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Original Article

COVID-19 pandemic and weight gain in American adults: A nationwide population-based study

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ABSTRACT

Background: The COVID-19 pandemic has affected the lives of people in many ways. However, little is known about weight gain in American adults during the pandemic.
Aims and methods: The purpose of this study was to conduct a national assessment of weight gain in adult Americans after the first year of the pandemic. An online questionnaire was employed to explore perceptions of adults regarding pandemic weight gain and the relationship between weight gain and sociodemographic characteristics, pre-pandemic weight status, and psychological distress. Multiple methods were used to assess the psychometric properties of the questionnaire (i.e., face validity, content validity, and internal consistency reliability testing). Chi-Square tests and logistic regression analysis were used to assess group differences and predictors of weight gain in the study participants.
Results: A total of 3,473 individuals participated in the study with weight changes distributed as: gained weight (48%), remained the same weight (34%), or lost weight (18%). Those who reported being very overweight before the pandemic were most likely to gain weight (65%) versus those who reported being slightly overweight (58%) or normal weight (40%) before the pandemic. Weight gain was statistically significantly higher in those with anxiety (53%), depression (52%), or symptoms of both (52%). The final multiple regression model found that the statistically significant predictors of pandemic weight gain were psychological distress, pre-pandemic weight status, having children at home; and time since last bodyweight check.
Conclusions: Population health promotion strategies in the pandemic should emphasize stress reduction to help individuals manage body weight and avoid chronic diseases in the future.

1. Introduction

COVID-19 pandemic has had a significant impact on people's health and health-related behaviors. Lengthy social isolation due to COVID-19, whether self-imposed or imposed by others increased the risk of developing anxiety, depression, and high stress [1–3]. The risk of having high stress during the pandemic has also been linked to various factors such as fear of acquiring the disease, loneliness due to isolation, loss of family members or friends, work-life imbalance and multiple responsibilities, or loss of financial resources or employment [2–5]. These pandemic-related stressors have affected two very important health-related behaviors associated with excess weight gain, dietary behaviors and physical activity [6–8].

Numerous factors affect dietary patterns and eating habits, and they include: knowledge of healthy/unhealthy foods, taste, cultural preferences, socioeconomic resources, availability and marketing of foods, psychological (e.g., stress and emotion), social elements and other influences (e.g., interpersonal contacts) [7–9]. Psychological factors influencing eating habits seem to be the most affected by the COVID-19 pandemic. A study of 7,753 participants in April 2020 from four countries (63% participants from the U.S) found that 36%

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reported eating less healthy, 44% reported an increase in snacking, and 27% reported weight gain [10]. Almost a year later, the American Psychological Association (APA) conducted a national survey in February 2021 regarding stress in the adult American population and found that many reported undesired changes in weight, consumed more alcohol to cope with stress, and had sleep disruptions during the pandemic [2]. More specifically, 42% of the respondents claimed they had gained more weight since the start of the pandemic (men reported a greater weight gain than women) [2]. In these studies, and others during the pandemic, a key finding was that those who had higher stress, were obese or overweight, younger or with lesser incomes, or those who were racial/ethnic minorities were significantly more likely to report unhealthy eating practices [6–8,10–12].

The second component of weight control is energy expenditure (e.g., physical activity and exercise). Lockdowns along with social distancing and isolation have resulted in major reductions in physical activity and exercise behaviors such as going to work, recreation parks and gyms, and shopping centers for household needs. For example, an April 2020 study of 3052 adult Americans found that weekly physical activity was reduced among previously active participants by 32.3%, but remained largely unchanged among previously inactive participants. However, large increases in sitting time were observed in both previously active (26.4%) and inactive (16%) individuals [13]. In contrast, a May 2020 study of 5036 U S. adults found that 42.6% of participants reported sitting for more than 8 hours per day, a manifold increase compared to the levels before the pandemic [14]. The APA survey, Stress in America (February 2021), also explored the impact of the COVID-19 pandemic on physical activity and found that the majority of the respondents (53%) indicated they had been less physically active than they wanted since the pandemic started [2]. A few studies also highlighted wearable technology data in the early stages of the pandemic (March–June 2020) [15,16]. One study of 268 American adults who provided both survey and wearable device data found a 21% decrease for walking and a 46% decrease for moderate-intensity exercise [15]. Irrespective of the assessment methods, but similar to diet behaviors, higher physical activity declines were noticed across several studies among racial/ethnic minorities, individuals of lower socioeconomic status, those with greater weight or less physical activity before the pandemic, and those with greater stress [2,12–17].

The existing studies on weight gain estimation during the pandemic in the U.S. have certain limitations [10–17]. First, many of these assessments have exclusively focused on diet and/or physical activity, but not weight gain. Second, many of the assessments are based on small regional samples (often outside of the U.S.) limiting the generalizability of findings to adult Americans. Third, many of the studies were conducted early in the pandemic (e.g., Spring and Summer of 2020) precluding accurate assessment of long-term changes in body weight and quantification of weight gain. Fourth, studies often did not comprehensively assess key sociodemographic characteristics and weight-related perceptions or measures among study participants. Finally, psychological distress was either not measured across studies or measured without using valid and reliable screening measures to indicate serious mental health problems [10–17]. Thus, the purpose of this study was to conduct a comprehensive national assessment of weight change in adult Americans during the first year of the COVID-19 pandemic (March 2020–April 2021). Specifically, we aimed to explore the relationship between weight gained during the pandemic and pre-pandemic body weight perception, current body mass index (BMI), body weight monitoring behaviors, psychological distress, and sociodemographic characteristics.

2. Methods

A multi-component online questionnaire was deployed using a customized message including the consent letter and study details through community-based networks, social and professional groups, and Amazon mTurk across the U.S. A comprehensive review of the literature was conducted to search for studies on pandemic related weight gain which helped create a draft of the study questionnaire using questions from existing scales and studies (i.e., to establish face validity). Subsequently, a panel of experts (n = 3) reviewed the questionnaire for content and structure. The panel of experts suggested changes that were made after discussion among authors and this helped establish content validity. After approval from the Institutional Review Board, the survey was distributed from May–June 2021. Individuals 18 years of age or older and those who resided in the U.S. were eligible to participate in the study. Considering the total population of adults in the USA to be 210 million, 99% confidence levels, and a conservative 3% margin of error, a total of 1844 participants were needed to make reasonable inferences to the total adult U.S population (3473 participated in this study, far exceeding the required sample size) [1,4,6,8,18].

In the first section of the questionnaire, participants were asked about their pre-pandemic weight status (with response options ranging from 'very overweight' to 'very underweight') and the last time they checked their body weight (with response options ranging from 'within the last 3 months' to 'more than 1 year ago'). In this section, the key study outcome was also assessed by asking the participants how much weight they had gained during the last year (i.e., from March 2020–April 2021; during the pandemic). The response options for this question ranged from 'gained a lot of weight' to 'lost a lot of weight' (with each response categorized as pounds of body weight gained or lost) [2,10–12]. Next, the highly reliable and valid 4-item screening tool PHQ-4 (Patient Health Questionnaire) was used to assess symptoms of depression (PHQ-2), anxiety (GAD-2), or both within the past two weeks. Cronbach alpha values for PHQ-4 scales were computed from the final sample of respondents in this study, and the internal consistency reliability was found to be acceptable for PHQ-2 (alpha = 0.70), GAD-2 (alpha = 0.72), and PHQ-4 (alpha = 0.81) [1,4]. In the last section of the questionnaire, study participants were asked to report their current body weight and height (to help determine the BMI). Finally, sociodemographic information of the study participants was collected via a set of 10 questions. These selected questions on sociodemographic information were included in the survey due to their relationship with BMI in the adult U.S. population.

Data were analyzed using SPSS 24. First, we computed descriptive statistics (i.e., frequencies and percentages) to describe the study population based on sociodemographic characteristics and to understand the distribution of responses to questions on weight gained during the first year of the pandemic. Pandemic weight gain distribution was also assessed based on current BMI and psychological distress. Chi-square tests were conducted to assess group differences for perceived weight gain during the pandemic. Finally, a multiple regression analysis was conducted to explore the relationships between weight gained during the pandemic (outcome variable) and other study variables that were treated as independent predictor variables (e.g., sociodemographic characteristics, psychological distress, pre-pandemic weight status). Adjusted odds ratios (AOR with 95% confidence intervals) were computed to assess the probability of weight gain during the pandemic based on independent predictor variables. Statistical significance was established a priori at an alpha level of $p < 0.05$.

3. Results

3.1. Demographic characteristics and weight change in participants (from March 2020–April 2021)

There were 3,473 respondents to the study questionnaire who were predominantly male (60%), White (60%), 26–35 years of age (49%), married (62%), had children in their home (64%), urban residents (56%), and lived in the South (35%) or Western U.S. (28%). Additionally, the respondents were most likely to have a bachelor's degree (50%), employed full-time (77%), and had an annual income of $30,000-$60,000 (45%) (Table 1).

Almost half of the respondents (48%) reported gaining some weight (≥10 pounds for 11% and ≤9.9 pounds for 37%) during the pandemic while the majority (52%) either remained the same weight (34%) or lost weight (18%) (Table 1). Those who reported they had gained weight were significantly more likely to be males (49%), White (49%), Hispanic (49%), married (51%), had children in the home (51%), lived in rural areas (52%), lived in the South (50%), and older (51% for 46–59 years old and 50% for those ≥60 years of age). Weight gainers were also more likely to have a high school education or less (51%), employed full-time (49%), and had an annual household income of $30,000 or less (49%) (Table 1). Those who lost weight during the pandemic were more likely to be females, Asians, 26–45 years old, single or never married, without children at home, suburban dwellers, with annual household income ≥$60,000, or living in the West (a fifth or more of the participants in these groups reported losing weight).

3.2. Weight gain predictors during COVID-19 pandemic (from March 2020–April 2021)

An examination of weight gain based on perceived body weight before the pandemic found that those who reported being very overweight before the pandemic were the group most likely to gain weight (65%) (Table 2). Among those who perceived themselves as

Table 1
Sociodemographic characteristics and weight gain in study participants (March 2020–April 2021).

Variable	Total N (%)	Gained Lot ≥10 Pounds	Gained Some ≤9.9 Pounds	Same Wt. N(%)	Lost Some ≤9.9 Pounds	Lost Lot ≥10 Pounds	P value
All Participants	3473(100)	365(11)	1300(37)	1171(34)	524(15)	109(3)	
Sex							0.03
Male	2070(60)	207(10)	812(39)	699(34)	294(14)	57(3)	
Female	1365(39)	153(11)	474(35)	464(34)	224(16)	50(4)	
Race/Ethnicity							0.01
White	2079(60)	248(11)	793(38)	744(36)	218(11)	76(4)	
Black	518(15)	56(11)	185(36)	174(34)	93(18)	10(2)	
Asian	233(7)	25(11)	72(31)	87(37)	40(17)	9(4)	
Multiracial	265(8)	12(5)	111(42)	57(22)	82(30)	3(1)	
Other race	328(9)	22(7)	122(37)	95(29)	83(25)	6(2)	
Non-Hispanic	1924(57)	219(11)	694(36)	651(34)	286(15)	74(4)	
Hispanic	1499(43)	142(10)	589(39)	504(333)	231(15)	33(2)	
Age Group							0.003
18–25 years	512(15)	50(10)	195(38)	158(31)	93(13)	16(3)	
26–35 years	1710(49)	159(9)	645(38)	596(35)	266(15)	44(3)	
36–45 years	724(21)	76(11)	278(38)	237(33)	106(15)	27(3)	
46–59 years	327(9)	47(15)	118(36)	109(33)	37(11)	16(5)	
≥60 years	150(5)	28(18)	47(32)	56(38)	15(10)	4(2)	
Marital Status							<0.001
Single/never married	867(25)	85(10)	291(34)	320(37)	139(16)	32(4)	
Married	2147(62)	236(11)	856(40)	702(33)	291(14)	62(3)	
Engaged/live with partner	212(6)	15(7)	73(34)	65(31)	54(26)	5(2)	
Divorced/separated	154(5)	21(14)	48(31)	53(34)	27(18)	5(3)	
Other (e.g. widowed)	43(1)	2(5)	15(35)	17(40)	6(14)	3(7)	
Children in Home							<0.001
Yes	2227(64)	253(11)	887(40)	708(32)	310(14)	69(3)	
No	1196(35)	106(9)	396(33)	349(38)	207(17)	38(3)	
Education ≤ High school	296(9)	23(8)	128(43)	77(26)	57(19)	11(4)	<0.001
Some college experience	907(26)	77(9)	328(36)	277(30)	198(22)	27(3)	
Bachelor's degree	1724(50)	190(11)	653(37)	621(36)	216(13)	44(3)	
≥Master's degree	496(14)	69(14)	174(35)	182(37)	46(9)	25(5)	
Current Employment							<0.001
Full-time	2681(77)	274(10)	1034(39)	913(34)	384(14)	76(3)	
Part-time	548(16)	58(11)	185(34)	191(34)	97(18)	17(3)	
Not employed	194(6)	27(14)	64(33)	53(27)	36(19)	14(7)	
Annual Household Income							<0.001
0-$30,000	353(10)	50(14)	125(35)	108(31)	51(15)	19(5)	
$30,001-$60,000	1531(45)	158(10)	581(38)	571(37)	178(12)	43(3)	
$60,001-$99,999	1239(36)	112(9)	484(39)	373(30)	245(20)	25(2)	
≥100,000	300(9)	39(13)	93(31)	105(35)	43(14)	20(7)	
Area of Residence							<0.001
Rural	726(21)	96(13)	284(39)	224(31)	92(13)	30(4)	
Urban	1929(56)	181(9)	714(37)	701(36)	286(15)	47(2)	
Suburban	768(22)	82(11)	285(37)	232(30)	139(18)	30(4)	
Region							<0.001
Northeast	490(14)	45(9)	182(37)	168(34)	79(16)	16(3)	
Midwest	762(22)	75(10)	267(35)	277(36)	112(15)	30(4)	
South	1231(35)	159(13)	452(37)	424(35)	154(13)	39(3)	
West	981(28)	82(8)	395(40)	301(31)	179(18)	24(2)	

N(%) indicates frequencies and percentages. p-value indicates statistical significance for group differences.

Table 2
Perceived weight gain, body weight assessment, and psychological distress.

Variable	Total N (%)	Gained Lot ≥10 Pounds	Gained Some ≤9.9 Pounds	Same Wt. N(%)	Lost Some≤9.9 Pounds	Lost Lot ≥10 Pounds	p-value
Before the Pandemic, You Were							0.001
Very overweight	253(7)	86(34)	77(31)	39(15)	27(11)	23(9)	
Slightly overweight	1016(29)	132(13)	460(45)	189(19)	183(18)	51(5)	
Normal weight	1883(54)	109(6)	647(34)	859(46)	245(13)	21(1)	
Slightly underweight	280(8)	26(9)	103(37)	75(27)	68(24)	8(3)	
Very underweight	41(2)	12(29)	13(32)	9(22)	1(2)	6(15)	
Weight Checked Last Time							0.002
Within the last 3 months	1474(43)	200(14)	503(34)	487(33)	213(14)	71(5)	
3–6 months ago	1117(32)	90(8)	490(44)	363(32)	156(14)	18(2)	
6–12 months ago	658(19)	54(8)	227(34)	241(37)	122(19)	14(2)	
>1 year ago	220(6)	21(10)	80(36)	80(36)	33(15)	6(3)	
Current BMI Underweight	220(8)	20(9)	60(27)	94(43)	36(16)	10(5)	0.001
Normal Weight	1408(49)	102(7)	518(37)	515(37)	241(17)	32(2)	
Overweight	806(28)	76(9)	374(46)	223(28)	110(14)	23(3)	
Obese	471(16)	104(22)	160(34)	123(26)	66(14)	18(4)	
Anxiety Symptoms (GAD-2)							<0.001
Yes	1388(40)	189(14)	536(39)	443(31)	166(12)	54(4)	
No	2078(60)	176(8)	764(37)	727(35)	357(17)	54(3)	
Depression Scale (PHQ-2)							0.003
Yes	1637(47)	191(12)	648(40)	535(33)	223(13)	40(2)	
No	1829(53)	174(9)	652(36)	635(35)	300(16)	68(4)	
Moderate/Severe Psychological Distress (PHQ-4)							<0.001
Yes	1331(38)	179(13)	521(39)	422(32)	160(12)	49(4)	
No	2135(62)	186(9)	779(36)	748(35)	363(17)	59(3)	

N(%) indicates frequencies and percentages. p-value indicates statistical significance for group differences.

slightly overweight before the pandemic, 58% gained weight while 40% of those who reported being normal weight before the pandemic had gained weight in the past year. Based on when participants last checked their body weight, the groups that were most likely to gain weight during the pandemic were those who had checked their body weight 3–6 months ago (52%) or within the last 3 months (48%). In contrast, the prevalence of weight gain was lower among those who checked their bodyweight 6–12 months back or more than a year ago (42% and 46% weight gainers respectively). Based on current BMI, individuals who were obese or overweight had the highest prevalence of self-reported weight gain during the pandemic (56% and 54%, respectively). In contrast, while at lower levels, weight gain during the pandemic was also reported by those who currently had a normal BMI (44%). Individuals classified as underweight based on current BMI were the most likely to report weight loss during the pandemic (21%). Additional analyses found that current BMI levels varied based on the perception of pre-pandemic weight status. In ANOVA tests, current BMI was statistically significantly higher for those who believed they were very overweight before the pandemic ($M = 31.68$, S.E. $= \pm 0.74$) or slightly overweight before the pandemic ($M = 26.69$, S.E. $= \pm 0.18$) compared to those who believed they were normal weight ($M = 23.95$, S.E. $= \pm 0.12$), slightly underweight ($M = 22.32$, S.E. $= \pm 0.31$, or very underweight before the pandemic ($M = 21.65$, S.E. $= \pm 0.64$) ($F = 33.9$, $p < 0.01$).

Individuals who had anxiety symptoms were significantly more likely to gain weight during the pandemic compared to those who did not have these symptoms (53% vs. 45%). Weight gain was also more likely among those who had depression symptoms versus those who did not have these symptoms (52% vs. 45%). Similarly, those with symptoms of both depression and anxiety (i.e., moderate to severe psychological distress) were statistically significantly more likely (52%) to report weight gain compared to those without these symptoms (45%).

While key differences were found between those who gained weight during the pandemic versus those who did not (in Tables 1 and 2), we conducted a multiple regression analysis to examine factors that could predict weight gain during the pandemic. For this analysis, the binary outcome variable was weight gain (yes. vs. no/lost weight) (Table 3). The Hosmer–Lemeshow goodness-of-fit test results indicated that the final regression model adequately fits the data. In this final model, the only statistically significant predictors for weight gain during the pandemic were having children at home (AOR = 1.39, p = 0.001), symptoms of psychological distress (AOR = 1.25, p = 0.003), pre-pandemic weight status of being overweight (AOR = 2.07, $p < 0.001$), and time since the last bodyweight check by the participants (AOR = 1.32, p = 0.001) (Table 3).

4. Discussion

In this study, we examined the relationships between weight gain during the pandemic among adult Americans and psychological distress and sociodemographic characteristics. Individuals who gained weight during the pandemic were more likely to be males, above the age of 45 years, White, Hispanic, working full-time, married, living with children, from the South, living in rural areas, those with lower education, and household income. Many of these determinants of weight gain during the pandemic are not surprising given the vulnerability of these groups to multiple stressors before and during the pandemic (e.g., lack of financial resources, unhealthy diet, and food deserts, being overweight, a higher burden of chronic diseases and disability, lower access to healthcare, working in essential but low paying jobs before and during the pandemic, taking care of children and family members, etc.) [8–15]. A plethora of studies from before the pandemic and during the pandemic confirm the high levels of stress, depression, and anxiety among these vulnerable groups [1,8,19–23]; high levels of psychological distress were found to be significant predictors of weight gain in this study. Pre-pandemic weight was also found to be a determinant of weight gain during the pandemic which is not unusual given the high rates of obesity before the pandemic in the aforementioned groups. Unfortunately, many of the aforementioned high-risk individuals also belong to communities with higher social vulnerability and deprivation; such

Table 3
Multiple regression analysis to predict weight gain during the pandemic.

Predictor Variables	Wald	p-value	AOR	95% Ci for AOR	
				Lower	Upper
Sex	3.142	0.07	0.88	0.76	1.014
Race	2.696	0.10	0.96	0.91	1.009
Ethnicity	.037	0.84	1.02	0.88	1.175
Age	.137	0.72	0.99	0.92	1.062
Marital Status	.054	0.82	0.98	0.90	1.088
Children at home (Yes vs. No)	16.243	**0.001**	1.39	1.19	1.626
Highest level of education	.137	0.72	0.99	0.90	1.078
Employment status	.088	0.77	0.98	0.86	1.118
Annual household income	1.517	0.22	0.95	0.85	1.035
Region in the U.S.	2.184	0.14	1.06	0.99	1.128
Area of Residence	.033	0.86	1.01	0.91	1.125
Pre-pandemic weight (overweight vs. normal/underweight)	97.551	**0.00**	2.07	1.80	2.392
Psychological distress (Yes vs. No)	8.604	**0.003**	1.25	1.08	1.442
Weight checked within the past 6 months (Yes vs. No = more than 6 months ago)	11.281	**0.001**	1.32	1.12	1.546

AOR = Adjusted odds ratio for the likelihood of the outcome (i.e., weight gain during the pandemic). The p-value indicates significance levels (bold sign indicates significantly higher odds for the outcome). 95% CI = indicates 95% confidence intervals for adjusted odds ratios. Predictor variables include measures from Tables 1 and 2 showing group differences depending on whether an individual gained weight in the pandemic or not.

communities in the U.S. were found to have more COVID-19 infections, lower testing access, and higher disparities in COVID-19 related hospitalizations and mortality [24,25]. Such stressors and socioeconomic deprivation, high probability of getting infected or knowing individuals who were infected, and being at high risk of severe COVID-19 outcomes may have also resulted in excessive stress among those who already were overweight and ended up gaining additional weight during the pandemic.

Earlier studies also shed light on the impact of stress in society during the pandemic, especially on the determinants of weight gain (i.e., physical activity and diet) [2,8,10,11,13–15,26]. First, multiple studies have confirmed that depression and anxiety symptoms among U.S. adults have increased significantly during the pandemic [1,2,4,23]. Second, concerning physical activity and stress, the APA February 2021 national survey found that those who had greater stress reported being less physically active (60%) than those reporting lesser stress (42%). This survey also reported weight gain among 42% of the participants (with parents = 61% and essential workers = 50% reporting the highest average weight gain) [2]. Although conducted at different times, our study findings resemble the APA national survey to some extent (overall, we found that 48% gained weight and the most likely to gain weight were those who were married or living with children at home = 51%) [2]. Interestingly, a large international study (n = 13,696) found that during the pandemic, 24% of the participants decreased exercise frequency and 30% had a decline in exercise intensity. Also, those who exercised more before the pandemic exercised more frequently during the pandemic, and those who had a reduction in exercise frequency had the worst mood states [17]. Finally, as it relates to diet and stress, a national study of U.S adults early in the pandemic (April 2020) found that almost a third reported worsening of diet during the pandemic (31%) and more than a tenth of the participants reported more unhealthy eating practices during the pandemic lockdowns such as fasting (16%), restricting eating (20%), skipping meals (25%), and overeating (39%). Higher stress was associated with the worsening of all diet measures in this study [8]. Another study compared two national cohorts of adult Americans (February 2019 and March 2020) and found that during the pandemic, greater stress in response to the pandemic was associated with more eating to cope, added sugars intake (14% more), and food addiction symptoms [26]. Given these findings, it is logical that the additional levels of psychological distress during the pandemic adversely impacted both diet and physical activity in the groups that had the greatest gains in body weight.

The COVID-19 pandemic has created, in part, a perfect health storm. The U.S. consists of an adult population in which it is estimated that the majority (60%) suffer from chronic diseases, a large portion are obese (43%), more than a third do not meet Physical Activity Guidelines for Americans (35%), and more than half follow unhealthy eating patterns with lower consumption of fruits and vegetables [9,27–29]. Unfortunately, based on our findings and earlier studies, it seems like weight gain is higher among certain groups who were already vulnerable to poorer health outcomes (e.g., overweight before the pandemic and gained additional weight, higher stressors/deprivation before the pandemic, and greater prevalence of psychological distress during the pandemic, unhealthy diet and lower physical activity before the pandemic with worsening of diet and physical activity during the pandemic) [12–17,26–29]. This could likely exacerbate the widening sociodemographic disparities in health (e.g., among those with lower education, lesser income, lack of social and financial resources, and certain demographic groups) [5,8,9,12,20,22,30]. The psychosocial impact of the COVID-19 pandemic is likely to continue to impact body weight measures resulting in long-term burdens of chronic diseases and escalating healthcare expenses.

Population-based surveillance of trends in body weight changes and community-based health promotion measures with a renewed emphasis on a pre-existing epidemic of obesity are urgently warranted. In addition, fiscal and social policies during the pandemic should consider opportunities for increasing healthier diets and food security, physical activity and exercise in communities, mental health services and access to care, engagement in wellness programs, and preventive health screenings [3,5,8,9,21,30]. Mass media outlets that continue to focus on COVID-19 related updates should also emphasize on problems such as mental health issues and unhealthy lifestyles (e.g., poor diet and sedentary behaviors) to increase the publics' awareness on these issues. Clinicians also have a unique opportunity to screen for psychological distress and body weight during their interactions with the general public. Such screenings can help individuals become aware of the need to manage stress and weight to prevent chronic diseases.

The results of this study have potential limitations. The study results are restricted by all limitations of a cross-sectional survey design (e.g., self-reported behaviors, recall bias in participants, and the inability to establish cause and effect relationships among study variables). For example, weight-related questions can be sensitive or individuals may not be aware of their current body weight. If so, socially desirable responses can be a preference for

some participants limiting the validity of the findings. As the questionnaire was deployed through multiple online channels anonymously, we do not know how many individuals received it and the response rates. If the respondents differ from non-respondents, this could be a threat to validity of our findings. Another threat to external validity is that the sample is limited in nature as it relates to the total U.S. population (e.g., younger, those with a bachelor's degree or higher, self-selected, and limited to those who used the internet or participated in online survey panels). However, this threat is minimized as our final sample exceeds the required sample size and resembles the total U.S. population in several ways (e.g., the majority were white, employed, from the South or West, and lived in urban/suburban areas) [1,4,6,8,18]. Our study is one of the first and few of its kind in the U.S. with a focus on psychological distress and weight gain among adults during the first year of the COVID-19 pandemic (i.e., from March 2020–April 2021). Finally, a unique aspect is that we explored pre-pandemic weight and its impact on pandemic weight gain.

5. Conclusions

The findings of this study suggest that psychological distress during the pandemic may have compounded issues associated with weight control in the adult U.S. population. Those who had been overweight before the pandemic were also the most likely to gain weight. In addition, individuals who gained weight were those with psychological distress symptoms, have full-time employment, or children at home indicating multiple responsibilities that could create behavior changes that have increased the risk of gaining weight. Finally, the study provides insights into the need for public health professionals to examine the indirect health effects of the COVID-19 pandemic beyond mitigating the effects of the virus. Additional studies regarding the predictors of unhealthy weight gain are warranted, especially in hard to reach (e.g., older adults) and marginalized groups. Population-based health promotion strategies during the pandemic should emphasize stress reduction and avoidance of unhealthy lifestyles to help individuals manage body weight and avoid excessive weight gain to prevent multiple chronic diseases in the future.

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Declaration of competing interest

The authors have no conflicts of interests to declare.

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