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Epidemiology/Genetics

COVID-19 pandemic and stay-at-home mandates promote weight gain in US adults

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Abstract

Objective: The purpose of this study was to prospectively examine the effect of state stay-at-home mandates on weight of US adults by BMI over 3 months during COVID-19.

Methods: US adults completed an online questionnaire containing demographics, weight, physical activity, sedentary time, fruit/vegetable intake, depressive symptoms, stress, and sleep at baseline (May 2020) and after 3 months (August 2020).

Results: Participants gained 0.6 kg (76.7-77.3 kg, $p = 0.002$). A total of 26% of those with obesity gained > 2 kg compared with 14.8% of those with normal weight ($p < 0.001$). A total of 53.3% of individuals with obesity maintained weight within 2 kg compared with 72.5% of those with normal weight ($p < 0.001$). Greater weight gain was related to longer stay-at-home mandates ($\beta = 0.078$, $p = 0.010$), lower baseline minutes of physical activity per day ($\beta = -0.107$, $p = 0.004$), greater declines in minutes of physical activity per day ($\beta = -0.076$, $p = 0.026$), depressive symptoms ($\beta = 0.098$, $p = 0.034$), and greater increases in time preparing food ($\beta = 0.075$, $p = 0.031$).

Conclusions: US adults gained weight, and stay-at-home mandates were associated with atypical weight gain and greater reported weight gain in individuals with obesity over 3 months.

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), commonly known as COVID-19, quickly resulted in an unpredictable global health crisis. In order to slow the spread of the virus, United States (US) state-issued stay-at-home mandates became widespread, but the duration varied by state (1). Essential activities such as medical visits and grocery shopping were allowed, but the varying state mandates might have had unintended negative consequences of altering behaviors and ultimately promoting weight gain. For example, in March 2020, FitBit Inc. reported a 12% reduction in step count in the US (2). Bracale and Vaccaro showed reduced fresh food consumption with stay-at-home measures (3). Additionally, previous studies have shown that life-altering events may disproportionately impact individuals with obesity and overweight, thereby promoting more weight gain (4). It is possible that stay-at-home mandates and self-isolation may have negatively affected depressive symptoms, stress, sleep, and other psychosocial factors, further impacting weight gain over time, particularly in individuals with obesity (5,6).

One recent longitudinal study using Bluetooth-connected weight scales reported weight gain of 0.27 kg every 10 days during mandates (7). Two observational studies have shown that US adults reported weight gain during the pandemic at a rate higher than typically seen in US adults (0.3 kg/y) (6,8-10). However, these studies were cross-sectional or retrospective in nature and/or did not assess possible predictors of weight gain.

Therefore, the purpose of this longitudinal study was to examine the effect of state-ordered stay-at-home mandates on the weight of US adults and by BMI over 3 months. We hypothesized more weight gain during stay-at-home mandates than typically seen over

3 months in US adults, and that individuals with overweight and obesity would report more weight gain than those with normal weight. Second, we explored predictors and correlates of weight change, including behaviors (physical activity, sedentary time, and fruit and vegetable consumption), depressive symptoms, stress, and sleep, over 3 months.

Study Importance

What is already known?

- Previous research has shown that COVID-19-related mandates are associated with body weight gain, and that this gain may disproportionately affect individuals with overweight or obesity.

What does this study add?

- Longer mandate length was associated with more 3-month weight gain.
- Greater weight gain was related to more depressive symptoms and engaging in less physical activity and more time preparing food.

How might these results change the direction of research or the focus of clinical practice?

- Future research is needed to examine long-term effects of stay-at-home orders on weight and related behavioral and psychosocial parameters to inform potential targets of lifestyle interventions.

METHODS

This study was approved by the Institutional Review Board at California Polytechnic State University before any data were collected and was performed in accordance with the Declaration of Helsinki. All participants gave online consent. Recruiting was completed through Qualtrics Research Panels (Qualtrics International Inc.) and Research Match (researchmatch.org, Vanderbilt University Medical Center). Participants were recruited across the US in all 50 states, with a majority from California (15%), New York (9%), Ohio (7%), and Florida (5%). In order to be included in Qualtrics and Research Match databases, participants must have lived in the US, had internet access, and had a valid email. Additional participant eligibility included adults ≥ 18 years of age and those who were able to read English at a fifth grade level based on self-report. Qualtrics and Research Match use randomizer functions to match individuals who have agreed to be added to databases with institutional research surveys. Once contacted, a link to the consent form and a questionnaire was sent using Qualtrics Survey Software.

In this observational cohort study, the survey was sent to the same participants on two occasions, first in May 2020 and an identical follow-up survey sent to completers of the first survey in August 2020. The first pandemic-related mandates occurred on March 19, 2020, when California implemented statewide stay-at-home mandates, with most states following closely behind. The survey comprised questions grouped in four domains, including demographics and body weight, psychosocial measures, diet, and physical activity. For each completed survey, participants recruited through Research Match were entered into a raffle to win a $100 gift card. Participants recruited through Qualtrics Research Panels were compensated $10 by Qualtrics for each completed questionnaire. All participants were given the option to omit any questions they did not feel comfortable answering.

Demographics and weight

Basic demographic information was collected, including age, sex, race, ethnicity, income, education, smoking habits, and marital status. Length of state-mandated pandemic-related restrictions was determined using the Johns Hopkins Coronavirus Resource Center (11). Mandate length was measured from the beginning of the participants' state-issued mandate to the date of reopening within the 3-month time frame of the study. Height at baseline and weight at both time points were self-reported (12). BMI (kilograms per meters squared) was calculated and used to categorize weight status (underweight: < 18.5; healthy weight: 18.5-24.9; overweight: 25-29.9; obesity: ≥ 30). Weight change was computed as the difference between study entry and 3 months. As in previous literature, weight change was used to classify participants into four categories: those who lost more than 2 kg, those who maintained weight between ±2 kg, those who gained any weight (>0 kg), and those who gained more than 2 kg (13).

Psychosocial measures

Depressive symptoms was measured using the Center for Epidemiological Studies Depression Scale (CES-D) (14). The questionnaire focuses on feelings and behaviors during the previous week. Responses range from "rarely or none of the time" to "most or all of the time." Higher composite scores represent the presence of more symptomatology, with possible scores ranging from 0 to 60. CES-D scores of 16 or more are often used as criteria for risk of depression. Stress was measured using the four-item Perceived Stress Scale (15). The questionnaire focuses on feelings and thoughts during the previous month and requires respondents to indicate how often they have felt a variety of stressors, ranging from "never" to "very often." Higher composite scores indicate higher stress levels, with possible scores ranging from 0 to 16. Perceived vulnerability to COVID-19 was assessed as a

sum of responses to five questions regarding chances and seriousness of infection, frequency of worrying of infection, perception of controlling infection, and ability to prevent infection. Five response options were provided, ranging from "not at all" to "very likely," which were subsequently numbered from 1 to 5 and then summed. Higher scores represent increased worry of COVID-19 infection.

Diet

Dietary habits were measured using the National Cancer Institute's Fruit and Vegetable Screener (16). Five questions regarding frequency of fruit and vegetable intake were used to create a composite score of ingestion over the prior 7 days. Responses ranged from "never" to "5+ times per day," which were given numerical values and then summed. Higher scores indicate more consumption of fruits and vegetables, with possible scores ranging from 0 to 30. Participants were also asked to estimate how many sodas and alcoholic beverages they consumed over the previous week as well as how many hours each day were spent on food preparation and cooking.

Physical activity, sedentary time, and sleep

Physical activity and sedentary time were measured using the 2017 Nurses' Health Study Physical Activity Questionnaire (17). For physical activity, participants were asked to estimate how much time during the past week they spent walking, jogging, running, performing other aerobic exercise, lower intensity exercise, other vigorous activity, and/or weight training each day. For sedentary time, participants estimated how much time during the past week they spent sitting, either away from or at home. Physical activity response options ranged from 0 to 11+ hours per day, and sedentary time response options ranged from 0 to 15+ hours per day. Hours were converted to minutes to create a composite score representing how many minutes of physical activity or sedentary time participants performed in the past week. Amount of sleep was estimated using a sliding bar scale; participants were asked to drag a bar to the number representing the average hours of sleep per night in the past week.

Statistical analysis

All data were analyzed using JMP Pro 15 (SAS Institute). Summary statistics are reported as mean (SD). In order to ensure data quality, a preliminary exploratory data analysis was carried out for each of the study variables to look for outliers and ensure reported values were within logical ranges. Individual response values outside the range specifications (n = 402) were recoded as missing and were excluded from statistical models. Only participants who completed both the baseline and 3-month time points were included in the analysis. χ^2 and t tests were used to assess demographic differences between respondents to only the baseline time point and respondents to baseline and 3-month time points. A paired t test was used to assess unadjusted changes in weight from baseline to 3 months, and a χ^2 test with Bonferroni correction was used to assess differences in the percentage of each BMI category that lost >2 kg, maintained weight within 2 kg, and gained >2 kg (18). A paired t test was also used to assess unadjusted changes in all diet, physical activity, and psychosocial variables. A multivariate regression was used to assess relationships between state-ordered stay-at-home mandate length, baseline body weight, demographics, psychosocial measures, diet, physical activity, sedentary time, sleep, and weight change during the 3-month interval. Predictors with highly skewed distributions (baseline and change in minutes of physical activity, baseline and change in time spent preparing food, and baseline and change in frequency of fruit and vegetable intake) were log-transformed to symmetry to prevent skewed values from exerting high leverage on regression estimates. Statistical significance for all analyses was set a priori at $p < 0.05$.

RESULTS

Participant characteristics and demographics are presented in Table 1. A total of 4,088 potential participants were initially contacted, and 2,968 participants responded. A total of 640 of the responses were collected through Qualtrics, and the remaining 2,328 responses were collected through Research Match. Of the 2,968 respondents to the baseline survey, a total of 1,516 (51%) participants completed the 3-month follow-up. Demographics of baseline respondents (N = 2,968) were similar to participants who completed both time points. Participants who responded to both time points were mainly female (78.8%), non-Hispanic (95.4%), White (86.7%), and varied in income, education, and BMI status (Table 1). There were differences in age, sex, education, marital status, race, body weight, and ethnicity between baseline-only respondents and respondents to both time points ($p < 0.05$).

On average, self-reported body weight modestly increased (+0.6 [0.5] kg) from baseline to 3-months (t = 3.06, p = 0.002, Figure 1). Approximately 30% of participants reported weight gain (>0 kg). A significantly higher percentage of individuals with obesity gained more than 2 kg (26%) compared with individuals of normal weight (14.8%; $p < 0.001$, Figure 2). A significantly lower percentage of individuals with obesity maintained weight within 2 kg (53.3%) compared with individuals of normal weight (72.5%; $p < 0.001$, Figure 2). A total of 18.4% of participants reported significant weight gain of more than 2 kg, 15.9% lost more than 2 kg, and 65.7% maintained weight within 2 kg after 3 months. From baseline to 3 months, depressive symptoms significantly increased, stress modestly decreased, and physical activity minutes per day and sleep decreased ($p < 0.05$; Table 2).

TABLE 1 Participant demographics

	Baseline-only respondents	Baseline and 3-month respondents	Total respondents
N	1,452	1,516	2,968
Sex, *n* (%)			
Male	373 (25.6)*	322 (21.2)	693 (23.3)
Female	1,079 (74.4)*	1,193 (78.8)	2,274 (76.6)
Prefer not to answer	0 (0.0)	1 (<0.1)	1 (<0.1)
Hispanic or Latino, *n* (%)			
Yes	119 (8.2)*	70 (4.6)	189 (6.4)
No	1,331 (91.8)*	1,445 (95.4)	2,776 (93.6)
Not reported	2 (<0.1)	1 (<0.1)	3 (<0.1)
Race/ethnicity (participants could select multiple), *n* (%)			
White	1,195 (82.3)*	1,315 (86.7)	2,510 (84.6)
Asian	81 (5.6)	79 (5.2)	160 (5.4)
Black or African American	108 (7.4)*	69 (4.6)	177 (5.9)
American Indian or Alaska Native	27 (1.9)	25 (1.7)	52 (1.8)
Native Hawaiian or Pacific Islander	5 (0.3)	2 (0.1)	7 (0.2)
Other	33 (2.3)	25 (1.7)	58 (2.0)
Not reported	3 (0.2)	1 (<0.1)	4 (<0.1)
Marital status, *n* (%)			
Divorced/separated	152 (10.6)	171 (11.3)	324 (10.9)
Married	559 (38.4)*	691 (45.5)	1,248 (42.1)
Not married and living with significant other	146 (10.1)	140 (9.2)	286 (9.6)
Single/never married	548 (37.8)*	455 (30.0)	1,004 (33.8)
Widowed	46 (3.2)	59 (3.9)	105 (3.5)
Not reported	1 (<0.1)	0 (0.0)	1 (<0.1)
Annual household income, *n* (%)			
$0-$24,999	198 (13.6)	170 (11.2)	368 (12.3)
$25,000-$49,999	245 (16.9)	252 (16.6)	498 (16.7)
$50,000-$74,999	303 (20.8)	304 (20.0)	606 (20.3)
$75,000-$99,999	184 (12.7)	236 (15.6)	420 (14.1)
$100,000-$149,999	256 (17.6)	275 (18.2)	531 (17.8)
$150,000 and above	244 (16.8)	249 (16.4)	493 (16.5)
Not reported	22 (1.5)	30 (1.9)	52 (2.2)
Education, *n* (%)			
Grades 0-8	2 (0.1)	1 (<0.1)	3 (0.1)
Some high school (grades 9-11)	16 (1.1)*	5 (0.3)	21 (0.7)
High school diploma/GED	193 (13.3)*	118 (7.8)	312 (10.5)
Completed certificate, business, or technical school	46 (3.2)	41 (2.7)	87 (2.9)
Currently enrolled in or 1-3 years of college	176 (12.1)*	87 (5.7)	263 (8.9)
Associate's degree in college (2-year)	135 (9.3)	112 (7.4)	247 (8.3)
Bachelor's degree in college (4-year)	496 (34.1)	534 (35.2)	1,029 (34.7)
Postgraduate degree	388 (26.7)*	617 (40.7)	1,005 (33.9)
Not reported	0 (0.0)	1 (<0.1)	1 (<0.1)
Age (y), mean ± SD	40.7 ± 16.9*	46.7 ± 17.6	43.8 ± 17.5
Weight (kg), mean ± SD	75.1 ± 21.8*	76.7 ± 21.6	75.9 ± 21.7
Height (m), mean ± SD	1.7 ± 0.1	1.7 ± 0.1	1.7 ± 0.1

(Continues)

TABLE 1 (Continued)

	Baseline-only respondents	Baseline and 3-month respondents	Total respondents
BMI (kg/m^2), mean ± SD	26.5 ± 7.2*	27.1 ± 6.8	26.9 ± 7.1
BMI category, *n* (%)			
Underweight	53 (3.8)	43 (2.9)	96 (3.3)
Normal weight	658 (46.5)	652 (43.4)	1,308 (44.9)
Overweight	390 (27.6)	406 (27.1)	796 (27.3)
Obesity	312 (22.1)	399 (26.7)	713 (24.5)
Not reported	39 (2.7)	16 (1.1)	55 (1.9)

Abbreviations: GED, general equivalency diploma.

*Indicates variable is significantly different from completers of both baseline and 3-month time points.

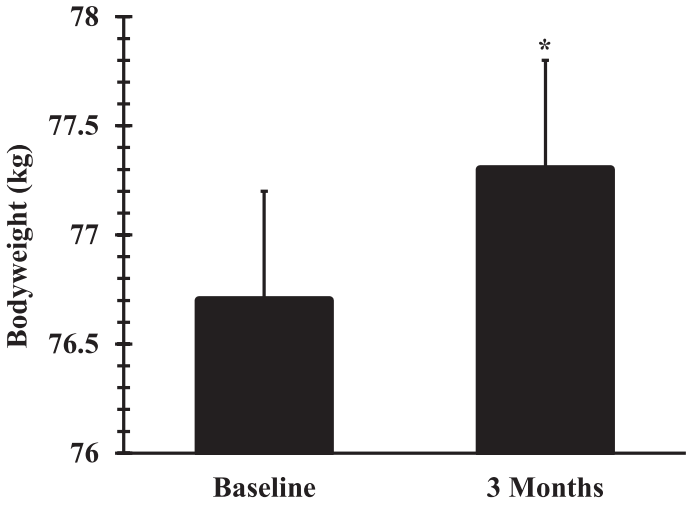

FIGURE 1 Body weight (kilograms) at baseline and 3 months. *Indicates significantly different from baseline ($p < 0.05$)

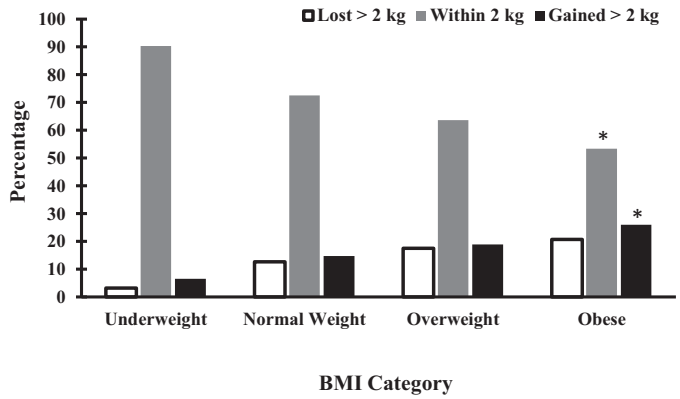

FIGURE 2 Percentage of BMI group that lost > 2 kg, stayed within 2 kg, or gained > 2 kg. BMI groups: underweight = <18.5; normal weight = 18.5 to 24.9; overweight = 25 to 29.9; obesity ≥30. *Indicates significantly different from normal weight group ($p < 0.006$)

The overall multivariate regression model examining age, sex, demographics, psychosocial measures, diet, physical activity, sedentary time, and sleep as predictors of weight changes was significant ($R^2 = 0.05$, $p = 0.012$; Table 3). Specifically, greater 3-month weight gain was related to longer stay-at-home mandate length ($\beta = 0.078$, $p = 0.01$), lower baseline minutes of physical activity ($\beta = -0.107$, $p = 0.004$), greater declines in minutes of physical activity minutes per week over 3 months ($\beta = -0.076$, $p = 0.026$),

TABLE 2 Change in domains from baseline to 3 months

	Baseline	3 months	SE	*p*
Depressive symptoms (CES-D) +	16.3	18.9*	0.20	<0.001
Stress (Perceived Stress Scale) +	6.9	6.7*	0.10	0.001
Perceived COVID-19 vulnerability +	8.8	8.7	0.10	0.730
Fruit and vegetable frequency (NCI screener) +	6.3	6.4	0.10	0.585
Time preparing food (h/d)	1.6	1.7	0.04	0.445
Alcohol (drinks/wk)	3.5	3.5	0.10	0.929
Physical activity (min/d)	128.7	102.2*	5.2	<0.001
Sedentary time (h/d)	12.1	11.9	0.16	0.189
Sleep (h/d)	7.3	7.1*	0.03	<0.001

Abbreviations: CES-D, Center for Epidemiological Studies Depression Scale; NCI, National Cancer Institute.

+Indicates variable is a composite score.

*Indicates variable is statistically significant from baseline ($p < 0.05$).

depressive symptoms ($\beta = 0.098$, $p = 0.034$), and greater increases in time spent preparing food ($\beta = 0.075$, $p = 0.031$). The average length of stay-at-home mandates for participants was 48.6 (23.3) days, ranging from 0 to 80 days. Sociodemographic factors were not significant predictors of weight changes (Table 3).

TABLE 3 Predictors of change in body weight between baseline and 3 months (kilograms)

	F ratio	*p*	*β*
Baseline body weight	1.64	0.201	0.041
Age	1.93	0.165	0.053
Sex	1.62	0.203	0.041
Education	0.52	0.471	0.023
Ethnicity	0.01	0.909	0.003
Loss of income	0.98	0.322	−0.030
Marital status	2.23	0.064	0.097
Change in marital status	2.09	0.149	−0.081
Mandate length (d)	6.57	0.010*	0.078
Baseline depressive symptoms (CES-D score)	0.56	0.453	0.038
Change in depressive symptoms (CES-D score)	4.50	0.034*	0.098
Baseline stress (Perceived Stress Scale score)	<0.01	0.979	0.001
Change in stress (Perceived Stress Scale score)	0.05	0.828	0.008
Baseline COVID-19 perception (composite)	1.27	0.260	0.039
Change in COVID-19 perception (composite)	0.76	0.383	−0.029
Baseline eating fruit and vegetable frequency +	0.01	0.921	−0.003
Baseline time spent preparing food (h/d) +	<0.01	0.984	0.001
Change in fruit and vegetable frequency +	0.43	0.510	−0.023
Change in time spent preparing food (h/d) +	2.01	0.031*	0.075
Baseline number of alcoholic beverages (drinks/wk)	0.04	0.850	0.006
Change in number of alcoholic beverages (drinks/wk)	1.75	0.186	0.043
Baseline smoking (cigarettes/wk)	0.10	0.909	0.003
Baseline minutes of activity per day +	8.55	0.004*	−0.107
Change in minutes of activity per day +	4.98	0.026*	−0.076
Baseline hours sedentary	2.48	0.116	0.059
Change in hours sedentary	2.45	0.118	0.058
Baseline hours of sleep	0.26	0.611	0.018
Change in hours of sleep	0.67	0.415	0.028

Abbreviations: CES-D, Centers for Epidemiological Studies Depression Scale.

+Indicates variable has undergone logarithmic transformation + 1.

*Indicates statistically significant ($p < 0.05$).

DISCUSSION

In the current study, state-ordered stay-at-home measures, initially implemented to slow the spread of COVID-19, were associated with increased body weight in adults. More specifically, these data show an almost 1% (0.6 kg) increase in body weight over 3 months, with 18.4% of participants gaining more than 2 kg. This is one of the first studies, to our knowledge, to prospectively examine whether stay-at-home mandates were related to weight gain (7), indicating that duration of mandate length was directly related to the magnitude of weight gain. The observed weight gain disproportionately affected individuals with obesity compared with individuals of normal weight. Furthermore, lower baseline physical activity, declines in physical activity over 3 months, depressive symptoms, and increased time spent preparing food were other correlates of increased body weight. Taken together, these data suggest that stay-at-home mandates, although designed to slow the spread of COVID-19, may have had negative unintended consequences on weight gain, particularly in individuals with obesity and overweight.

The observed 0.6 kg weight gain over 3 months was surprising given the relatively short time frame. Previous observational studies in the US have shown annual weight gain 0.34 kg per year and holiday weight gain of 0.4 kg (10,19). If the observed rate in the current study were to continue, this would far exceed typical weight gain in a single year. A recent cross-sectional, retrospective study by Flanagan et al. showed comparable weight gain as well as similar percentages (~30%) of those reporting weight gain (6). Two other studies have used a longitudinal design to report pandemic-related weight changes. Lin et al. measured weight directly and reported

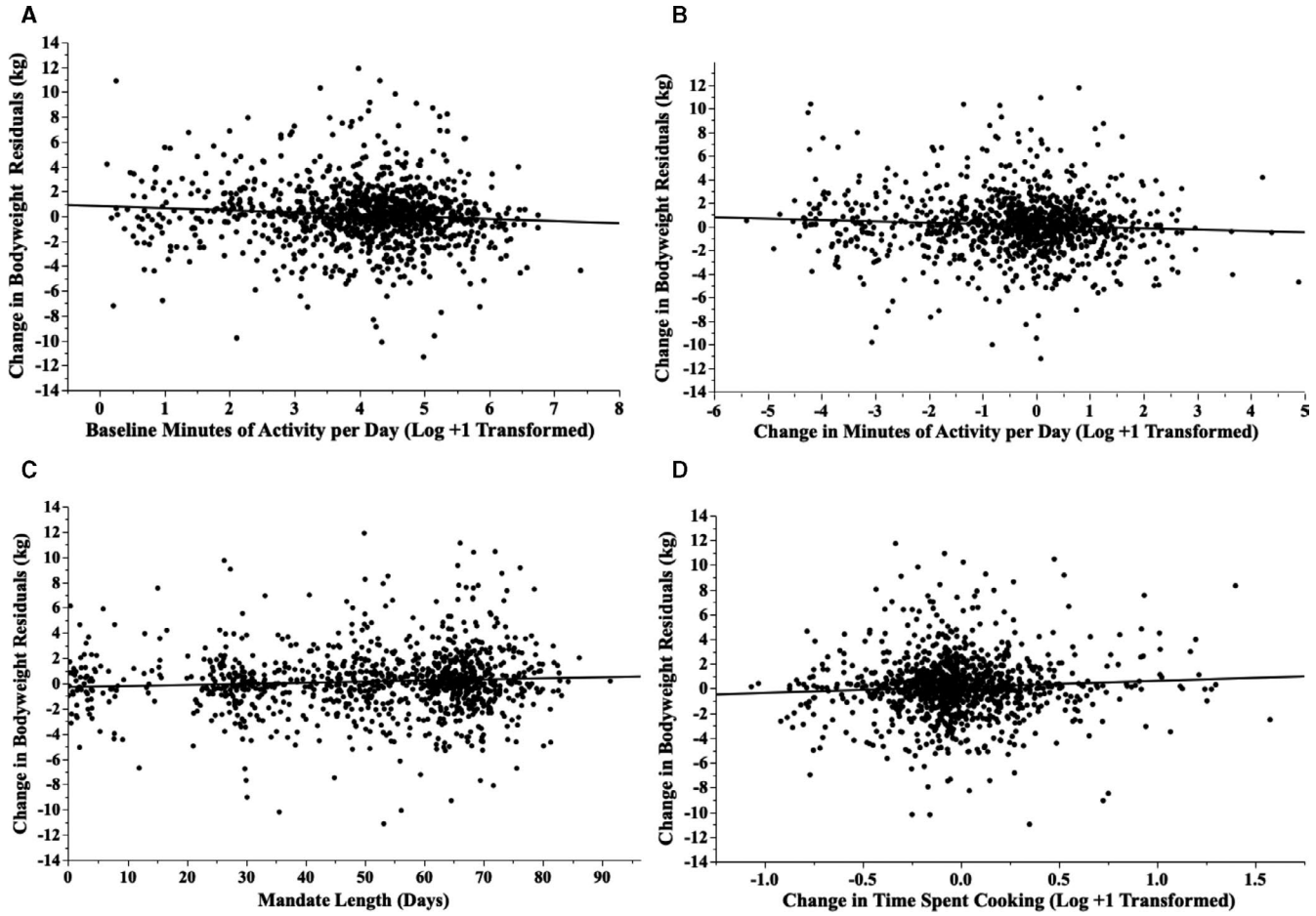

FIGURE 3 Relationship between change in body weight residuals (kilograms) and (A) baseline minutes of physical activity (log +1 transformed); (B) mandate length; (C) change in minutes of activity; and (D) change in time spent cooking (log +1 transformed)

weight gain of 0.27 kg per 10 days during stay-at-home mandates (7). Bhutani et al. used self-report data and observed a 0.62 kg increase in weight, which is nearly identical to weight change reported in the current study (20). Additionally, in the current study, we noted that a higher percentage of participants with obesity reported weight gain over 2 kg compared with individuals of normal weight. These findings are consistent with previous studies that have suggested that the pandemic or life-altering events promote more weight gain in individuals with obesity (8,21). Neither ethnicity nor income predicted weight gain, perhaps reflecting the limited diversity of the people enrolled in the current study. Collectively, these studies have suggested that state-ordered stay-at-home mandates, initially designed to slow the spread of COVID-19, promoted weight gain, particularly in individuals with obesity and overweight.

Several important predictors of weight change were observed. Length of stay-at-home mandate was positively correlated with greater weight gain, suggesting that longer mandates could result in greater weight gains. We also observed that lower baseline physical activity and greater decline in physical activity were related to greater weight gain. This is in line with previous retrospective and cross-sectional studies that have shown that the COVID-19 pandemic has decreased physical activity levels (6,8,22,23). Contrary to previous evidence (24), sedentary time was not related to weight gain, possibly because baseline assessment occurred during stay-at-home orders as opposed to before.

Examining dietary correlates, we observed that increased time spent preparing food was associated with greater weight gain. Flanagan et al. (6) noted in their retrospective study that at-home cooking increased during the initial stages of the pandemic. It is possible that a combination of more food availability and time spent preparing food at home during the pandemic led to greater eating and/or meal frequency and related weight gain. Nevertheless, these results are somewhat contrary to previous studies that have shown that more time spent preparing food at home is generally associated with better diet quality and lower weight compared with eating at restaurants (25,26). Fruit and vegetable intake and alcohol intake over the 3 months of observation were also not significantly related to weight change in the current study. Other studies have reported alcohol consumption has increased and fruit and vegetable intake has decreased during the pandemic but did not relate these changes to weight gain (27,28).

In the current study, increased depressive symptoms were positively related to greater weight gain, independent of activity, diet, and other behaviors. This is consistent with a previous retrospective study that has shown that worsening mood and depression during 1

month of COVID-19 quarantine was associated with an increase in body weight in individuals with obesity (21). Baseline levels of depressive symptoms were not significantly related to magnitude of weight gain, suggesting a possibility that greater weight gain could have contributed to worsening depressive symptoms (rather than *vice versa*), but future, longer-term research is needed to untangle these relationships. Perceived vulnerability of COVID-19 was not significantly related to weight gain.

This study has notable strengths and some limitations. Strengths of this study include the longitudinal nature with repeat assessment, large sample size, sample stratification across BMI, income, and education, and validated predictors of weight changes. However, there are some limitations. The sample was only recruited through Research Match and Qualtrics Research Panels and was largely composed of non-Hispanic White female individuals, which is not representative of the US population. There was a high attrition rate between baseline and 3-month time points and demographic differences between respondents who completed both time points and respondents to baseline only. Although these differences were small, they were statistically significant, possibly affecting generalizability. Additionally, a true baseline measurement would have been collected precisely before the pandemic and before stay-at-home mandates began; however, it was not possible to attain data before mandates were implemented. Weight changes may have already occurred between the date of initial lockdowns and our baseline survey. Also, weight was self-reported, and surveys for sleep and food preparation have not been validated.

We observed that state stay-at-home mandates, designed to slow the spread of COVID-19, had unintended consequences of promoting weight gain that disproportionately impacted individuals with obesity. In light of these data, as COVID-19 restrictions are lifted, it may be even more important to support programs and lifestyle interventions to reduce body weight, increase physical activity, and promote mental health. Future studies will analyze the long-term impact of the COVID-19 pandemic on weight and related behaviors over multiple years.

CONFLICT OF INTEREST

SP reports a grant from WW (formerly WeightWatchers) unrelated to this work. The other authors declared no conflict of interest.

AUTHOR CONTRIBUTIONS

ADS, HBG, MT, SP, SK, JA, and TH developed the questionnaire and conducted data collection. ADS, AS, IK, and TH analyzed the data and provided interpretations. ADS wrote the paper. TH was the principal investigator and had primary responsibility for the final content. All authors read, critically revised, and approved the final manuscript.

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