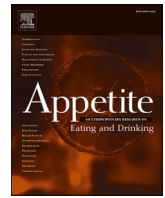




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## Restaurant dining during the COVID-19 pandemic among adults with low-income in the United States

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### ABSTRACT

The COVID-19 pandemic caused widespread non-essential business closures in the U.S., which may have disproportionately impacted food consumption in lower-income communities, in part due to reduced access to healthy and affordable foods, as well as occupations that may have required working outside the home. The aims of this study were to examine restaurant dining behaviors (including drive-through, takeout, and delivery) at fast-food and non-fast-food (i.e., fast casual and full-service ['other']) restaurants and the impact on diet quality among racially/ethnically diverse low-income adults during the early months of the pandemic. Participants completed an online survey using CloudResearch regarding restaurant dining behaviors in the past week (during June 2020) and during a typical week prior to the pandemic. Diet quality was measured using the Prime Diet Quality Score (PDQS). Surveys from 1,756 low-income adults (incomes <250% of the Federal Poverty Level) were analyzed using chi-squared tests to examine differences in demographic characteristics among those dining at restaurants during the pandemic, as well as to examine differences in dining frequency compared with prior to COVID-19. Negative binomial regressions were used to examine the mean frequency of eating food from fast-food and other restaurants, adjusted for socio-demographic characteristics. This study found reductions in fast-food and other restaurant dining compared with prior to COVID-19, although overall restaurant consumption remained high with over half of participants reporting fast-food consumption in the week prior (average consumption of twice per week). Greater fast-food consumption was associated with poorer diet quality. In conclusion, while fast-food consumption was slightly lower during the pandemic, the overall high levels observed among socioeconomically disadvantaged adults remains concerning, highlighting the continued need for initiatives and policies to encourage greater access to and consumption of affordable and healthier foods.

### 1. Introduction

In the United States, household food expenditures on food away from home (FAFH), including full-service and fast-food restaurants, have been steadily rising over the past several decades (Todd, 2017). Prior to the COVID-19 pandemic, roughly a third of adults consumed fast-foods on any given day, and FAFH accounted for 55% of all food expenditures

(Fryar, Hughes, Herrick, & Ahluwalia, 2018; United States Department of Agriculture Economic Research Service, 2020b). Frequent consumption of FAFH can have adverse health implications as these foods are associated with increased energy intake and poorer diet quality (compared with meals prepared at home, which is associated with healthier diets), thus increasing the risk of obesity and other chronic diseases (Bahadoran, Mirmiran, & Azizi, 2015; Fryar & Ervin, 2013;

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Nguyen & Powell, 2014; Todd, 2017; Wolfson & Bleich, 2015).

Several factors are associated with FAFH consumption. Prior research has identified price, taste preferences, household structure, and the amount of time spent working (resulting in less time for meal preparation) to be primary determinants of FAFH consumption (Saksena et al., 2018). Marketing can also strongly influence decisions to consume FAFH (Harris, Bargh, & Brownell, 2009; Okrent & Kumcu, 2016; Saksena et al., 2018). Lastly, physical access plays a key role; a previous systematic review of fast food access documented a significantly greater prevalence of fast food restaurants in low income and racial/ethnic minority communities (Fleischhacker, Evenson, Rodriguez, & Ammerman, 2011). Conversely, there are often fewer grocery stores with healthier, affordable options in these areas (United States Department of Agriculture Economic Research Service, 2020a). Overall, food access may in part contribute to the disparities in obesity observed by these populations (Fleischhacker et al., 2011).

Consumer food shopping behaviors changed substantially in the U.S. amid the spread of COVID-19 in 2020 (Chenarides, Grebitus, Lusk, & Printezis, 2021). Across the globe, countries implemented various strategies to contain the spread of COVID-19, and in the United States, states and local governments enacted differing rules, including the closures of non-essential businesses and schools as well as varying stay-at-home orders (Kaiser Family Foundation, 2022). Due to concerns and uncertainties around the evolving pandemic, many consumers began to rely more heavily on grocery stores for their food sources (Chenarides et al., 2021; Ellison, McFadden, Rickard, & Wilson, 2021), and increases in scratch cooking were observed during the early stages of the pandemic, which was associated with higher fruit and vegetable intake (Cummings, Wolfson, & Gearhardt, 2022). Additionally, while indoor dining in restaurants became restricted, other options such as drive-thru, takeout, and delivery from restaurants remained with some restaurants pivoting to more limited menus with the more popular and high-performing options. Some research has found reductions in frequent fast-food consumption (defined as 3 or more times per week) (Chen et al., 2021). However, little is known about socioeconomically disadvantaged adults, particularly from racial/ethnic minority groups. These populations may have been differentially impacted by the pandemic, due to more limited access to affordable, healthy foods in grocery stores and/or occupations as “essential workers” (i.e., jobs critical to public health and safety, such as grocery retail and transportation). These individuals required to return to work in person may have increased reliance on FAFH, potentially exacerbating diet-related disparities (McCormack, Avery, Spitzer, & Chandra, 2020). Therefore, the aims of this study were to examine restaurant dining behaviors at fast-food and non-fast-food (i.e., fast casual and full-service [‘other’]) restaurants and the impact on diet quality among racially/ethnically diverse adults with low-income in the U.S. during the early months of the COVID-19 pandemic. A secondary aim was to examine differences in dining behaviors and diet quality by other demographic characteristics, including age, sex, and food security status.

## 2. Methods

We designed a web-based survey using Qualtrics software. The survey was fielded using CloudResearch (formerly TurkPrime), an online crowdsourcing platform designed to be used for academic research across multiple disciplines (Litman, Robinson, & Abberbock, 2017). The objective of the survey was to measure potential impacts of COVID-19, and included measures related to participant demographics, food behaviors, food security, and diet quality (as well as other measures outside the scope of the present study). After providing consent, study participants first completed a demographics module, followed by questions about food security, then diet quality, and finally questions about food behaviors. We fielded the survey using a census-matched panel of US adults (matched on age, sex, and race/ethnicity to the overall population) while also limiting our sample to adults with

household incomes of less than 250% of the 2020 Federal Poverty Level (FPL). FPL is a measure of how far above or below a household’s income falls based on the level of income the federal government determines is needed for food, clothing, transportation, shelter and other necessities each year, adjusted for inflation. The FPL is based on both household size and income (e.g., <250% of the FPL was <\$31,900 annually for an individual and <\$65,500 annual income for a household of four in 2020).

The survey was open to participants from June 23, 2020–July 1, 2020 via an advertisement inviting eligible CloudResearch panel members to complete the survey. Data collection was ongoing until the target sample size for all demographic targets was reached (i.e., a minimum of 1,500 total participants with a distribution similar to the US adult population based on age, sex and race/ethnicity) (U.S. Census Bureau, 2021). We received 2,307 complete survey responses. We excluded participants who indicated they did not live in the US ( $n = 2$ ), completed the survey unrealistically quickly (in <10 min) ( $n = 240$ ), or who failed to answer attention check questions correctly ( $n = 309$ ) resulting in a final analytic sample of 1,756. This study was determined to be exempt by the University of Michigan Institutional Review Board.

### 2.1. Measures

Survey questions related to FAFH were based on existing or minimally modified questions from the National Health and Nutrition Examination Survey (NHANES) (Centers for Disease Control and Prevention, 2021). Fast-food and other restaurants dining behaviors were assessed during the past seven days and during a typical week before the COVID-19 outbreak began in March 2020. Participants were asked, “In the past 7 days, how many times did you eat food from a restaurant (do NOT include fast-food restaurants such as McDonald’s or Burger King)?” and “In the past 7 days, how many times did you eat food from a fast-food restaurant (e.g. McDonald’s or Burger King)?” For both questions, participants were instructed to include take-out, delivery, drive through, or curbside pick-up.

To measure other restaurant dining prior to the COVID-19 pandemic, participants were asked “Before the COVID-19 outbreak began in March 2020, during a typical week, how frequently did you eat out at restaurants?” and the same question about fast-food restaurants. For these two questions participants were instructed to include eating in the restaurant and getting take-out, or delivery. For all four questions about eating food from restaurants response options ranged from 0 times to 30 times.

We created two binary measures of current restaurant dining behaviors: 1) eating food from fast-food restaurants at all during the past seven days (vs. 0 times), and 2) eating food from other restaurants at all during the past seven days (vs. 0 times). We also categorized current and pre-COVID-19 other restaurant and fast-food dining into four category variables (one variable for each combination of time period and restaurant type [e.g., pre-COVID fast-food frequency]): 1) 0 times, 2) 1 time, 3) 2 times, 4)  $\geq 3$  times, during the past 7 days. Finally, we created two measures of whether participants frequented 1) fast-food and 2) other restaurants in the past seven days less often, the same, or more often compared to a typical week pre-COVID-19, which were calculated based on differences in continuous frequency measures of all variables.

Diet quality was measured using the Prime Diet Quality Score (PDQS), a food-based diet quality index (Gicevic, Mou, Bromage, Fung, & Willett, 2021). The PDQS measures intake of the 22 component foods/food groups over the last 30 days with seven possible responses for each component ranging from “once a month or less” to “ $\geq 2$  times/day.” Responses are coded from 0 to 6 with unhealthy components (e.g., processed meats, refined grains, sugar-sweetened beverages) scored in reverse and the neutral component (e.g., eggs) not scored. Scores are then summed to create a PDQS total diet quality score with a possible score from 0 to 126 with higher scores indicating a healthier diet. Prior validation studies have compared PDQS to other standard measures of diet (ASA-24) and diet quality (Healthy Eating Index [HEI]-2015) scores and found it to be a reliable and valid measure (more

information about the development and validation of the PDQS is available elsewhere) (Fung, Isanaka, Hu, & Willett, 2018; Gicevic et al., 2018, 2021).

Covariates included age (18–39, 40–59, ≥ 60), sex (male, female, other), race/ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, Asian, other), marital status (single, married, divorced/separated/widowed, living with a partner), presence of children <18 years old in the household (yes/no), household income (<\$35,000, ≥\$35,000), education (High school degree/GED [i.e., a high school equivalency diploma] or less, some college, college degree or higher), student status (yes, no), employment status (full time, part time, unemployed/looking for work, out of the labor force), and food security status (food secure [high or marginal food security] and food insecure [low or very low food security] based on the 18-item US Household Food Security Survey Module) (United States Department of Agriculture).

2.2. Analysis

First, we used chi-squared tests to examine the demographic characteristics of adults with low-income associated with consuming foods from fast-food and other restaurants at all during the last 7 days. Next, we used negative binomial regressions to examine the mean frequency of eating food from fast-food and other restaurants, adjusted for all socio-demographic characteristics. Frequency of fast-food dining was estimated among people who ate at fast-food restaurants at all in the last 7 days, and frequency of other restaurant dining was estimated among those who ate at other restaurants at all in the last 7 days. We used post-estimation margins to estimate predicted mean visits by each covariate. A sensitivity analysis also re-estimated those models, mutually adjusting for frequency of eating at each restaurant type. We then examined the differences in fast-food and other restaurant dining in the last 7 days compared to prior to the COVID-19 pandemic using chi-squared analyses. Finally, we used linear regression models to examine the associations between fast-food and other restaurant dining frequency and diet quality. We examined unadjusted associations, and models accounting for the socio-demographic covariates, and a third set of models that mutually adjusted for fast-food and other restaurant dining frequency. All analyses were conducted in Stata version 15.0 (StataCorp, College Station, TX); all tests were two-sided; and significance was considered at  $p < 0.05$ .

3. Results

Participant demographics overall and among those who frequented fast-food and other restaurants at least once in the past seven days are presented in Table 1. Among the 1,756 lower-income adults who completed the survey, over half of participants (55%) reported eating fast-food in the last 7 days and 44% reporting consuming foods from other restaurants during that time period, primarily among participants who had incomes of <\$35,000 per year. Differences in fast-food consumption (during the past week) were also observed across participant demographics, with a greater percentage of adults who were male, younger age, and single reporting fast-food consumption.

When examining the average number of times fast-food or foods from other restaurants were consumed over the past week (among participants who reported any consumption of foods from fast-food or other restaurants), participants reported consuming these foods on average twice per week from both fast-food and other restaurants, with greater frequency from fast-food restaurants (Table 2). Frequency of fast-food consumption was lower among participants who were female, working part-time, or older (40–59 years or 60 years and older), but higher among those who were non-Hispanic Black or Hispanic. In secondary analysis that mutually adjusted for fast-food and other restaurant frequency (Supplemental Table 1), on average, individuals who frequently ate fast-food (3+ times per week) were more likely to also eat at other restaurants frequently (and vice versa). Additionally,

**Table 1**  
Description of the study sample.

Variable	Overall	Ate at a fast-food restaurant in the last 7 days		Ate at other types of restaurants in the last 7 days	
	N (%)	N (%)	p-value	N (%)	p-value
<b>Total</b>	1,756 (100)	961 (55)		770 (44)	
<b>Food security status</b>					
Food secure	988 (56.8)	518 (54)	0.011	419 (55)	0.142
Food insecure	751 (43.2)	440 (46)		345 (45)	
<b>Age</b>					
18-39	798 (45.4)	514 (53)	<0.001	412 (54)	<0.001
40-59	496 (28.3)	274 (29)		213 (28)	
≥60	462 (26.3)	173 (18)		145 (19)	
<b>Sex</b>					
Male	847 (48.2)	487 (51)	0.024	381 (50)	0.264
Female	892 (50.8)	462 (48)		379 (49)	
Other	17 (1.0)	12 (1)		10 (1)	
<b>Race/Ethnicity</b>					
Non-Hispanic White	1,119 (64)	584 (61)	0.001	475 (62)	0.031
Non-Hispanic Black	195 (11)	114 (12)		83 (11)	
Hispanic	252 (14)	165 (17)		129 (17)	
Asian	115 (7)	64 (7)		57 (7)	
Other	75 (4)	34 (4)		26 (3)	
<b>Marital Status</b>					
Single, never married	673 (38)	396 (41)	<0.001	309 (40)	<0.001
Married	538 (31)	308 (32)		250 (33)	
Separated, divorced, widowed	354 (20)	150 (16)		120 (16)	
Living with a partner	186 (11)	105 (11)		89 (12)	
<b>Children &lt; 18 years of age in home</b>					
No	1,231 (70)	616 (64)	<0.001	495 (64)	<0.001
Yes	525 (30)	345 (36)		275 (36)	
<b>Income</b>					
< \$35,000/year	1,067 (61)	534 (56)	<0.001	401 (52)	<0.001
≥ \$35,000/year	689 (39)	427 (44)		369 (48)	
<b>Education</b>					
High school/GED	568 (32)	312 (33)	0.053	226 (29)	0.056
Some College	588 (34)	342 (36)		266 (35)	
College/graduate degree	600 (34)	307 (32)		278 (36)	
<b>Employment Status</b>					
Working full time	474 (27)	312 (33)	<0.001	255 (33)	<0.001
Working part time	230 (13)	138 (14)		108 (14)	
Unemployed	269 (15)	138 (14)		109 (14)	
Out of labor force	783 (45)	373 (39)		298 (39)	

differences by age remained the same with younger adults (ages 18–39) consuming fast-food more frequently, as well as more frequent fast-food consumption among individuals who were Hispanic. Differences were also observed by educational attainment; adults who were college graduates consumed fast-food less frequently than those with a high

**Table 2**  
Frequency of dining at fast-food and other restaurants in the past week during the COVID-19 Pandemic.<sup>a</sup>

	Number of times individuals ate at a fast-food restaurant in the last 7 days (N = 961)		Number of times individuals ate at a restaurant in the last 7 days (N = 770)	
	Predicted Mean Visits	95% CI	Predicted Mean Visits	95% CI
<b>Food security status</b>				
Food secure [ref]	2.21	(2.05, 2.37)	1.97	(1.81, 2.12)
Food insecure	2.34	(2.16, 2.51)	2.12	(1.95, 2.29)
<b>Age</b>				
18-39 [ref]	2.48	(2.30, 2.66)	2.10	(1.93, 2.27)
40-59	2.13*	(1.92, 2.34)	2.06	(1.85, 2.28)
≥60	1.85**	(1.58, 2.12)	1.79	(1.50, 2.08)
<b>Sex</b>				
Male [ref]	2.39	(2.22, 2.56)	2.20	(2.03, 2.37)
Female	2.13*	(2.00, 2.29)	1.86**	(1.71, 2.02)
Other	2.72	(1.58, 3.85)	2.14	(1.08, 3.20)
<b>Race/Ethnicity</b>				
Non-Hispanic White [ref]	2.12	(1.98, 2.26)	1.94	(1.80, 2.08)
Non-Hispanic Black	2.53*	(2.17, 2.88)	2.37*	(1.99, 2.74)
Hispanic	2.49*	(2.20, 2.78)	2.05	(1.78, 2.33)
Asian	2.50	(2.02, 2.98)	2.17	(1.74, 2.60)
Other	2.34	(1.72, 2.96)	2.27	(1.63, 2.91)
<b>Marital Status</b>				
Single, never married [ref]	2.19	(2.01, 2.37)	2.04	(1.86, 2.23)
Married	2.22	(2.00, 2.44)	2.03	(1.81, 2.25)
Separated, divorced, widowed	2.47	(2.13, 2.80)	2.00	(1.70, 2.30)
Living with a partner	2.46	(2.10, 2.83)	2.08	(1.74, 2.41)
<b>Children &lt; 18 years of age in home</b>				
No [ref]	2.32	(2.16, 2.48)	2.10	(1.95, 2.26)
Yes	2.18	(1.98, 2.38)	1.92	(1.73, 2.12)
<b>Income</b>				
< \$35,000/year [ref]	2.27	(2.11, 2.43)	2.14	(1.96, 2.31)
≥ \$35,000/year	2.27	(2.08, 2.45)	1.93	(1.77, 2.10)
<b>Education</b>				
High school/GED [ref]	2.41	(2.20, 2.62)	2.07	(1.85, 2.28)
Some College	2.23	(2.04, 2.42)	1.85	(1.67, 2.03)
College/graduate degree	2.17	(1.97, 2.37)	2.19	(2.00, 2.39)
<b>Employment Status</b>				
Working full time [ref]	2.33	(2.12, 2.55)	2.18	(1.97, 2.40)
Working part time	1.95*	(1.68, 2.22)	1.81*	(1.53, 2.09)
Unemployed	2.43	(2.11, 2.74)	2.06	(1.76, 2.35)
Out of labor force	2.27	(2.08, 2.48)	1.98	(1.79, 2.17)

Note: Negative binomial regression model adjusted for age, sex, race, marital status, presence of children <18 years old in the home, household income, education, employment status, and food security status. Results in the table are

number of predicted visit based on post estimation margins.

Difference from reference category significant at \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

<sup>a</sup> Limited to participants who reported any dining at fast-food or other restaurants in the past 7 days.

school/GED degree or less. When examining other restaurant consumption, the frequency was lower among females or those working part-time, but greater among individuals who were non-Hispanic Black. No significant differences in other demographic characteristics (e.g., marital status, presence of children, etc.) were observed.

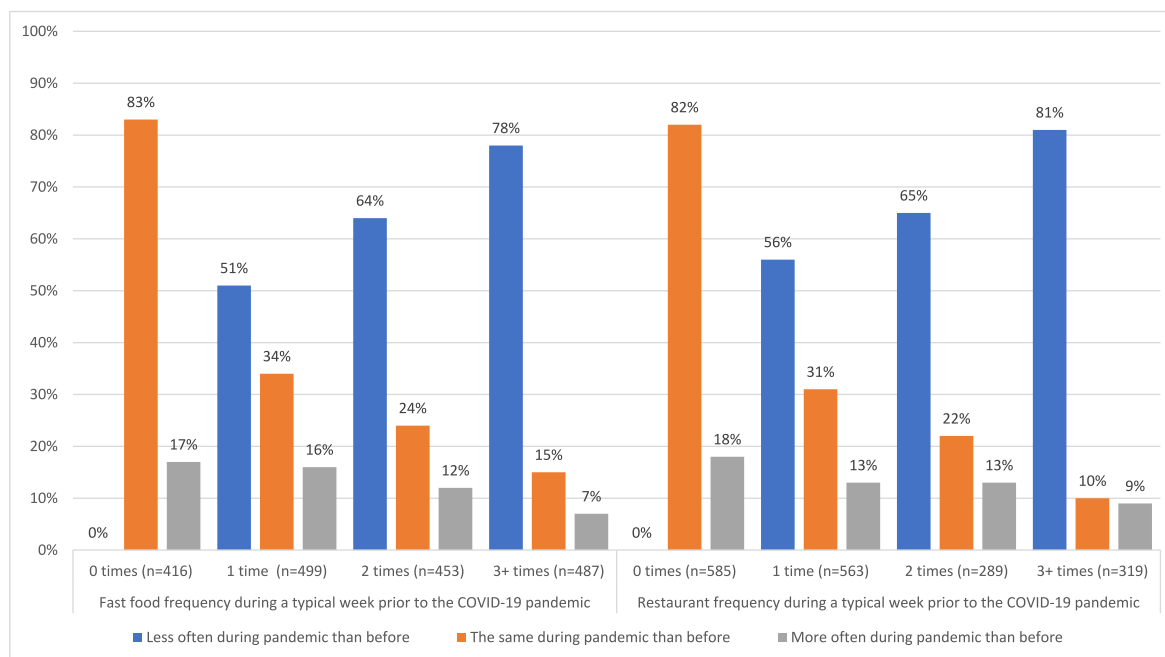
The frequency of consuming fast-food in the past 7 days compared to a typical week prior to COVID-19 is presented in Fig. 1. Among adults who reported that they did not eat fast-food in a typical week prior to the COVID-19 pandemic, 83% continued to not eat fast-food during the pandemic. Across all frequencies of prior fast-food consumption (1, 2 or 3+ times per week), a greater percentage of individuals reported eating fast-food less often during the pandemic. Among those who ate at fast-food restaurants 1 time per week prior to the pandemic, 34% continued to do so and 16% reported eating fast-food more frequently during the pandemic. Nearly one-quarter (24%) of those who ate fast-food 2 times per week prior to the pandemic did so during the pandemic as well. Similarly, when examining the frequency of consuming foods from other restaurants, among individuals who reported that they did not eat at other restaurants in a typical week prior to COVID-19, 82% continued to not eat at other restaurants during the pandemic. Among adults who did consume foods from other restaurants prior to the pandemic, a reduction in frequency was also reported with more individuals reporting they ate at other restaurants less often during the pandemic.

Associations between fast-food and other restaurant consumption and diet quality are shown in Table 3 (with higher scores indicating a healthier diet). Fast-food consumption was inversely associated with PDQS scores; compared with adults who did not eat fast-food (PDQS Score = 55.9), individuals who had fast-food two times per week had a PDQS score of 52.4 (p < 0.001) and those who ate fast-food 3 or more times per week had a PDQS score of 51.3 (p < 0.001). There were no significant differences in PDQS score by frequency of consuming foods in other restaurants. There were, however, differences in PDQS scores by different combinations of consuming fast-food and other restaurant foods, jointly; lower PDQS scores were observed with greater fast-food consumption and less frequent other restaurant consumption, and conversely, higher scores were observed among individuals who ate at other restaurants more often but less frequent fast-food consumption.

#### 4. Discussion

This study found that during the early months of the COVID-19 pandemic, there was regular fast-food consumption among adults with low-income (on average twice per week), especially among those who were younger, male, and/or single. Greater consumption of fast-food was also observed among those who were non-Hispanic Black, Hispanic or with lower educational attainment (compared with those who were non-Hispanic White or with a graduate degree, respectively). Additionally, frequent fast-food consumption (3 or more times per week) was also associated with frequent dining from other restaurants as well. While adults with lower-income reported consuming FAFH on average twice per week during the pandemic, the majority reported that they dined out even more frequently previously. During the pandemic, greater fast-food consumption was consistently associated with poorer diet quality, although higher diet scores were observed among people who ate at other restaurants (e.g., fast casual and full-service dining).

The self-reported reductions in fast-food and other restaurant dining frequency in the present study is consistent with other recent research conducted during the pandemic. Dube et al. documented substantial reductions in restaurant dining in several countries (including Australia,



**Fig. 1.** Self-reported difference in frequency of eating out before vs. during the COVID-19 pandemic. Note: Based on cross tabulation between frequency of eating in fast food or other restaurants during a typical week prior to the COVID-19 pandemic and the within-person difference in eating out pre-covid vs during covid and frequency of eating out pre-covid.

**Table 3**  
Diet quality associated with eating out during the COVID-19 pandemic.

	Unadjusted			Adjusted*			Mutually Adjusted**		
	Coef (SE)	Predicted PDQS Score	p-value	Coef (SE)	Predicted PDQS Score	p-value	Coef (SE)	Predicted PDQS Score	p-value
<b>Fast-food</b>									
0 times	[REF]	55.6		[REF]	55.9		[REF]	56.2	
1 time	-1.93 (0.70)	53.7	0.006	-2.33 (0.68)	53.6	0.001	-2.60 (0.71)	53.6	<0.001
2 times	-2.99 (0.83)	52.6	<0.001	-3.52 (0.81)	52.4	<0.001	-3.98 (0.83)	52.2	<0.001
3+ times	-4.02 (0.83)	51.6	<0.001	-4.69 (0.83)	51.2	<0.001	-5.72 (0.92)	50.5	<0.001
<b>Restaurants</b>									
0 times	[REF]	53.9		[REF]	54.3		[REF]	53.6	
1 time	0.05 (0.72)	54.0	0.948	-0.67 (0.70)	53.6	0.337	0.34 (0.71)	53.9	0.633
2 times	0.74 (0.88)	54.7	0.403	-0.14 (0.86)	54.1	0.867	1.34 (0.88)	54.9	0.127
3+ times	0.40 (0.98)	54.3	0.682	-0.19 (0.97)	54.1	0.843	2.60 (1.05)	56.2	0.013

Note: Linear regression models adjusted for age, sex, race, marital status, presence of children <18 years old in the home, household income, education, employment status, and food security status.

\*\* Model is mutually adjusted for fast-food and restaurant frequency. Covariates from the adjusted model are also included.

Canada, Germany, Ireland, Mexico, and the United Kingdom) due to various lockdown policies (Dube, Nhamo, & Chikodzi, 2021). In the U. S., a study that examined fast-food consumption more broadly found that the percentage of adults who reported eating fast-food at least three times per week decreased from 37.7% to 33.3% during the beginning of COVID-19 (Chen et al., 2021). It is noteworthy that while there were reductions in fast-food consumption relative to prior to the pandemic, overall rates were still high with over half of participants reporting fast-food consumption in the past week. This is important because similar to previous research, this study found poorer diet quality scores among adults who consumed fast-food more frequently (Todd, 2017). However, contrasting with prior studies, this study found that those with the relatively lowest incomes (less than \$35,000 per year) consumed fast-food more frequently (Fryar et al., 2018). It is possible that this may have been due to differential impacts of the pandemic by income, with those with the fewest resources more likely to have to work outside the home at the beginning of the pandemic and therefore more likely to get fast-food takeout for meals (Wolfson & Leung, 2020).

Surprisingly, this study found no association when examining more frequent other restaurant consumption and diet quality in general. Conversely, prior research has found that consumption of food away from home is associated with poorer diet quality (Binkley, 2008; Todd, 2017). It is possible that these results are directly associated with other restaurant dining (e.g., if there was a shift to more limited but relatively healthier dining options during the pandemic), or potentially due to residual confounding if fast casual/full-service restaurant consumption (which is typically more expensive than fast-food dining) was associated with having greater resources more broadly.

This study also found differences by race/ethnicity with the greatest fast-food consumption during the pandemic among adults who identified as non-Hispanic Black or Hispanic. Research conducted before COVID-19 similarly found greater fast-food consumption among racial and ethnic minority populations (Fryar et al., 2018). It is possible that these disparities in consumption rates are due to the continuation of habitual dietary behaviors, differences in fast-food locations, which tend to be skewed toward neighborhoods with greater minority populations,

or less access to grocery stores (Block, Scribner, & DeSalvo, 2004; James, Arcaya, Parker, Tucker-Seeley, & Subramanian, 2014). Additionally, previous research has documented the targeted marketing by fast-food restaurants to these populations, which may influence consumption (Cohen et al., 2021; Harris, 2020; Kumanyika & Grier, 2006). Lastly, disparities in access to healthy, affordable food options in racial/ethnic minority communities may have widened during the pandemic (e.g., due to long lines and limited inventory in grocery stores and local markets), and therefore fast food drive-thru options may have provided quick and inexpensive access to food.

This study had several limitations. First, this study relied on participants' self-reported fast-food and other restaurant dining frequency. However, this type of recall, similar to food frequency questionnaires, is an established and validated method (Willett, 2012). Additionally, the study included a large sample size that was census-matched to the overall US population. However, the online survey was conducted only in English and this, and the online distribution method, may have excluded individuals who had limited internet access or did not speak English. In addition, the participants were limited to adults with lower-incomes, and this is a population that may have been particularly impacted by the pandemic, especially with regards to access to healthier food choices. Future studies should also examine the impact of the pandemic on dining behavior among adults more broadly, as well as among children.

In conclusion, this study found that while the COVID-19 pandemic was associated with reductions in fast-food and other restaurant dining among adults with low income, overall rates remained relatively high with over half of participants consuming fast-food in the week prior. Fast-food consumption was greatest among racial and ethnic minority populations, as well as among those who were younger, male, and single. Additionally, greater fast-food consumption was associated with poorer diet quality. Overall, these results suggest the continued need for initiatives and policies to encourage greater access to and consumption of affordable and healthier food choices.

#### Ethical statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and was determined to be exempt by the University of Michigan Institutional Review Board. Electronic informed agreement to participate was obtained from all subjects involved in the study.

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#### Data availability statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

#### Author contributions

Conceptualization, J.A.W.; methodology [insert all initials]; formal

analysis [J.A.W. & Hannah]; writing—original draft, J.F.W.C.; writing—review and editing, [insert all initials]. All authors have read and agreed to the published version of the manuscript.

#### Declaration of competing interest

None.

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Not applicable.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2022.105976>.

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