



Research article

Age-related differences in the association between financial hardship and weight change during the COVID-19 pandemic

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A B S T R A C T

Objective: To examine the association of financial hardship with weight changes in the US during the COVID-19 pandemic.

Methods: We used data from the COVID-19's Unequal Racial Burden survey, a nationally representative, cross-sectional, online survey of diverse adults living in the US, 12/2020-2/2021. This study included 1000 Asian, Black, Latino (half Spanish-speaking), and White adults and 500 American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and multiracial adults (5500 total). Age-specific (18–39, 40–59, ≥60) associations between financial hardship domains and weight change were estimated using multinomial logistic regression, adjusted for demographic and health characteristics.

Results: Financial hardship during the COVID-19 pandemic was prevalent across all age groups (18–39: 76.2 %; 40–59: 75.6 %; ≥60: 50.6 %). Among adults aged 18–39 and ≥ 60 years old, food insecurity was significantly associated with weight loss (18–39: aOR = 1.42, 95 % CI = 1.04, 1.95; ≥60: aOR = 3.67, 95 % CI = 1.50, 8.98). Among all age groups, unmet healthcare expenses was also associated with weight loss (18–39: aOR = 1.31, 95 % CI = 1.01, 1.70; 40–59: aOR = 1.49, 95 % CI = 1.06, 2.08; ≥60: aOR = 1.73, 95 % CI = 1.03, 2.91). Among adults aged 18–39 and ≥ 60 years old, lost income was significantly associated with weight gain (18–39: aOR = 1.36, 95 % CI = 1.09–1.69; ≥60: aOR = 1.46, 95 % CI = 1.04, 2.06), and among adults 40–59 years old, experiencing increased debt was significantly associated with weight gain (aOR = 1.50, 95 % CI = 1.13, 1.99).

Conclusions: For those aged 18–39 and ≥ 60 years old experiencing financial hardship during the COVID-19 pandemic was associated with both weight loss and weight gain. Less correlation was observed among adults aged 40–59.

1. Introduction

During the COVID-19 pandemic, there has been an increase in the number of people in the United States (US) experiencing financial hardship [1], with roughly one quarter of households reported difficulty covering food, housing, and medical care expenses [2]. Older and younger adults may be more susceptible to experiencing financial hardship than middle-aged adults. For example, older adults are less likely to be in the labor force and may have fewer resources to absorb or recover from financial setbacks [3]. On the other hand, older adults may be less dependent on a job for their income and hence less likely to experience hardship due to job loss. Similarly, younger adults tend to have the lowest levels of wealth and job security in the US, which also place them at elevated risk for financial hardship [4].

Financial hardship has the potential to impact weight change (e.g., stress-related overeating, food insecurity) [5–7] and the

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long-term health effects of weight change (e.g., increased risk of morbidity and mortality) [8–10]. Prior to the pandemic, financial hardship has been associated with both an increased risk of weight loss and weight gain. For example, an Australian study found that prolonged hardship over 1 year, independent of income or education, increased the 1-year risk of obesity by 20 % [11]. Another study examining Finnish middle-aged adults found that individuals who had economic difficulties were more likely to gain 5 kg in weight [12]. Conversely, among older adults, financial hardship has also been associated with increased risk of unintentional weight loss [13].

However, these studies also have several limitations, which minimize our ability to understand the relationships between financial hardship and weight change. First, studies focus mainly on weight gain, and often fail to include weight loss as an outcome [11,12,14]. This is particularly problematic as weight loss can be a strong indicator for worsening health, especially among older adults [15]. Additionally, the definition of financial hardship varies across studies, and the specific types or domains of financial hardship (e.g., food insecurity, lost income), could impact weight change differently, a point that is seldom investigated. Third, while both the risk and impact of financial hardship may vary across age, few studies have estimated age-specific effects [16]. Finally, little is known about the association between financial hardship during the COVID-19 pandemic and weight change among US adults. To date, most studies conducted during the pandemic have taken place outside of the US or with small regional samples, limiting the potential generalizability of findings to US adults [16–18].

Using data from the COVID-19's Unequal Racial Burden (CURB) survey, we previously found that financial hardship during the COVID-19 pandemic impacted weight change (gain and loss) differently across race and ethnicity [19]. However, a similar analysis has not been performed across age groups. Thus, the purpose of this analysis was to estimate age-specific associations between financial hardship (overall and across specific domains) and self-reported weight change using data from our nationally representative sample of adults living in the US. We hypothesized that the different domains of financial hardship (e.g., food insecurity, lost income) would be differentially associated with weight change across age groups.

2. Methods

2.1. Study population and survey development

This cross-sectional study used data from the online COVID-19's Unequal Racial Burden (CURB) survey which was administered by YouGov, a consumer research firm based in Palo Alto, California; details of the survey have been described elsewhere [20]. The target sample was drawn from the 2018 American Community Survey 1-year data, and included 5500 adults (18+) from all major racial and ethnic populations: 500 American Indian or Alaska Native, 1000 Asian, 1000 Black or African American, 1000 Latino (half Spanish-speaking), 500 Native Hawaiian or Pacific Islander, 1000 White, and 500 multiracial. YouGov panel members were recruited and matched to the target sample using demographic information to generate nationally representative samples within each racial and ethnic group. Surveys were completed between December 8, 2020, and February 17, 2021 (response rate: 20.0 %).

2.2. Financial hardship during the COVID-19 pandemic

Participants were asked twelve questions regarding loss of employment and their current financial status, which were then categorized into six domains: 1) *lost income*, 2) *increased debt*, 3) *unmet expenses* for general needs, 4) *unmet healthcare expenses*, 5) *housing insecurity*, and 6) *food insecurity*. Financial hardship severity was captured by counting the number of domains each participant experienced and then categorized into substantial (4–6 hardships), some (2–3), a little (1), or no (0) hardship. Details on the development of the CURB financial hardship domains and financial hardship severity have been described elsewhere [21].

2.3. Self-reported weight change

Self-reported weight change was assessed using a single question; “How has your weight changed since the start of the pandemic?” with five response options of 1) lost a lot of weight, 2) lost a little weight, 3) weigh about the same, 4) gained a little weight, or 5) gained a lot of weight. For analyses, this question was collapsed into 1) lost weight (little/a lot), 2) gained weight (little/a lot), and 3) no weight change. Details on the weight change measure can be found in our prior analysis on racial and ethnic differences in financial hardship and weight change [19].

2.4. Statistical analyses

Chi-square and Cochran-Armitage trend tests were used to compare the prevalence of each financial hardship domain and financial hardship severity across age groups (categorized as 18–39 years old, 40–59 years old, and ≥ 60 years old). Age-specific multinomial logistic regression models were used to estimate associations between financial hardship (by domain and overall severity) and weight change (weight gain and weight loss vs. no change). All models were adjusted for race and ethnicity, gender, highest education level, self-reported physical health, and chronic condition status. Interaction terms between age group and financial hardship (domain and overall severity) were used to assess whether the differences across age groups were statistically significant. When estimating the association between financial hardship domains and weight change, all six domains were included in a single model to estimate the independent associations.

All analyses were performed in SAS version 9.4 (SAS Inc., Cary, NC). Analyses were weighted to produce nationally representative estimates within each racial and ethnic group and counts were rounded for interpretation. Transgender and non-binary adults were

Table 1

Participant characteristics, weighted to be nationally representative within racial and ethnic groups, stratified by weight change during the first year of the pandemic, December 2020-February 2021.

	Lost a lot	Lost a little	No Change	Gained a little	Gained a lot
Total, N (%)	393 (7.2)	993 (18.0)	2158 (39.2)	1450 (26.4)	506 (9.2)
Age group, n (%)					
18-39	211 (8.4)	435 (17.4)	954 (38.1)	671 (26.8)	231 (9.2)
40-59	111 (6.3)	317 (17.9)	680 (38.5)	464 (26.3)	196 (11.1)
≥60	71 (5.8)	241 (19.6)	523 (42.6)	314 (25.6)	79 (6.4)
Race and ethnicity, n (%)					
American Indian/Alaska Native	32 (6.4)	107 (21.3)	196 (39.3)	118 (23.6)	47 (9.4)
Asian	47 (4.7)	150 (15.0)	469 (46.9)	269 (26.9)	65 (6.5)
Black/African American	100 (10.0)	170 (17.0)	345 (34.5)	264 (26.4)	121 (12.1)
Latino					
English-speaking	41 (8.3)	91 (18.3)	181 (36.5)	123 (24.7)	60 (12.2)
Spanish-speaking	23 (4.5)	93 (18.5)	212 (42.2)	142 (28.1)	34 (6.7)
Native Hawaiian/Pacific Islander	47 (9.5)	112 (22.3)	168 (33.7)	118 (23.5)	55 (11.0)
White	70 (7.0)	166 (16.6)	413 (41.3)	281 (28.1)	70 (7.0)
Multiracial	33 (6.6)	104 (20.9)	173 (34.6)	136 (27.1)	54 (10.9)
Gender, n (%)					
Man	177 (6.8)	450 (17.4)	1172 (45.3)	641 (24.8)	148 (5.7)
Woman	202 (7.3)	521 (18.8)	943 (34.0)	765 (27.6)	340 (12.3)
Transgender/Non-binary ^a	15 (11.1)	22 (16.2)	42 (31.3)	37 (27.9)	18 (13.6)
Self-reported physical health, n (%)					
Excellent/very good/good	277 (6.9)	688 (17.1)	1720 (42.8)	1030 (25.7)	300 (7.5)
Fair/poor	117 (7.9)	304 (20.5)	438 (29.5)	420 (28.3)	206 (13.8)
Chronic conditions^b, n (%)					
One or more	116 (10.1)	258 (22.4)	408 (35.4)	280 (24.3)	90 (7.8)
None	277 (6.4)	735 (16.9)	1748 (40.2)	1170 (26.9)	416 (9.6)
Obesity, n (%)					
Yes	68 (7.9)	165 (19.2)	180 (20.9)	260 (30.2)	188 (21.9)
No	325 (7.0)	828 (17.9)	1976 (42.6)	1190 (25.7)	318 (6.8)
Health insurance, n (%)					
Any private insurance	137 (5.7)	429 (18.0)	945 (39.7)	662 (27.7)	211 (8.9)
Public insurance only	163 (8.4)	359 (18.4)	744 (38.1)	500 (25.6)	186 (9.5)
Uninsured	93 (8.2)	200 (17.6)	458 (40.3)	282 (24.8)	103 (9.1)
Immigration status, n (%)					
US-born citizen	334 (7.8)	784 (18.3)	1615 (37.8)	1134 (26.5)	409 (9.6)
Foreign-born citizen/legal resident	51 (5.4)	153 (16.2)	423 (44.7)	245 (25.9)	74 (7.8)
Undocumented	9 (3.2)	53 (19.4)	119 (43.2)	71 (25.9)	22 (8.2)
Education, n (%)					
Less than high school graduate	60 (12.0)	99 (19.9)	186 (37.4)	114 (22.8)	39 (7.9)
High school/GED	122 (6.8)	315 (17.6)	767 (42.8)	440 (24.6)	147 (8.2)
Some college/vocational school	143 (8.4)	316 (18.7)	586 (34.7)	460 (27.2)	185 (11.0)
College graduate or more	69 (4.5)	263 (17.3)	620 (40.7)	436 (28.7)	134 (8.8)
Family annual income^c, n (%)					
<\$20,000	141 (12.9)	200 (18.3)	377 (34.4)	266 (24.3)	111 (10.1)
\$20,000-\$59,999	109 (5.7)	375 (19.5)	748 (38.9)	517 (26.9)	173 (9.0)
\$60,000-\$99,999	55 (5.6)	165 (16.9)	397 (40.7)	278 (28.5)	80 (8.2)
≥\$100,000	41 (5.0)	139 (17.0)	355 (43.4)	211 (25.7)	73 (8.9)
Employment status, n (%)					
Employed (Full or Part time)	144 (5.9)	442 (18.1)	977 (40.1)	660 (27.1)	216 (8.8)
Not Employed	249 (8.1)	551 (18.0)	1180 (38.6)	790 (25.8)	290 (9.5)
Marital status, n (%)					
Married/domestic partnership	148 (5.8)	454 (17.8)	1065 (41.8)	674 (26.4)	211 (8.3)
Not married	246 (8.3)	539 (18.3)	1093 (37.1)	776 (26.3)	295 (10.0)
Household configuration, n (%)					
Lives alone	87 (8.9)	153 (15.6)	392 (40.1)	268 (27.4)	79 (8.1)
Adults only	168 (6.5)	483 (18.6)	1064 (41.0)	657 (25.3)	221 (8.5)
Single parent and child(ren)	17 (7.3)	48 (21.0)	76 (33.1)	62 (27.0)	26 (11.5)
Adults and child(ren)	122 (7.2)	307 (18.1)	627 (36.9)	464 (27.3)	180 (10.6)

^a Includes individuals who identified as non-binary, gender queer, gender fluid, other, and none.

^b Chronic conditions included: cancer, chronic obstructive pulmonary disease (COPD), chronic kidney disease, diabetes, heart conditions, immunocompromised from transplant, and sickle cell disease.

^c Collected by YouGov at enrollment into panel and updated every 6 months.

excluded from all models due to small sample sizes.

3. Results

Demographics of participant characteristics, stratified by age group, are reported in [Supplemental Table 1](#). Adults 18–39 (76.2 %) and 40–59 (75.6 %) years old were more likely to report experiencing at least one type of financial hardship, compared to adults ≥ 60 years old (50.6 %, $p = 0.03$ and $p < 0.0001$, respectively); adults aged 18–39 also reported the highest prevalence for each of the six financial hardship domains, [Supplemental Table 2](#). The prevalence of each financial hardship domain and financial hardship severity, overall and stratified by sociodemographics, have been previously reported [19,21,22].

Self-reported weight change, stratified by participant demographics, are reported in [Table 1](#). The prevalence of both self-reported weight loss (18–39 years old: 25.8 %, 40–59 years old: 24.2 %, ≥ 60 years old: 25.4 %) and self-reported weight gain (18–39 years old: 36.1 %, 40–59 years old: 37.3 %, ≥ 60 years old: 32.0 %) were similar across age groups.

3.1. Age-specific associations between financial hardship domains and weight change

Among adults 18–39 and 40–59 years old, experiencing financial hardship was associated with both increased prevalence of both weight loss and weight gain, compared to experiencing no hardships, [Fig. 1A](#) and [B](#). Among adults ≥ 60 years old, experiencing a

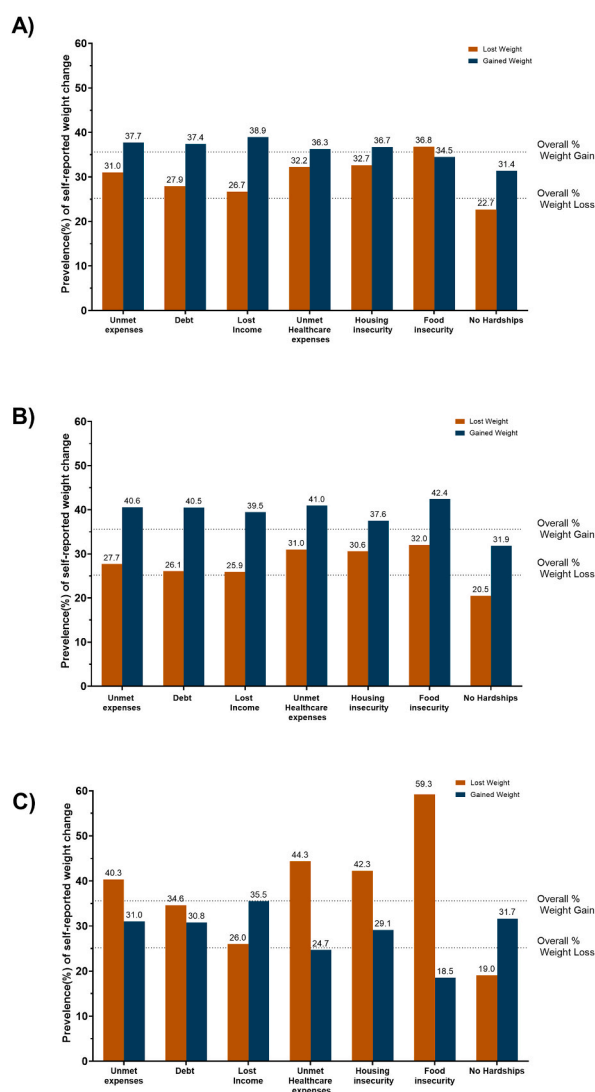


Fig. 1. Prevalence of self-reported weight change during the first year of the COVID-19 pandemic, stratified by financial hardship domains (including experiencing no financial hardship), among A) 18–39 year old, B) 40–59 year old, and C) ≥ 60 year old adults, weighted to be nationally representative within racial and ethnic groups, December 2020–February 2021.

financial hardship domain (especially food insecurity) was associated with higher prevalence of weight loss except for lost income; smaller differences in weight gain were seen when comparing each financial hardship domain and experiencing no financial hardship, Fig. 1C. While food insecurity was consistently associated with weight loss across all age groups, the differences were most pronounced among adults ≥ 60 years old (18–39: 36.8 % vs. 23.5 %, $p < 0.0001$; 40–59 years: 32.0 % vs. 23.2 %, $p = 0.004$; ≥ 60 years: 59.3 % vs. 24.0 %, $p < 0.0001$), Supplemental Table 3.

After adjustment, *food insecurity* remained associated with weight loss among adults 18–39 years old (aOR = 1.42, 95 % CI = 1.04–1.95) and ≥ 60 years old (aOR = 3.67, 95 % CI = 1.50–8.98), Table 2. *Food insecurity* appeared to increase the odds of weight loss among 40–59-year-olds, but estimates were imprecise (aOR = 1.37, 95 % CI = 0.87–2.15). Experiencing *unmet healthcare expenses* was associated with weight loss across all age groups (18–39: aOR = 1.31, 95 % CI = 1.01–1.70; 40–59: aOR = 1.49, 95 % CI = 1.06–2.08; ≥ 60 : aOR = 1.73, 95 % CI = 1.03–2.91), Table 2. *Debt* was also associated with weight loss, but only among adults ≥ 60 years old (aOR = 1.48, 95 % CI = 1.02–2.16).

Lost income was associated with weight gain among adults aged 18–39 years old (aOR = 1.36, 95 % CI = 1.09–1.69) and ≥ 60 years old (aOR = 1.46, 95 % CI = 1.04–2.06), Table 2. *Debt* was significantly associated with weight gain, but only among adults 40–59 years old (aOR = 1.50, 95 % CI = 1.13–1.99). *Unmet healthcare expenses* (aOR = 1.26, 95 % CI = 0.92–1.72) and *food insecurity* (aOR = 1.41, 95 % CI = 0.92–2.14) also appeared to also be associated with weight gain among those 40–59 years old but estimates were imprecise.

3.2. Age-specific associations between financial hardship severity and weight change

Among all age groups, increasing financial hardship severity was associated with weight loss ($p < 0.0001$ for all trend tests), Supplemental Fig. 1. It was also associated with increased prevalence of weight gain among adults 18–39 ($p = 0.02$) and 40–59 ($p = 0.003$) years old.

After adjustment, experiencing substantial hardship, compared to experiencing no hardship, was significantly associated with weight loss across all age groups, although the magnitude of the association was much higher among adults ≥ 60 years old (18–39: aOR = 1.94, 95 % CI = 1.42, 2.64; 40–59: aOR = 2.35, 95 % CI = 1.60, 3.45; ≥ 60 : aOR = 5.65, 95 % CI = 2.85, 11.17), Table 3. Among adults 40–59 years old, experiencing some financial hardship was also associated with increased odds of weight loss (aOR = 1.60, 95 % CI = 1.11, 2.29). Among adults ≥ 60 years old, experiencing both some financial hardship (aOR = 2.09, 95 % CI = 1.39, 3.13) and a little financial hardship (aOR = 1.91, 95 % CI = 1.30, 2.80) increased the odds of self-reported weight loss during the pandemic. Increasing financial hardship severity was also significantly associated with increased odds of weight gain among 18–39 and 40–59 years old adults, but effect estimates were generally smaller, Table 3.

4. Discussion

Using survey data from a large, nationally representative, diverse sample of adults living in the U.S., we found that specific types of financial hardship experienced during the COVID-19 pandemic were associated with both weight gain and weight loss, and that these associations differed in direction and magnitude across age groups. For example, food insecurity had a stronger association with weight loss among older and younger adults, compared to middle-aged adults. Interestingly, increasing financial hardship severity was associated with both increased likelihood of weight loss (across all three age groups) and with weight gain among younger and middle-

Table 2

Adjusted associations between financial hardship domains and self-reported weight change during the first year of the COVID-19 pandemic, stratified by age, CURB survey, December 2020-February 2021.

	Weight Loss			Weight Gain		
	18–39 years old aOR (95 % CI) ^a	40–59 years old aOR (95 % CI) ^a	≥ 60 years old aOR (95 % CI) ^a	18–39 years old aOR (95 % CI) ^a	40–59 years old aOR (95 % CI) ^a	≥ 60 years old aOR (95 % CI) ^a
Lost income ^a	0.98 (0.77, 1.24)	1.20 (0.91, 1.59)	1.15 (0.78, 1.70)	1.36 (1.09, 1.69)	1.22 (0.95, 1.57)	1.46 (1.04, 2.06)
Unmet expenses ^b	1.26 (0.95, 1.68)	1.05 (0.74, 1.49)	1.11 (0.63, 1.94)	1.17 (0.90, 1.52)	1.15 (0.85, 1.57)	1.17 (0.67, 2.02)
Debt ^c	1.06 (0.81, 1.38)	1.20 (0.87, 1.66)	1.48 (1.02, 2.16)	1.05 (0.83, 1.34)	1.50 (1.13, 1.99)	0.98 (0.69, 1.39)
Unmet healthcare expenses ^d	1.31 (1.01, 1.70)	1.49 (1.06, 2.08)	1.73 (1.03, 2.91)	1.05 (0.81, 1.34)	1.26 (0.92, 1.72)	0.98 (0.56, 1.71)
Housing insecurity ^e	1.12 (0.83, 1.51)	1.08 (0.74, 1.56)	1.17 (0.53, 2.58)	0.96 (0.72, 1.27)	0.74 (0.53, 1.05)	0.90 (0.40, 2.01)
Food insecurity ^f	1.42 (1.04, 1.95)	1.37 (0.87, 2.15)	3.67 (1.50, 8.98)	0.98 (0.72, 1.34)	1.41 (0.92, 2.14)	1.11 (0.39, 3.17)

Adjusted for race and ethnicity, gender (male, female), highest education level, chronic conditions, and self-reported physical health.

Weighted to be nationally representative within racial and ethnic groups.

Reference group were individuals who did not report experiencing specific financial hardship domains listed below.

^a Lost income included loss of job or reduced hours, or loss of work-related income.

^b Unmet expenses included not having enough money to meet daily needs or not enough money to pay monthly bills.

^c Debt included using up all/most of savings, having no savings before the pandemic, or having gone into debt or increased debt during the pandemic.

^d Unmet healthcare expenses included loss of health insurance, not having enough money to pay for healthcare, and not having enough money to pay for medications.

^e Housing insecurity included not having a regular place to live and not having enough money to pay rent, mortgage, or housing costs.

^f Food insecurity included being hungry but didn't eat because not enough money for food.

Table 3

Adjusted association between financial hardship severity and self-reported weight change during the first year of the COVID-19 pandemic, stratified by age, CURB survey, December 2020-February 2021.

	Weight Loss			Weight Gain		
	18–39 years old aOR (95 % CI) ^a	40–59 years old aOR (95 % CI) ^a	≥60 years old aOR (95 % CI) ^a	18–39 years old aOR (95 % CI) ^a	40–59 years old aOR (95 % CI) ^a	≥60 years old aOR (95 % CI) ^a
Financial hardship severity^b						
Substantial hardship	1.94 (1.42, 2.64)	2.35 (1.60, 3.45)	5.65 (2.85, 11.17)	1.58 (1.42, 2.12)	2.11 (1.60, 3.00)	1.46 (0.70, 3.04)
Some hardship	1.20 (0.89, 1.62)	1.60 (1.11, 2.29)	2.09 (1.39, 3.13)	1.47 (0.89, 1.92)	1.81 (1.11, 2.48)	1.32 (0.90, 1.94)
A little hardship	1.07 (0.78, 1.47)	1.03 (0.71, 1.50)	1.91 (1.30, 2.80)	1.25 (0.78, 1.66)	1.17 (0.71, 1.62)	1.40 (0.99, 1.97)
No hardship	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)

Weighted to be nationally representative within racial and ethnic groups.

^a Adjusted for race and ethnicity, gender (male, female), highest education level, chronic conditions, and self-reported physical health.

^b Financial hardship severity was calculated by counting the number of domains each participant reported experiencing (range 0–6); financial hardship was categorized as substantial [4–6], some [2–3], little [1], and no hardships [0].

aged adults.

Our findings are consistent with at least one other study conducted prior to the pandemic which found that financial stress was associated with a higher prevalence of weight gain in the US, especially among those experiencing difficulty paying bills or who had less money to meet life necessities [5]. A Canadian study conducted during the pandemic also found that financial hardship was strongly associated with both weight loss and weight gain [6]. Although there is minimal evidence on the association between financial hardship and weight change during the pandemic in the US, one study did find that economic stress during the pandemic was linked to increases in unhealthy behaviors (less exercise, sleep, and healthy eating; more smoking/vaping and drinking alcohol), which could lead to weight change [7].

When it comes to weight change, and specifically weight loss, older adults represent a particularly vulnerable group. During the pandemic, compared to their younger coworkers, employed older adults were more vulnerable to financial challenges [23,24]. Similarly, retired older adults, many of whom rely on Social Security and have a fixed income, have less economic flexibility to handle unexpected expenses, increasing their sensitivity to financial challenges [24,25]. Prior to the pandemic, studies also found that older adults experiencing severe food insecurity were more likely to experience weight loss [26,27]. Similarly, we found that experiencing food insecurity during the pandemic was associated with weight loss, and that it had the most substantial impact among older adults, compared to both other sources of financial hardship and younger age groups. During the early stage of the pandemic, older adults experienced more than double the rates of severe food insecurity compared to pre-pandemic levels in 2019, and those experiencing financial difficulty reported skipping meals [24,28]. Furthermore, we found that increasing debt was associated with increased risk of weight loss in older adults.

Research on the mechanisms by which food insecurity and debt affect weight change is limited, especially among older adults. Food insecurity may lead to unintentional weight loss, through a reduction in the quantity and quality of foods consumed and can consequently lead to malnutrition [27]. Weight loss often serves as a marker of disease severity and loss of muscle mass, which may explain the relationship of weight loss to disability and poor health outcomes in older adults [29,30]. There is limited information on the association between debt and weight, however one study among older British adults found that non-mortgage debt is linked to poor mental wellbeing [31]. We also found using data from our online CURB survey that all six financial hardship domains and increasing financial hardship severity were also associated with increased likelihood of anxiety and depression symptoms, perceived stress, and loneliness/isolation [22]. For older adults, having depression is considered to be a primary explanation for weight loss [32,33].

In our study, compared to those who reported no food insecurity, young and middle-aged (to a lesser degree) adults experiencing food insecurity were more likely to report weight loss during the pandemic. There is limited research on food insecurity among young adults, however a study conducted in the UK found that young people aged 16–30 years had higher odds of reporting food insecurity during the pandemic compared to older adults [34]. Even prior to the pandemic, young adulthood is a time of educational and economic transitions, which may increase risk for food insecurity [35]. For instance, adults ≥18 years old and enrolled in college at least half time are not eligible for Supplemental Nutrition Assistance Program (SNAP) benefits unless they are also working at least 20 hours a week, participating in a work study program, or taking care of a young child [36]. Many colleges moved to virtual learning during the pandemic, which resulted in loss of campus jobs for students, which could impact their SNAP eligibility [36]. Middle-aged adults are more likely to have to care for their children and aging parents, and may incur expenses or lost wages due to caregiving duties that may lead to insufficient resources to afford enough food [37]. Additionally, compared to other age groups, middle-aged adults may be less aware of food assistance programs, like SNAP [38].

Unmet healthcare expenses were consistently associated with weight loss across all age groups. Groups who lack health insurance or with high co-payments tend to postpone needed medical care or medications [39] and might also experience higher levels of food insecurity compared to those with access to better health care resources. Older adults who experience a greater number and severity of chronic diseases are more likely to incur medical debt because of high health care needs and limited financial resources to pay out-of-pocket costs [40]. Medical debt may leave individuals unable to pay for utilities, housing and food, and may be associated with adverse health outcomes [41].

During the pandemic, experiencing financial hardship was also associated with weight gain. For example, experiencing

employment/change loss among adults aged 18–39 and ≥ 60 years and debt among adults aged 40–59 were associated with increased odds of weight gain. Economic hardships may induce stress eating, leading to the consumption of high-calorie foods and an increase in body weight [42]. A recent study conducted during the pandemic found that relative to those without financial hardship, those with new financial hardships reported increased soft drink purchases [43]. Prior to the pandemic, experiencing financial hardship was found to take up cognitive ‘bandwidth’ reducing self-control, resulting in increased unhealthy behaviors [44]. The prevalence of unhealthy behaviors during the pandemic was found to be higher in individuals who gained $\geq 5\%$ of body weight [45].

There are potential long-term effects of financial hardship and weight change during the pandemic. Weight changes are associated with increased risk of various chronic diseases and all-cause mortality [8–10]. Specifically, substantial weight gain increases the risk of diabetes [46] and cardiovascular disease [47], while significant weight loss has been associated with an increased risk of mortality [48]. Malnutrition in older adults has been associated with greater risk of death, hospital readmission, susceptibility to infections, and loss of mobility and independent living [49]. Prior to the pandemic, nationally representative studies and meta-analyses have found that weight loss and weight gain in middle and older aged adults increase the risk of mortality [50].

This study is subject to some limitations. First, the YouGov survey was an online survey, which may limit the representation of adults without internet access or familiarity with technology. It was also only administered in English and Spanish. Second, this was a cross-sectional survey, and we were unable to determine whether weight change occurred before, after, or concurrently with experiencing financial hardship. Furthermore, weight change was a self-reported variable; however, using self-reported weight change has been validated in studies prior to the pandemic [51,52]. We did not ask about participant weight prior to the pandemic and are unable to assess whether reported changes were clinically meaningful. We also did not ask about diet quality, food access, or resource utilization such as SNAP, which could modify the effect of financial hardship on weight change. Additionally, despite capturing multiple domains of financial hardship, our measures were not comprehensive. For example, we asked if individuals had ‘lost [their] job or business’ but did not ask about other household or family members, which could also impact financial security. We are also unable to determine if financial hardship was newly experienced during the pandemic. Finally, we also acknowledge that even after adjustment, there is an inflation in the estimates of odds ratio.

This study also has several strengths, which includes using a large, nationally representative survey of all major racial and ethnic groups in the US. This is also one of the first studies to assess both weight gain and weight loss, and to stratify estimates across age groups. Lastly, financial hardship was measured across six domains, allowing us to get a more comprehensive picture of financial hardship and how different domains can have different impacts, which have not been included in prior literature.

In conclusion, our study found that different domains of financial hardship impacted weight gain and weight loss differently, and that the magnitude of these potential effects varied across age groups. Our findings highlight the importance of using multi-dimensional measures of financial hardship, examining differences in weight outcomes by age, and assessing both weight loss and gain in relation to health status as these relationships are complex. These results can aid policy makers to prioritize providing COVID-related financial assistance and resource allocation to US adults who were and remain financially vulnerable, as weight gain and weight loss can have serious long-term consequences on health. Public health and healthcare providers should also encourage healthy coping mechanisms to avoid both weight gain and weight loss during stressful times, like when experiencing financial hardship, especially among younger and older adults.

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Data availability

The data that support the findings of this study are available from Dr. Paula Strassle (paula.strassle@nih.gov) upon reasonable request.

Ethical standards disclosure

The National Institutes of Health Office of Institutional Review Board Operations determined that this study does not qualify as human subjects research because data used were de-identified (IRB# 000166).

CRedit authorship contribution statement

Izabelle Mendez: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Paula D. Strassle:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization. **Stephanie Ponce:** Writing – original draft. **Randy Le:** Writing – original draft. **Anita L. Stewart:** Writing – review & editing. **Anna M. Nápoles:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e30917>.

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