

Consumption of Ultraprocessed Foods and Body Fat Distribution Among U.S. Adults. Junxiu Liu, Eurídice Martínez Steele, Yan Li, Stella S Yi, Carlos A. Monteiro, Dariush Mozaffarian. American Journal of Preventive Medicine.

Appendix Material

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Appendix Text

Dietary Assessment

Dietary intake information for each participant is obtained through dietary interview component, called What We Eat in America (WWEIA). Dietary recall interviews were conducted in person by trained dietary interviewers in a private room in the Mobile Examination Center (MEC). Each MEC interview room has a standard set of measuring guidelines to help the participant report the volume and dimensions of the food items consumed. The second dietary interview for those who complete the in-person recall was added since 2002 and collected by telephone scheduled 3 to 10 days later for a more complete picture of the usual dietary intake. The computerized 5-Step Multiple-Pass Method (AMPM) is used for assisting collection 24-h dietary recalls in WWEIA to enhance complete and accurate food recall information and reduce participant burden. The AMPM would collect a list of foods and beverages consumed the previous day, probe for foods forgotten, collect time and eating occasion for each food, for each food, collect detailed descriptions, amount, and additions, and final probe for anything else consumed. All foods and beverages consumed during the previous 24 hours (midnight to midnight) were recorded. Major food groups were assessed by the US Department of Agriculture (USDA) Food Patterns Equivalents Database and MyPyramid Equivalents Database across different NHANES cycles. Nutrients were estimated according to cycle-specific versions of the USDA Food and Nutrition Database for Dietary Studies.

FOOD CLASSIFICATION ACCORDING TO PROCESSING

Food items were initially classified into 4 groups shown in Appendix Table 1. This was accomplished by taking into account, the following 3 variables from the NHANES recall databases: “Main Food Description”, “Additional Food Description” and “SR Code Description”. Thereafter, the food item classification was modified, if necessary, taking 2 variables into account: “Combination Food Type” and “Source of food”. Thus, most “Frozen meals” or “Lunchables” or food items consumed in “Restaurant fast food/pizza” or acquired at a “Vending machine”, were classified as ultra-processed foods.

As explained in the Subjects and Methods section, when Food Codes were judged to be a handmade recipe, the classification was applied to the underlying ingredients (SR Codes), to enable a more precise food item classification.¹

It must be noted, however, that SR Codes and their proportions are not necessarily the ingredients and proportions consumed by the participant. One of the reasons is that links between FNDDS and SR were developed to estimate the nutrient content of a Food Code and not the ingredient intake.²

Absence of data or discrepancies regarding degree of processing were solved opting for the lesser degree of processing (conservative criterion), which could have led to a slight underestimation of ultra-processed food consumption.

We classified homemade recipes with unknown ingredients based on expected principal ingredients, which could slightly underestimate ultra-processed food consumption.

Regarding bread, the classification distinguishes between handmade bread (either homemade or made in restaurants or artisanal bakeries), and industrial bread (made in industrial bakeries or factories), either processed (when made only of ingredients used in the making of handmade breads -flour, yeast, water, salt, and, sometimes, walnuts, dried fruits and other whole foods-) or ultra-processed (when adding substances not commonly used in the making of handmade breads -such as hydrogenated fat, sugars, starches, and additives). In our study, because of the large amount of industrial breads with unknown

ingredients (approximately 3.7% of all industrial bread had fully known ingredients in cycle 2009–2010) and the very low consumption of processed breads when ingredients were reported (approximately 2.3% of industrial breads were processed in cycle 2009–2010), we ended up classifying all industrial bread as ultra-processed foods. This might overestimate ultra-processed food consumption.

Assessing Energy and Added Sugar Contents

For some handmade recipes, the sum of the “calorie intake per SR Code” (calculated by us) of all underlying SR Codes did not add up exactly to the “calorie intake per Food Code” (provided by NHANES). In these cases, the “final calorie intake per SR code” was calculated as follows:

$$\frac{\text{Calculated Calorie intake per SR code}}{\sum_{n=1}^{\infty} \text{Calculated Calorie Intake per SR code}}$$

Appendix Table 1. Characteristics of participants included and excluded in the analysis, NHANES 2011-2018.

	Included (n=9640)	Excluded (n=3404)	P-value
Age (SD), years	39.0 (10.2)	41.2 (9.92)	<0.001
20-39	51.6	45.1	
40-59	48.4	54.9	
Sex			<0.001
Male	51.5	43.2	
Female	48.5	56.8	
Race/Ethnicity			<0.001
Non-Hispanic White	60.0	60.5	
Non-Hispanic Black	11.2	15.5	
Hispanic	18.4	15.2	
Non-Hispanic Asian	6.72	4.37	
Other	3.66	4.38	
Education level			0.49
Less than high school graduate	12.9	13.8	
High school graduate or GED	22.0	23.6	
Some college	33.3	33.0	
College graduate or above	31.7	29.6	
Ratio of family income to poverty level			0.01
<1.30	22.8	24.2	
1.30 to 3.49	32.2	29.6	
>=3.50	38.7	37.6	
Smoking status			0.27
Never	58.9	58.5	
Former	19.6	19.2	
Current smoker			
Some days	4.77	4.18	
<20 cigarettes/d	11.3	11.1	
≥20 cigarettes/d	5.40	6.97	
Physical active in METs-min (SD)	4593 (5698)	3939 (5315)	0.009

Abbreviations: NHANES, National Health and Examination Survey; METs-Min, metabolic equivalent

Appendix Table 2. Adjusted Association of Total Body %Fat with Quintiles of the Contribution of Ultra-Processed Foods to Total Energy Intake by Age Group, Sex, Race/Ethnicity, Education, and Income, NHANES 2011-2018.

Total body % fat	Regression coefficients (95% CI)					Predicted margins (95% CI)					P for trend	P-Interaction
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5		
Age												0.88
20-39y	0.0 (Ref)	0.54 (-0.23, 1.32)	1.26 (0.52, 2.0)	1.32 (0.41, 2.23)	1.76 (0.94, 2.59)	30.4 (29.7-31.1)	30.9 (30.3-31.6)	31.7 (31.1-32.2)	31.7 (31-32.4)	32.2 (31.6-32.7)	<0.001	
40-59y	0.0 (Ref)	0.41 (-0.44, 1.26)	0.97 (0.22, 1.73)	1.36 (-0.51, 2.21)	1.29 (0.49, 2.09)	33.1 (32.5-33.7)	33.5 (32.8-34.2)	34.1 (33.5-34.6)	34.5 (33.8-35.1)	34.4 (33.7-35.1)	<0.001	
Sex												0.19
Female	0.0 (Ref)	0.61 (-0.27, 1.48)	1.04 (-0.30, 1.78)	1.32 (0.39, 2.25)	1.80 (0.91, 2.70)	37.6 (36.9-38.2)	38.2 (37.5-38.9)	38.6 (38.1-39.1)	38.9 (38.1-39.6)	39.4 (38.7-40)	<0.001	
Male	0.0 (Ref)	0.33 (-0.44, 1.11)	1.30 (0.58, 2.02)	1.40 (0.56, 2.25)	1.35 (0.45, 2.25)	26.2 (25.6-26.8)	26.5 (25.9-27)	27.5 (27-27.9)	27.6 (27-28.2)	27.5 (26.9-28.1)	<0.001	
Race/ethnicity												0.001
Non-Hispanic White	0.0 (Ref)	0.83 (-0.11, 1.77)	1.62 (0.86, 2.38)	1.72 (0.77, 2.67)	1.85 (0.86, 2.84)	31.3 (30.6-32.0)	32.1 (31.4-32.8)	32.9 (32.4-33.4)	33.0 (32.4-33.7)	33.2 (32.4-33.9)	<0.001	
Non-Hispanic Black	0.0 (Ref)	-0.18 (-1.5, 1.12)	0.43 (-0.88, 1.73)	0.23 (-1.10, 1.5)	0.22 (-0.93, 1.36)	31.6 (30.5-32.8)	31.4 (30.7-32.2)	32.1 (31.2-32.9)	31.9 (31.1-32.6)	31.8 (31.2-32.5)	0.47	
Hispanic	0.0 (Ref)	0.38 (-0.34, 1.10)	0.58 (-0.27, 1.43)	0.98 (0.22, 1.74)	1.57 (0.68, 2.46)	33 (32.4-33.6)	33.4 (32.7-34)	33.6 (32.9-34.2)	34 (33.1-34.8)	34.5 (33.7-35.4)	<0.001	
Non-Hispanic Asian	0.0 (Ref)	-0.53 (-1.4, 0.37)	0.72 (-0.27, 1.71)	0.67 (-0.51, 1.84)	0.93 (-0.57, 2.42)	31.5 (31-32)	31 (30.1-31.8)	32.2 (31.2-33.2)	32.2 (31-33.3)	32.4 (30.8-34)	0.04	
Others		-0.42 (-2.8, 1.93)	-0.81 (-3.40, 1.81)	2.81 (0.46, 5.17)	1.83 (-0.32, 3.97)	31.8 (29.8-33.7)	31.3 (29.8-32.9)	30.9 (28.8-33.1)	34.6 (32.5-36.6)	33.6 (31.8-35.4)	0.004	
Education level												0.87
Less than high school	0.0 (Ref)	0.03 (-0.99, 1.05)	0.64 (-0.56, 1.83)	1.16 (0.10, 2.22)	1.33 (0.12, 2.55)	31.8 (30.9-32.7)	31.8 (30.8-32.8)	32.4 (31.5-33.3)	32.9 (32.1-33.8)	33.1 (32.1-34.1)	0.004	
High school graduate or GED	0.0 (Ref)	0.77 (-0.68, 2.21)	1.17 (-0.13, 2.48)	1.56 (0.24, 2.88)	1.73 (0.24, 3.22)	31.2 (29.9-32.5)	32.0 (31.1-32.9)	32.4 (31.5-33.4)	32.8 (31.9-33.7)	33.0 (32-33.9)	0.006	
Some college	0.0 (Ref)	-0.08 (-1.1, 0.94)	1.17 (0.27, 2.07)	1.18 (0.05, 2.32)	1.32 (0.34, 2.31)	32.5 (31.7-33.3)	32.5 (31.6-33.3)	33.7 (33.1-34.4)	33.7 (32.9-34.5)	33.9 (33-34.7)	0.002	
College graduate or above	0.0 (Ref)	0.84 (0.12, 1.57)	1.19 (0.38, 1.99)	1.26 (0.26, 2.25)	1.48 (0.41, 2.54)	31.3 (30.6-31.9)	32.1 (31.3-32.9)	32.4 (31.7-33.2)	32.5 (31.6-33.5)	32.7 (31.8-33.7)	0.003	
Ratio of family income to poverty level												0.04
<1.30	0.0 (Ref)	-0.47 (-1.8, 0.82)	-0.01 (-1.20, 1.17)	0.004 (-1.10, 1.08)	0.13 (-1.10, 1.38)	32.9 (32-33.9)	32.5 (31.6-33.3)	32.9 (32.2-33.7)	33 (32.1-33.8)	33.1 (32-34.2)	0.51	
1.30 to 3.49	0.0 (Ref)	1.37 (0.19, 2.54)	1.79 (0.84, 2.74)	1.62 (0.34, 2.90)	2.06 (1.0, 3.11)	31.3 (30.3-32.3)	32.6 (31.9-33.4)	33.1 (32.4-33.7)	32.9 (32-33.8)	33.3 (32.7-34)	<0.001	
>=3.50	0.0 (Ref)	0.10 (-0.77, 0.98)	1.12 (0.32, 1.92)	1.71 (0.71, 2.70)	1.94 (0.72, 3.16)	31.6 (30.9-32.2)	31.7 (31-32.4)	32.7 (32.1-33.3)	33.3 (32.4-34.1)	33.5 (32.6-34.5)	<0.001	

Data were weighted to be nationally representative and adjusted for age (years), sex (male, female), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and others), education (less than high school, high school graduate or GED, some college, or college graduate or above), and the ratio of family income to poverty (<1.30, 1.30–3.49, and ≥3.5), smoking status (never smoker, former smoker, and smokers smoking for some days and smokers smoking daily less than 20 cigarettes per day and equal or larger than 20 cigarettes per day), and physical activity (METs-Min) except the corresponding subgroup variables. Individuals with missing data on education (n=2), income (n=727), physical activity (n=1), and smoking (n=9) was created as a special category.

Appendix Table 3. Adjusted Association of Android Body %Fat with Quintiles of the Contribution of Ultra-Processed Foods to Total Energy Intake by Age Group, Sex, Race/Ethnicity, Education, and Income, NHANES 2011-2018.

Android body % fat	Regression coefficients (95% CI)					Predicted margins (95% CI)					P for trend	P-Interaction	
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5			
Age													0.42
20-39y	0.0 (Ref)	0.26 (-0.74, 1.27)	1.44 (0.44, 2.44)	1.66 (0.51, 2.81)	2.01 (0.95, 3.06)	32.2 (31.2-33.1)	32.4 (31.6-33.2)	33.6 (32.9-34.3)	33.8 (33-34.7)	34.2 (33.4-34.9)	<0.001		
40-59y	0.0 (Ref)	0.33 (-0.81, 1.48)	1.40 (0.51, 2.30)	1.73 (0.68, 2.78)	2.06 (0.99, 3.13)	35.3 (34.6-36)	35.6 (34.8-36.5)	36.7 (36.1-37.3)	37 (36.2-37.8)	37.4 (36.6-38.1)	<0.001		
Sex													0.03
Female	0.0 (Ref)	0.26 (-0.86, 1.37)	1.43 (0.50, 2.37)	1.81 (0.65, 2.97)	2.38 (1.28, 3.47)	37.2 (36.4-38)	37.5 (36.5-38.4)	38.6 (37.9-39.3)	39 (38-40)	39.6 (38.8-40.4)	<0.001		
Male	0.0 (Ref)	0.38 (-0.62, 1.39)	1.59 (0.58, 2.59)	1.70 (0.54, 2.86)	1.76 (0.59, 2.93)	30.3 (29.4-31.1)	30.7 (30-31.4)	31.9 (31.2-32.5)	32.0 (31.2-32.7)	32.0 (31.3-32.8)	<0.001		
Race/ethnicity													0.006
Non-Hispanic White	0.0 (Ref)	0.62 (-0.61, 1.84)	1.93 (0.92, 2.94)	2.15 (0.99, 3.3)	2.35 (1.11, 3.58)	33 (32-34)	33.6 (32.7-34.5)	34.9 (34.3-35.5)	35.1 (34.4-35.9)	35.3 (34.4-36.2)	<0.001		
Non-Hispanic Black	0.0 (Ref)	-0.20 (-1.80, 1.42)	0.79 (-0.83, 2.41)	0.61 (-0.83, 2.06)	0.51 (-0.85, 1.86)	33.1 (31.8-34.4)	32.9 (32-33.9)	33.9 (32.7-35.1)	33.7 (32.8-34.6)	33.6 (32.8-34.4)	0.17		
Hispanic	0.0 (Ref)	0.46 (-0.52, 1.45)	1.06 (-0.06, 2.17)	1.51 (0.40, 2.61)	2.12 (0.89, 3.35)	35.8 (35.1-36.6)	36.3 (35.5-37)	36.9 (36-37.7)	37.3 (36.2-38.4)	37.9 (36.8-39)	<0.001		
Non-Hispanic Asian	0.0 (Ref)	-0.67 (-1.80, 0.49)	1.22 (0.03, 2.40)	1.12 (-0.50, 2.73)	1.83 (-0.39, 4.05)	33.8 (33.1-34.4)	33.1 (32-34.2)	35 (33.9-36.1)	34.9 (33.3-36.4)	35.6 (33.3-37.9)	0.007		
Others		-1.50 (-4.3, 1.33)	-1.30 (-4.70, 2.05)	1.96 (-1.0, 4.93)	1.29 (-1.80, 4.38)	34.8 (32.4-37.1)	33.3 (31.5-35.1)	33.4 (31-35.9)	36.7 (34.6-38.8)	36 (33.6-38.4)	0.06		
Education level													0.96
Less than high school	0.0 (Ref)	-0.26 (-1.50, 0.96)	0.66 (-0.87, 2.18)	1.46 (0.09, 2.84)	1.25 (-0.16, 2.66)	34.4 (33.4-35.5)	34.2 (33-35.3)	35.1 (34-36.2)	35.9 (34.8-37)	35.7 (34.6-36.8)	0.01		
High school graduate or GED	0.0 (Ref)	0.99 (-0.94, 2.91)	1.48 (-0.28, 3.24)	1.98 (0.28, 3.69)	2.23 (0.37, 4.08)	33.4 (31.9-35)	34.4 (33.2-35.6)	34.9 (33.7-36.1)	35.4 (34.4-36.4)	35.6 (34.6-36.7)	0.004		
Some college	0.0 (Ref)	-0.44 (-1.90, 0.98)	1.48 (0.20, 2.76)	1.22 (-0.26, 2.69)	1.49 (0.12, 2.86)	34.7 (33.6-35.8)	34.2 (33.1-35.3)	36.2 (35.3-37)	35.9 (34.9-36.8)	36.2 (35.1-37.2)	0.006		
College graduate or above	0.0 (Ref)	0.70 (-0.33, 1.74)	1.66 (0.37, 2.94)	1.96 (0.51, 3.41)	2.53 (1.0, 4.06)	32.6 (31.7-33.6)	33.4 (32.4-34.3)	34.3 (33.3-35.3)	34.6 (33.4-35.8)	35.2 (33.9-36.5)	<0.001		
Ratio of family income to poverty level													0.03
<1.30	0.0 (Ref)	-0.97 (-2.60, 0.71)	-0.36 (-2.0, 1.25)	0.14 (-1.20, 1.47)	-0.05 (-1.70, 1.58)	35.1 (33.9-36.3)	34.1 (33.1-35.1)	34.8 (33.8-35.7)	35.2 (34.2-36.3)	35.1 (33.7-36.4)	0.50		
1.30 to 3.49	0.0 (Ref)	1.36 (-0.11, 2.83)	2.53 (1.21, 3.84)	2.01 (0.41, 3.61)	2.62 (1.19, 4.05)	33.1 (31.9-34.3)	34.4 (33.5-35.4)	35.6 (34.7-36.5)	35.1 (34-36.2)	35.7 (34.8-36.6)	<0.001		
>=3.50	0.0 (Ref)	-0.002 (-1.1, 1.1)	1.56 (0.43, 2.68)	2.14 (0.86, 3.42)	2.90 (1.37, 4.43)	33.6 (32.7-34.4)	33.6 (32.6-34.5)	35.1 (34.4-35.9)	35.7 (34.7-36.7)	36.5 (35.3-37.7)	<0.001		

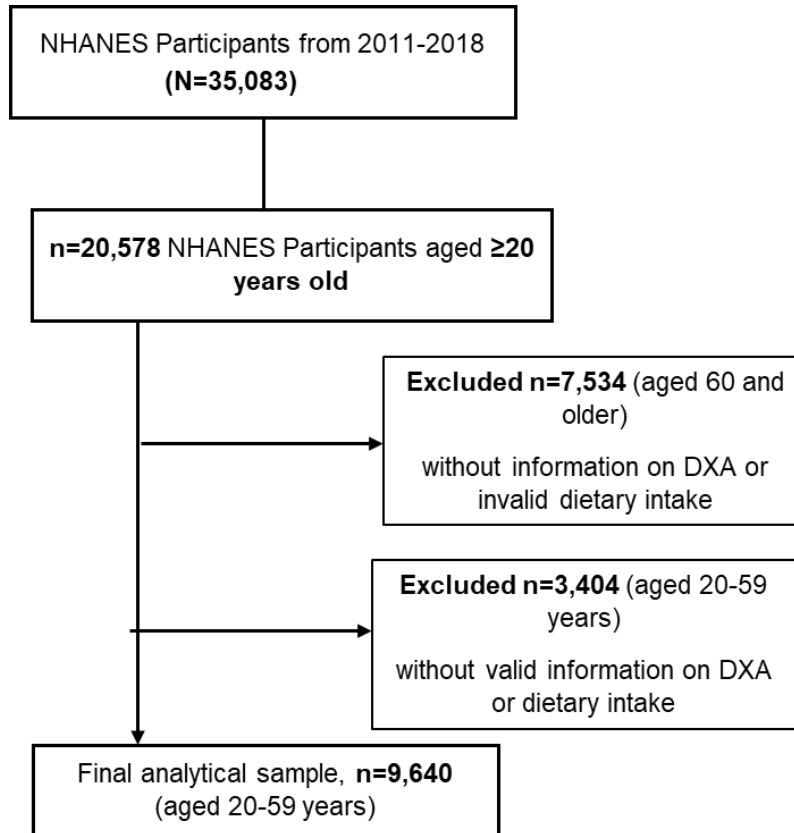
Data were weighted to be nationally representative and adjusted for age (years), sex (male, female), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and others), education (less than high school, high school graduate or GED, some college, or college graduate or above), and the ratio of family income to poverty (<1.30, 1.30–3.49, and ≥3.5), smoking status (never smoker, former smoker, and smokers smoking for some days and smokers smoking daily less than 20 cigarettes per day and equal or larger than 20 cigarettes per day), and physical activity (METs-Min) except the corresponding subgroup variables. Individuals with missing data on education (n=2), income (n=727), physical activity (n=1), and smoking (n=9) was created as a special category.

Appendix Table 4. Adjusted Association of Gynoid Body %Fat with Quintiles of the Contribution of Ultra-Processed Foods to Total Energy Intake by Age Group, Sex, Race/Ethnicity, Education, and Income, NHANES 2011-2018.

Gynoid body % fat	Regression coefficients (95% CI)					Predicted margins (95% CI)					P for trend	P-Interaction
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5		
Age												
20-39y	0.0 (Ref)	0.70 (-0.02, 1.42)	1.11 (0.44, 1.78)	1.23 (0.44, 2.02)	1.58 (0.84, 2.31)	33.6 (33.3-34.2)	34.3 (33.7-34.8)	34.7 (34.1-35.2)	34.8 (34.1-35.4)	35.1 (34.6-35.6)	<0.001	0.86
40-59y	0.0 (Ref)	0.59 (-0.11, 1.30)	0.98 (0.27, 1.69)	1.10 (0.34, 1.87)	0.89 (0.12, 1.66)	35.2 (34.6-35.8)	35.8 (35.2-36.4)	36.2 (35.7-36.7)	36.3 (35.6-36.9)	36.1 (35.4-36.7)	0.005	
Sex												0.67
Female	0.0 (Ref)	0.78 (0.001, 1.55)	1.09 (0.40, 1.78)	1.05 (0.25, 1.85)	1.42 (0.59, 2.25)	41.3 (40.7-41.9)	42.1 (41.6-42.6)	42.4 (41.9-42.9)	42.4 (41.8-42.9)	42.7 (42.1-43.3)	<0.001	
Male	0.0 (Ref)	0.50 (-0.22, 1.22)	1.11 (0.49, 1.74)	1.33 (0.61, 2.06)	1.16 (0.36, 1.96)	27.7 (27.2-28.2)	28.2 (27.7-28.8)	28.9 (28.4-29.3)	29.1 (28.5-29.7)	28.9 (28.4-29.4)	<0.001	
Race/ethnicity												0.0027
Non-Hispanic White	0.0 (Ref)	1.12 (0.24, 1.99)	1.69 (1.02, 2.37)	1.66 (0.84, 2.48)	1.69 (0.80, 2.58)	34 (33.4-34.6)	35.1 (34.5-35.8)	35.7 (35.2-36.2)	35.7 (35.1-36.3)	35.7 (35.3-36.4)	<0.001	
Non-Hispanic Black	0.0 (Ref)	-0.08 (-1.30, 1.16)	0.19 (-0.87, 1.24)	0.35 (-0.77, 1.47)	0.18 (-0.77, 1.13)	34 (33.1-35)	33.9 (33.1-34.7)	34.2 (33.4-35)	34.4 (33.7-35.1)	34.2 (33.5-34.9)	0.42	
Hispanic	0.0 (Ref)	0.44 (-0.24, 1.12)	0.42 (-0.37, 1.2)	0.70 (0.08, 1.31)	1.12 (0.16, 2.09)	35.3 (34.6-35.9)	35.7 (35.1-36.3)	35.7 (35.3-36.4)	36 (35.3-36.7)	36.4 (35.4-37.4)	0.009	
Non-Hispanic Asian	0.0 (Ref)	-0.44 (-1.3, 0.41)	0.24 (-0.66, 1.14)	0.27 (-0.81, 1.35)	-0.16 (-1.6, 1.25)	34.3 (33.8-34.9)	33.9 (33.1-34.7)	34.6 (33.7-35.4)	34.6 (33.5-35.7)	34.2 (32.7-35.7)	0.72	
Others	0.0 (Ref)	0.03 (-2.5, 2.54)	-0.35 (-2.8, 2.08)	2.07 (-0.22, 4.37)	1.31 (-0.70, 3.31)	34.3 (32.4-36.1)	34.3 (32.7-35.9)	33.9 (31.9-35.9)	36.3 (34.3-38.4)	35.6 (33.9-37.2)	0.03	
Education level												0.49
Less than high school	0.0 (Ref)	0.48 (-0.50, 1.47)	0.72 (-0.47, 1.9)	1.14 (0.29, 2.0)	1.64 (0.46, 2.82)	33.8 (33-34.7)	34.3 (33.4-35.2)	34.5 (33.6-35.5)	35 (34.2-35.8)	35.5 (34.5-36.5)	<0.001	
High school graduate or GED	0.0 (Ref)	0.88 (-0.43, 2.2)	1.11 (-0.02, 2.24)	1.59 (0.46, 2.71)	1.68 (0.37, 2.99)	33.7 (32.5-34.8)	34.5 (33.6-35.5)	34.8 (33.9-35.6)	35.2 (34.4-36.1)	35.3 (34.4-36.2)	0.003	
Some college	0.0 (Ref)	0.25 (-0.59, 1.08)	1.29 (0.49, 2.09)	1.17 (0.17, 2.16)	1.14 (0.24, 2.05)	34.9 (34.2-35.6)	35.2 (34.4-36)	36.2 (35.6-36.8)	36.1 (35.4-36.8)	36.1 (35.3-36.9)	0.01	
College graduate or above	0.0 (Ref)	0.85 (0.15, 1.56)	0.97 (0.31, 1.64)	0.89 (0.09, 1.69)	0.73 (-0.15, 1.61)	34.4 (33.8-35)	35.3 (34.5-36)	35.4 (34.7-36)	35.3 (34.5-36.1)	35.1 (34.4-35.9)	0.04	
Ratio of family income to poverty level												0.06
<1.30	0.0 (Ref)	0.25 (-0.95, 1.45)	0.55 (-0.44, 1.55)	0.33 (-0.63, 1.30)	0.39 (-0.62, 1.4)	35.1 (34.3-35.9)	35.3 (34.5-36.2)	35.6 (35-36.3)	35.4 (34.7-36.1)	35.5 (34.5-36.5)	0.44	
1.30 to 3.49	0.0 (Ref)	1.38 (0.26, 2.5)	1.46 (0.55, 2.37)	1.41 (0.18, 2.64)	1.77 (0.69, 2.84)	34 (33-35)	35.4 (34.7-36.1)	35.5 (34.9-36.1)	35.4 (34.6-36.2)	35.8 (35.1-36.4)	0.005	
>=3.50	0.0 (Ref)	0.19 (-0.62, 0.99)	0.97 (0.29, 1.64)	1.37 (0.51, 2.23)	1.41 (0.37, 2.45)	34.3 (33.7-34.9)	34.5 (33.8-35.2)	35.3 (34.7-35.9)	35.7 (34.9-36.5)	35.7 (34.9-36.5)	<0.001	

Data were weighted to be nationally representative and adjusted for age (years), sex (male, female), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and others), education (less than high school, high school graduate or GED, some college, or college graduate or above), and the ratio of family income to poverty (<1.30, 1.30–3.49, and ≥3.5), smoking status (never smoker, former smoker, and smokers smoking for some days and smokers smoking daily less than 20 cigarettes per day and equal or larger than 20 cigarettes per day), and physical activity (METs-Min) except the corresponding subgroup variables. Individuals with missing data on education (n=2), income (n=727), physical activity (n=1), and smoking (n=9) was created as a special category.

Appendix Figure 1. NHANES 2011-2018 analytic sample flow chart



Abbreviation: NHANES, National Health and Nutrition Examination Survey; DXA, dual-energy x-ray absorptiometry.

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