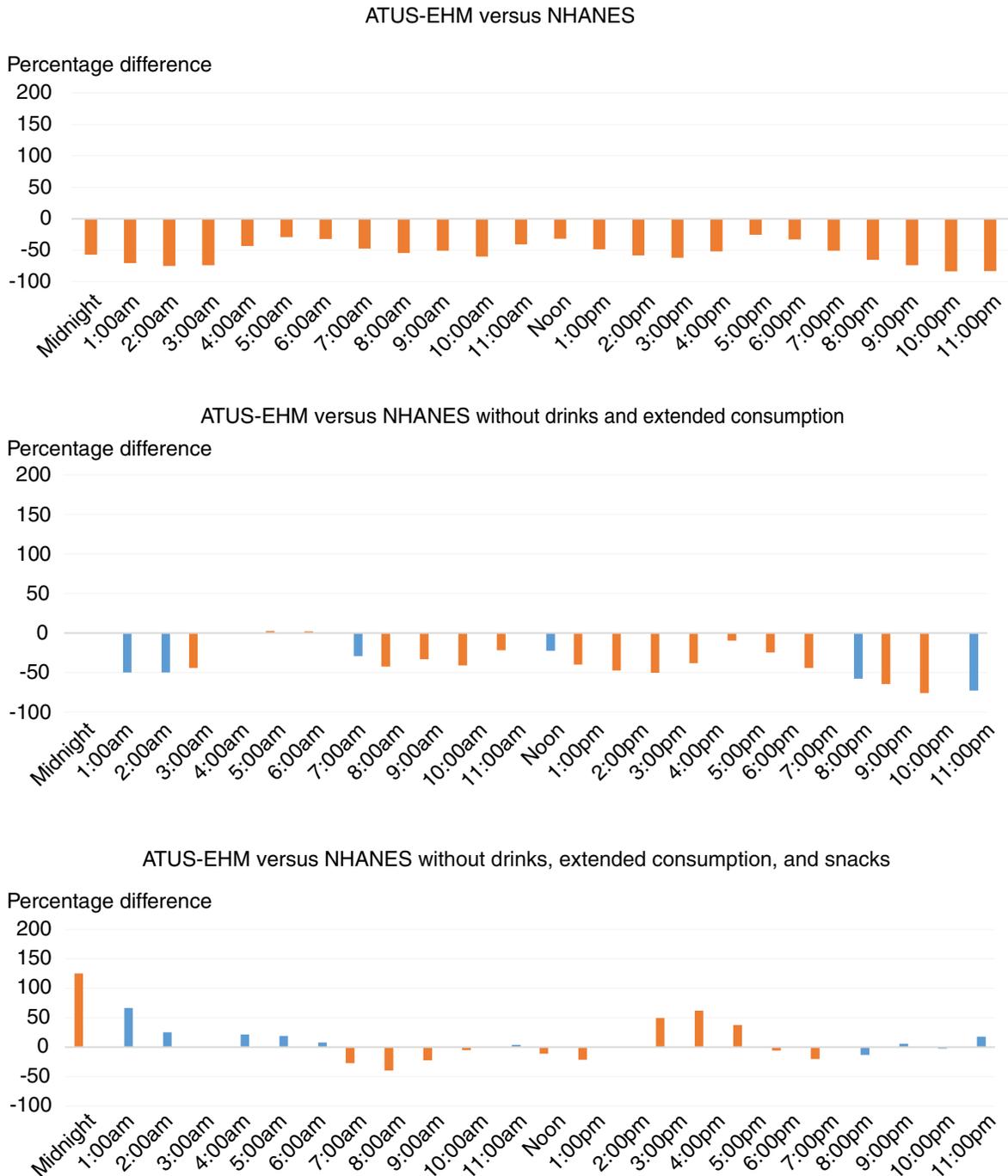
Figure 2 presents the differences between the ATUS-EHM and NHANES in the share of individuals who begin eating or drinking during each hour of the day as a percent of the NHANES share. Negative values indicate that the ATUS-EHM estimate is less than the NHANES estimate, while positive values indicate the ATUS-EHM estimate is greater than that from NHANES. When the differences are not statistically significant, the corresponding bars in the table are blue. The top panel of figure 2 is a repeat of the bottom panel of figure 1, showing the differences before any NHANES occasions are excluded. The next panel shows the differences when drinks and extended consumption are excluded. We see that many of the differences become much smaller or insignificant.

The bottom panel of the figure presents the differences when drinks, extended consumption, and snacks are excluded from NHANES. The differences between the two surveys are reduced further than in the other panels, and more are not statistically significant. However, there are still two time periods in the bottom panel when the ATUS-EHM estimate of the share of individuals reporting an eating occasion is greater than the estimate from NHANES: midnight, and between 3 and 6 pm.

When we exclude these more easily forgotten eating occasions from NHANES, the rank order in the percentage of Americans who engage in one, two, three, and four or more eating occasions on an average day in NHANES is now similar to that in ATUS-EHM, although the estimated shares differ: it is most common for Americans to have three eating occasions on an average day (highest share), followed by two eating occasions (second-highest share), and then four or more eating occasions (third-highest share).

Figure 2

**Percentage difference of Americans who engaged in eating between ATUS-EHM versus NHANES, by time of day, on an average day in 2014-16 and 2013-16, age 18 and older**



Notes: Weighted means reported, using the NHANES Dietary Day 1 sample weights and EHM survey sampling weights. Differences that are not statistically different from zero are shown in blue.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and the 2014-16 American Time Use Survey (ATUS) and Eating & Health Module (EHM).

## Classifying Meals and Snacks in NHANES Data

During the dietary interview for the National Health and Nutrition Examination Survey (NHANES), participants state what they ate, the time of day they started eating, and what they considered that occasion to be (e.g., breakfast, snack). Based on NHANES day 1 intake data, dinner tends to be the most calorie-dense eating occasion, followed by lunch and then breakfast; brunch, an eating occasion that tends to occur between breakfast and lunch, tends to have a calorie content between that of breakfast and lunch (see table).

### Frequency, percent, and mean calories by respondent-named eating occasions, 2013-16 NHANES day 1 intake, age 18 and older

Eating occasion	Number	Percentage	Calories	Percentage	Calories	Average meals per day
Breakfast	8,822	15.9	364	16.7	365	0.95
Desayuno	949	0.8	384			
Lunch	7,526	13.8	600	15.5	597	0.89
Brunch	505	0.7	463			
Almuerzo	691	0.6	632			
Comida	689	0.6	696			
Dinner	7,625	13.3	739	18.3	724	1.05
Supper	2,268	4.1	699			
Cena	962	0.8	611			
Snack	14,135	25.9	236	27.2	236	1.56
Entre comida	305	0.2	185			
Merienda	712	0.6	255			
Botana	286	0.3	236			
Bocadillo	269	0.3	209			
Tentempie	47	0.0	188			
Drink	7,907	15.3	80			
Bebida	750	0.7	83			
Extended consumption	3,419	6.3	117	6.3	117	0.36

Notes: Weighted means, using day 1 sample weights, reported for percent of all eating occasions and mean calories per occasion. N is unweighted.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES).

On average, snacks represent 27.2 percent of all NHANES eating occasions reported, drinks represent 16.0 percent, and extended consumption represents 6.3 percent. Each individual consumes an average of 1.56 snacks and 0.91 drinks and engages in 0.36 extended consumption occasions per day. Each snack has on average 236 calories, each drink has 81 calories, and each item that is considered extended consumption has 117 calories.

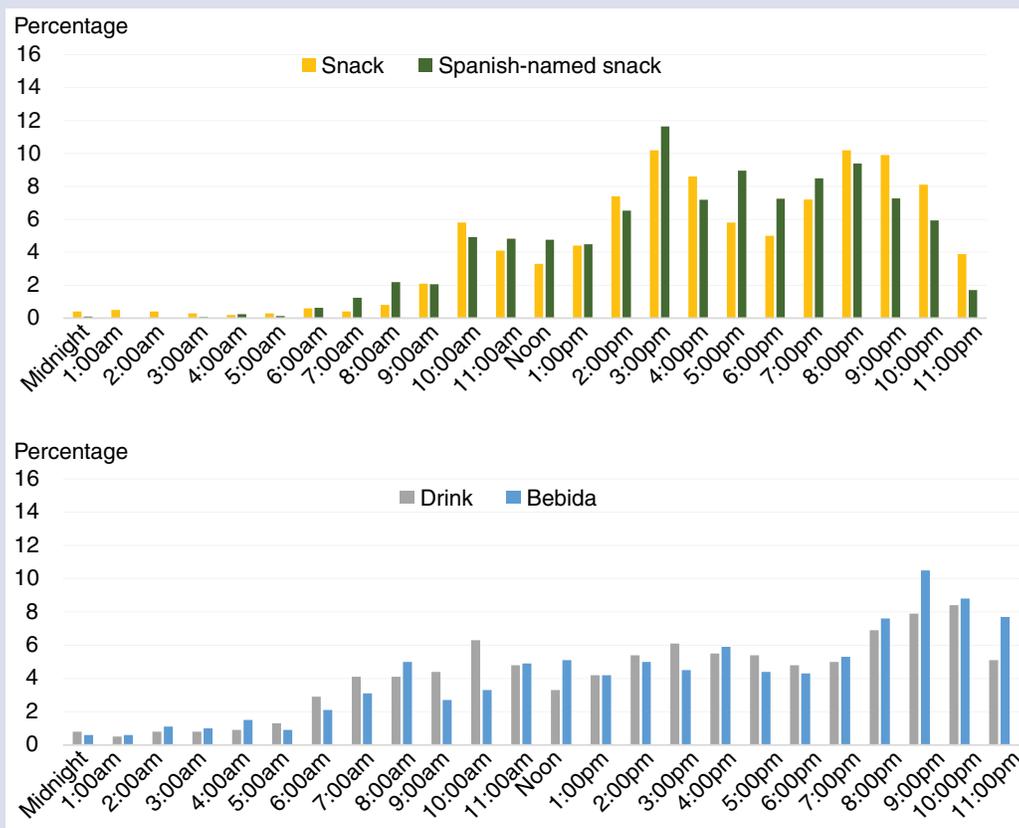
—continued

## Classifying Meals and Snacks in NHANES Data— continued

Snacks, when named in English, average about 236 calories as reported. There are five different terms used to refer to snacks in Spanish (entre comida, merienda, botana, bocadillo, tentempie), and these range from 185 to 255 calories per eating occasion. Drinks and bebidas ("drinks" in Spanish), as well as snacks and Spanish-named snacks, have a similar distribution of eating patterns throughout the day (see figure). Appendix figure 3 presents the share of individuals reporting each of the three main meals, beverages, and extended consumption in each hour of the day, grouping English and Spanish-named meals together. The time of day of the three main meals reported in Spanish (desayuno, almuerzo, and cena) correspond to their English equivalents (see appendix figure 4). A fourth term, comida, corresponds to lunch (occurring between noon and 4 p.m.) among individuals who report being of Mexican descent but corresponds to dinner (occurring between 3 p.m. and 9 p.m.) among all other Hispanics. We consider a meal named comida to be lunch if reported by someone of Mexican descent and to be dinner if reported by any other individual.

On average, when we eliminate drink-only occasions from the NHANES analysis, the mean daily intake falls by 74 calories, from 2,117 to 2,043. When we eliminate extended consumption, intake falls another 41 calories, to 2,002 per day. Finally, when we eliminate snacks, mean intake drops another 363 calories to 1,639 per day (table 2).

### Time-of-day eating patterns for harder-to-recall eating occasions on an average day in 2013-16 (NHANES), age 18 and older



Notes: Weighted means reported, using the NHANES dietary day 1 sample weights.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES).

## Discussion and Implications for Future Research

Rising constraints on time are causing more Americans to eat on the go or while working, a trend which, in part, motivated ERS to complement the core ATUS with the EHM to capture secondary eating occasions. A better understanding of how Americans allocate their time to meet dietary needs and preferences can provide insights into behaviors associated with nutrition and diet-related health. Such insights may help in the design of food and nutrition assistance programs and policies aimed at improving Americans' nutrition and health.

In this study, we show that when compared with the best available source of daily dietary intake (NHANES), the core ATUS captures only a small share of all daily eating occasions. The EHM helps to reduce—but does not eliminate—the gap in the estimated number of total daily eating occasions between the ATUS and NHANES. Our analysis suggests that a gap likely remains because, unlike the NHANES, neither the core ATUS nor the EHM was designed to achieve complete and accurate dietary recall. As a consequence, the frequency with which Americans engage in eating activity will be underestimated in both the core ATUS and EHM. Our analysis also suggests that the ATUS-EHM probably captures main meals best and is more likely to miss smaller eating occasions, such as snacks and beverages.

This study's findings have implications for research and for survey design. First, while data on time-of-day eating activity patterns are similar in both surveys, researchers who are interested in estimating eating activity should be aware that even when using the EHM data together with the core ATUS data to capture primary as well as secondary eating occasions, eating activity will be underestimated—and this underestimation will apply to every hour of the day. Second, incorporating a multiple-pass method of dietary recall, such as the one used in NHANES, into the ATUS-EHM might increase the number of eating occasions captured. However, modifying the ATUS-EHM to improve the collection of eating occasions may impact the quality of other data collected and reduce comparability of its data with earlier survey data.

Finally, although the ATUS-EHM data are missing eating occasions, the surveys seem to be capturing those eating occasions that contribute the most to daily calorie intake and, most importantly, those eating occasions that last the longest (i.e., snacking is generally fast). Therefore, assuming that individuals tend to spend only a modest amount of time snacking, we believe that ATUS-EHM is capturing most of the time an average American spends eating and drinking. ATUS-EHM is useful to measure the time spent on a wide variety of different activities, including eating activity. By contrast, NHANES provides information about when respondents start eating but not the duration of their eating occasions.

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## Appendix

Appendix table 1

### Primary and secondary eating reported in the American Time Use Survey and Eating & Health Module

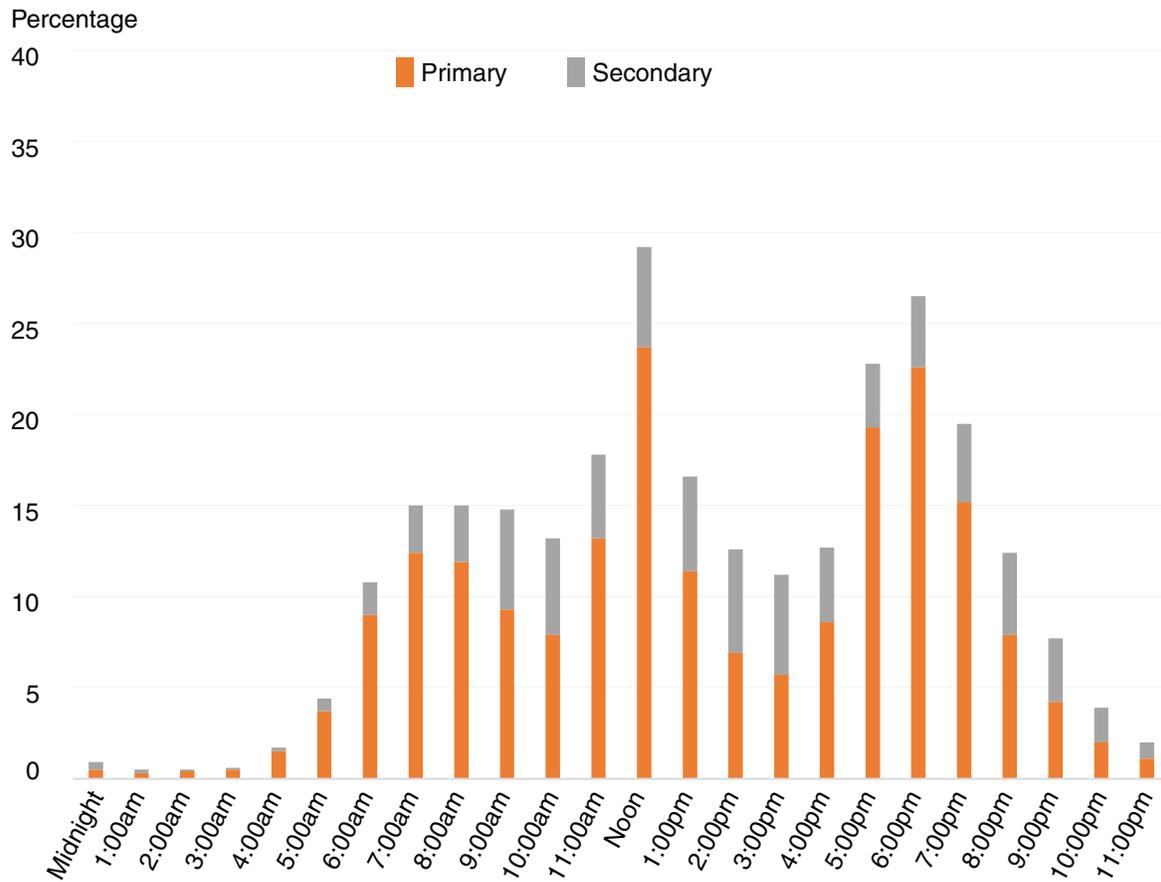
	Primary eating (ATUS)	Primary and secondary eating (ATUS-EHM)
Minutes between eating occasions	381.9 (1.49)	322.5 (1.05)
Average number of eating occasions per day	2.0 (0.01)	2.7 (0.01)
Percentage of Americans who engaged in:		
Zero eating occasions	4.8 (0.18)	0.9 (0.08)
One eating occasion	26.9 (0.33)	11.8 (0.24)
Two eating occasions	38.2 (0.40)	29.5 (0.33)
Three eating occasions	24.6 (0.32)	35.7 (0.37)
Four or more eating occasions	5.4 (0.18)	22 (0.32)

Notes: Weighted means using EHM survey sampling weights, standard errors in parentheses account for complex sampling design.

Source: USDA, Economic Research Service using data from the 2014-16 American Time Use Survey (ATUS) and Eating & Health Module (EHM).

Appendix figure 1

**Percentage of Americans who engaged in primary eating and secondary eating, by time of day, on an average day in 2014-16 ATUS-EHM, age 18 and older**



Notes: Weighted means reported, using the EHM survey sampling weights.

Source: USDA, Economic Research Service using data from the 2014-16 American Time Use Survey (ATUS) and Eating & Health Module (EHM).

Appendix table 2

**Summary of intake measures from NHANES, day 1 and day 2, adults age 18 and older**

	Day 1	Day 2
Calories	2,116.8 (13.50)	2,005.9 (20.04)
Minutes between eating occasions	186.9 (2.16)	198.5 (2.34)
Average number of eating occasions per day	5.7 (0.06)	5.4 (0.06)
Percentage of Americans who engaged in:		
Zero eating occasions	0 (0.00)	0.0 (0.00)
One eating occasion	0.2 (0.05)	0.5 (0.09)
Two eating occasions	1.7 (0.20)	2.4 (0.30)
Three eating occasions	8.5 (0.57)	10.7 (0.77)
Four or more eating occasions	89.6 (0.70)	86.5 (0.97)

Notes: NHANES dietary day 1 and 2 sample weights were used to compute nationally representative estimates. Standard errors in parentheses account for complex survey design.

Source: USDA, Economic Research Service, using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES).

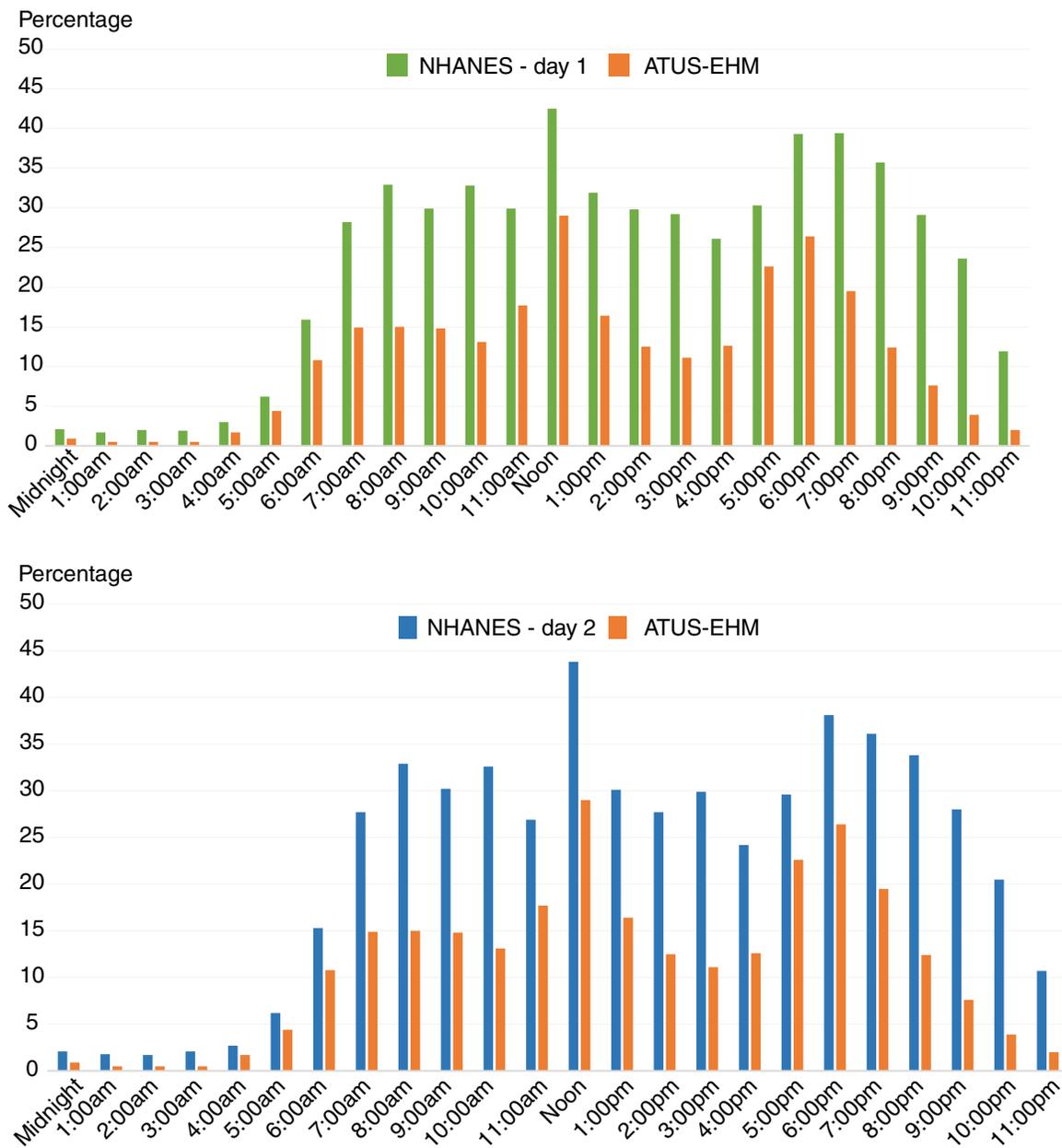
**Minutes between eating occasions and number of eating occasions on an average day in 2014-16 (ATUS-EHM) and 2013-16 (NHANES – day 2), age 18 and older**

	Full EHM-ATUS	NHANES day 2	NHANES without drinks and extended consumption	NHANES without drinks, extended consumption, and snacks
Minutes between eating occasions	322.5 (1.05)	198.5 (2.34)	246.2 (2.64)	349.3 (2.59)
Average number of eating occasions per day	2.7 (0.01)	5.4 (0.06)	4.2 (0.04)	2.7 (0.02)
Percentage of Americans who engages in:				
Zero eating occasions	0.9 (0.08)	0 (0.00)	0 (0.00)	0 (0.00)
One eating occasion	11.8 (0.24)	0.5 (0.09)	1.4 (0.19)	4.6 (0.41)
Two eating occasions	29.5 (0.33)	2.4 (0.30)	8.2 (0.62)	23.4 (1.00)
Three eating occasions	35.7 (0.37)	10.7 (0.77)	24.7 (0.87)	65.5 (1.18)
Four or more eating occasions	22 (0.32)	86.5 (0.97)	65.6 (1.25)	6.5 (0.44)
Calories	-- --	2,116.5 (13.76)	2,001.9 (11.90)	1,638.7 (11.26)

Notes: -- = not available. Weighted means reported, using the NHANES dietary day 1 sample weights and EHM survey sampling weights. Standard errors in parentheses account for complex survey design.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and from the 2014-16 American Time Use Survey (ATUS) and the Eating & Health Module (EHM).

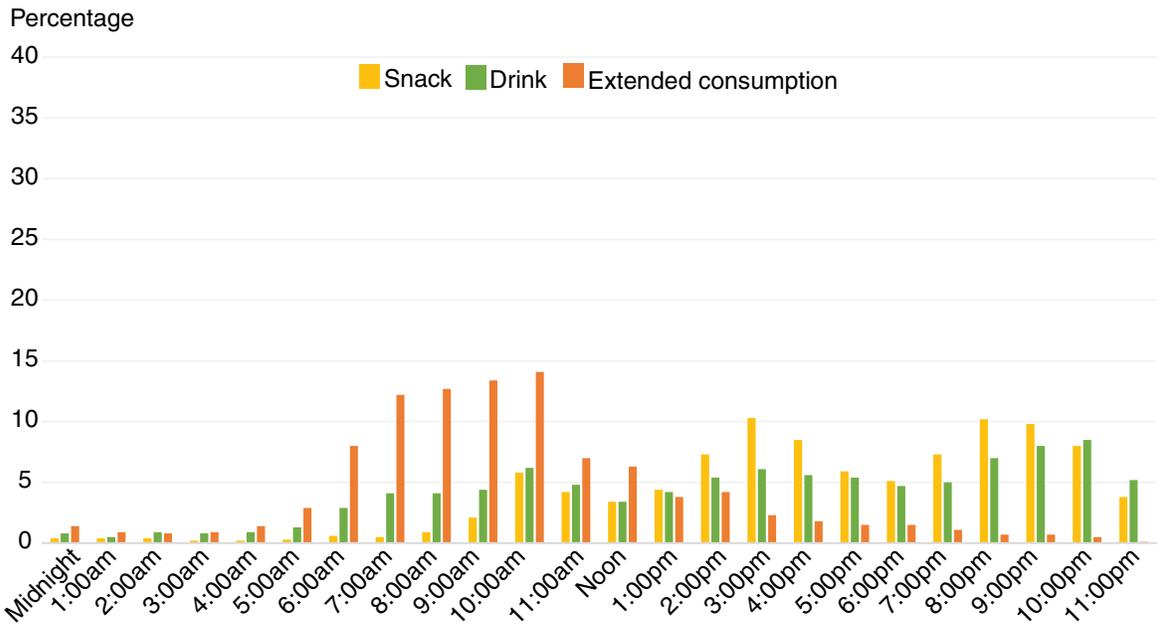
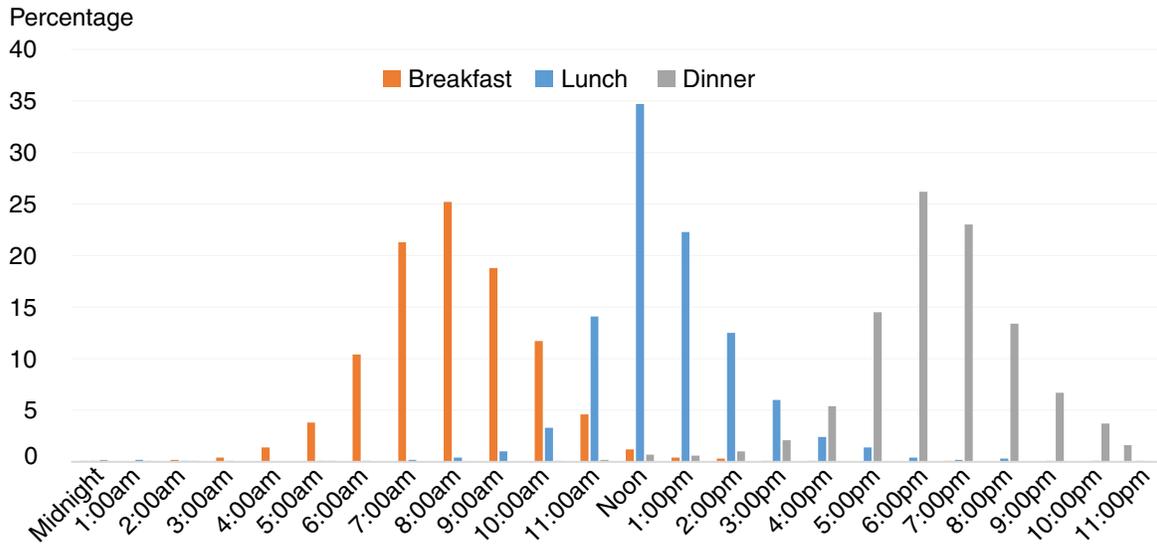
**Comparison of percentage of Americans who engaged in eating, ATUS-EHM versus NHANES day 1 and day 2, by time of day, on an average day in 2014-16 and 2013-16, age 18 and older**



Notes: Weighted means reported, using the NHANES dietary day 1 and day 2 sample weights and EHM survey sampling weights.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and the 2014-16 American Time Use Survey (ATUS) and Eating & Health Module (EHM).

**Percentage of Americans who engaged in meals and snacks, by time of day, on an average day in 2013-16, age 18 and older**

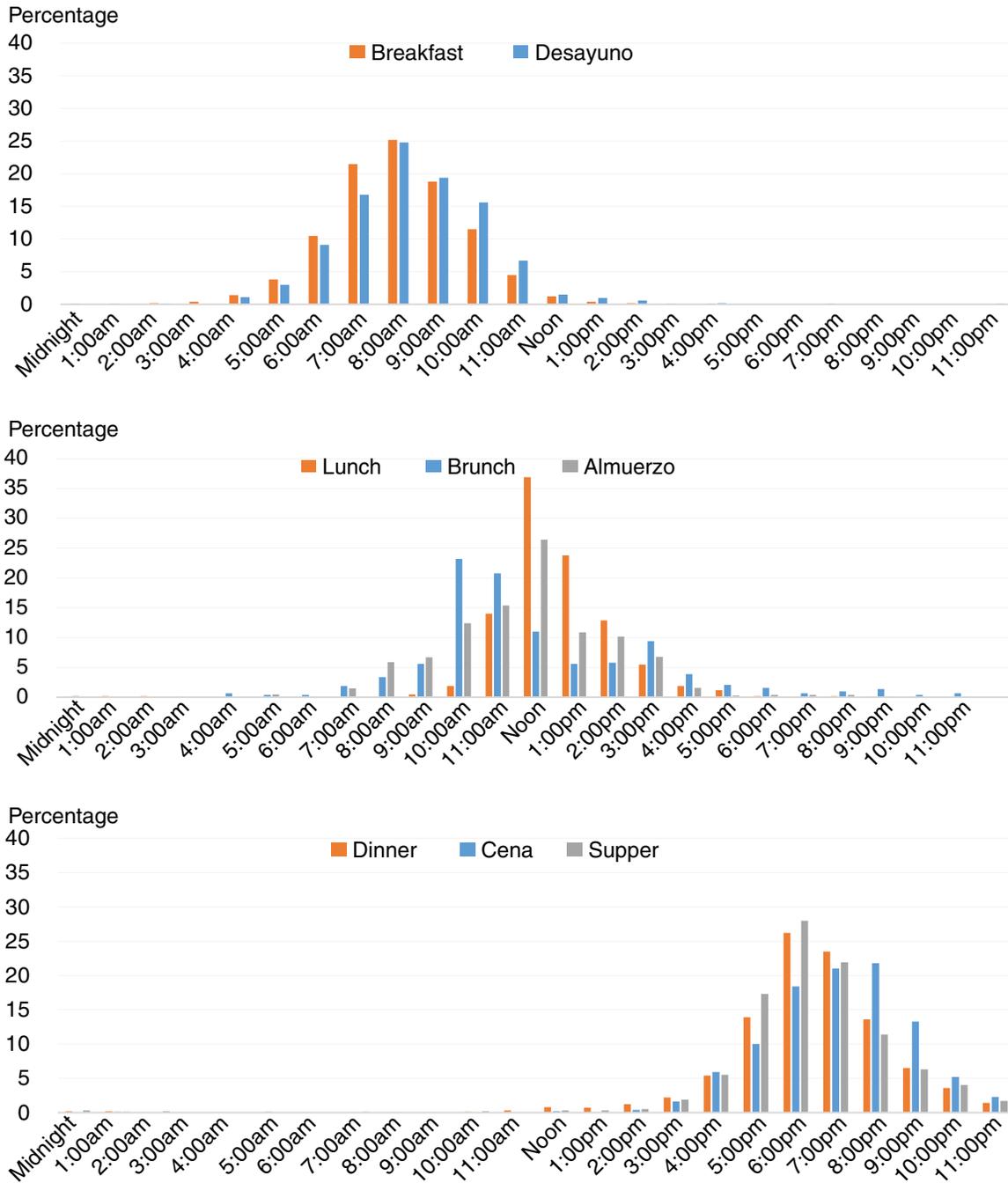


Notes: Weighted means reported, using the NHANES dietary day 1 sample weights.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES).

Appendix figure 4

**Percentage of Americans who engaged in English- and Spanish-named main meals, by time of day, on an average day in 2013-16 NHANES, age 18 and older**



Notes: Weighted means reported, using the NHANES dietary day 1 sample weights.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES).

Appendix table 4

**Number of eating occasions on an average day in 2014-16 (ATUS-EHM) and 2013-16 (NHANES) for various demographic subgroups, age 18 and older**

		ATUS-EHM (1)	NHANES (2)	Difference (1-2)	NHANES without drinks, extended consumption, and snacks (3)	Difference (1-3)
Gender	Male	2.7 (0.011)	5.6 (0.073)	<b>-2.90</b>	2.9 (0.024)	<b>-0.20</b>
	Female	2.8 (0.011)	5.8 (0.060)	<b>-3.00</b>	2.9 (0.016)	<b>-0.10</b>
Age (years)	18-24	2.6 (0.036)	5.1 (0.069)	<b>-2.50</b>	2.7 (0.038)	<b>-0.10</b>
	25-64	2.7 (0.009)	5.8 (0.069)	<b>-3.10</b>	2.9 (0.020)	<b>-0.20</b>
	65 and older	2.8 (0.018)	5.7 (0.069)	<b>-2.90</b>	2.9 (0.026)	<b>-0.10</b>
Ethnicity	Hispanic	2.6 (0.021)	5.4 (0.070)	<b>-2.80</b>	2.9 (0.021)	<b>-0.30</b>
	Non-Hispanic White	2.8 (0.009)	5.9 (0.068)	<b>-3.10</b>	2.9 (0.021)	<b>-0.10</b>
	Non-Hispanic Black	2.3 (0.028)	5.1 0.000	<b>-2.80</b>	2.7 0.000	<b>-0.40</b>
Education level	Lower than high school degree	2.4 (0.025)	5.3 (0.100)	<b>-2.90</b>	2.9 (0.044)	<b>-0.50</b>
	High school degree or GED	2.6 (0.016)	5.4 (0.078)	<b>-2.80</b>	2.9 (0.036)	<b>-0.30</b>
	Some college or associate's degree	2.7 (0.016)	5.8 (0.071)	<b>-3.10</b>	2.9 (0.018)	<b>-0.20</b>
	Bachelor's de- gree or higher	3.0 (0.012)	6.2 (0.075)	<b>-3.20</b>	3.0 (0.024)	<b>0.00</b>
Income	> 185% poverty line	2.5 (0.014)	5.4 (0.059)	<b>-2.90</b>	2.8 (0.019)	<b>-0.30</b>
	<= 185% poverty line	2.9 (0.010)	5.9 (0.067)	<b>-3.00</b>	3.0 (0.024)	<b>-0.10</b>
Body weight category*	Normal weight	2.9 (0.015)	5.9 (0.081)	<b>-3.00</b>	2.9 (0.030)	<b>0.00</b>
	Overweight	2.8 (0.015)	5.7 (0.071)	<b>-2.90</b>	2.9 (0.023)	<b>-0.10</b>
	Obese	2.6 (0.014)	5.7 (0.070)	<b>-3.10</b>	2.9 (0.026)	<b>-0.30</b>

—continued

**Number of eating occasions on an average day in 2014-16 (ATUS-EHM) and 2013-16 (NHANES) for various demographic subgroups, age 18 and older—continued**

		ATUS-EHM (1)	NHANES (2)	Difference (1-2)	NHANES without drinks, extended consumption, and snacks (3)	Difference (1-3)
Day of week	Weekend	2.6 (0.010)	5.6 (0.074)	<b>-3.00</b>	2.8 (0.026)	<b>-0.20</b>
	Weekday	2.8 (0.011)	5.8 (0.067)	<b>-3.00</b>	2.9 (0.020)	<b>-0.10</b>

Notes: GED = General Education Development. Weighted means reported, using the NHANES dietary day 1 sample weights and EHM survey sampling weights. Standard errors in parentheses account for complex survey design. Differences are in bold if they are statistically different from zero.

\*Body weight categories calculated for those age 20 and older, and education levels calculated for those age 25 and older. The body mass index (BMI) values associated with the body weight categories are normal weight, BMI of less than 24.9; overweight but not obese, BMI of 25-29.9; obese, BMI of 30 or above.

Source: USDA, Economic Research Service using data from the 2013-16 National Health and Nutrition Examination Survey (NHANES) and from the 2014-16 American Time Use Survey (ATUS) and the Eating & Health Module (EHM).