General

Original Article

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How did the dietary habits of patients with chronic medical conditions change during COVID-19?

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Abstract

Context: Previous studies have examined the changes in the dietary habits of general populations during the COVID-19 pandemic but have not focused on specific populations such as those with chronic medical conditions (CMCs). Prior to major vaccination efforts, 96.1% of deaths were attributed to patients with preexisting CMCs, thus it is important to examine how this population has endured changes.

Objectives: The purpose of this study was to identify differences in dietary habits, lifestyle habits, and food attitudes between those with CMCs compared to the populations without chronic medical conditions (non-CMCs) since the beginning of the COVID-19 pandemic.

Methods: An online cross-sectional study was conducted from May 2021 to July 2021. Participants (n=299) responded to a 58-item questionnaire regarding demographics (n=9), health information (n=8), lifestyle habits (n=7), dietary habits (n=28), and food attitudes (n=6). Frequency counts and percentages were tabulated, and t-test sampling and ANOVA testing were conducted to examine the associations utilizing SPSS V28 at a statistical significance level of $p<0.05$.

Results: When compared to non-CMC participants, with CMCs had a less frequent change in their diet and had better food attitudes when it came to consumption habits. Non-CMC and CMC participants had no statistically significant differences in overall dietary habits; however, an examination of specific food items reviews significant findings. Compared to non-CMC participants, those with CMCs reported significantly decreased consumption of energy-dense food such as French fries, white pasta, sweets, and salty snacks, with notable exceptions in increased consumption of energy-dense foods, starchy veggies, and vegetable/tomato juice.

Conclusions: These findings indicate that participants with CMCs indicated that fewer changes occurred in participants with a CMC; however, when these participants made changes, they were beneficial to their consumption habits. Future studies should aim to develop interventions for the demographics with poor dietary habits so that those that are most vulnerable may have their needs met.

Keywords: adults; chronic medical conditions; COVID-19; dietary habits; food attitudes; lifestyle habits.

Over the past 2 years, the COVID-19 pandemic has forced drastic changes in various aspects of normal life for millions worldwide. As of August 2022, there have been over 89.8 million cases of COVID-19 reported nationwide and over 1.019 million deaths in the United States [1, 2]. This pandemic has caused many policymakers and government entities to establish mandates to stop the spread of this virulent and contagious pathogen. These changes include social distancing protocols, recommendations on staying indoors, and limitations on the number of occupants in public spaces, such as grocery stores. These mandates have not only limited individuals' means of engaging in the public setting but also led to changes in habits among those who have been staying at home. This pandemic has caused major economic impacts on a variety of different industries across the United States, leading to a variety of effects on consumers throughout the country [3].

Researchers noted an adverse effect of these major shifts when examining changes in dietary habits among the general US population. A 2020 study from researchers in Spain examined adolescent participants (n=820) from Spain, Italy, Brazil, Colombia, and Chile, and found that they did not increase their overall diet quality but showed that they increased their consumption of legumes by 2.3%, fruit by 0.6%, and vegetables by 1.3%, and their consumption of sweet and fried foods by 20.7% [4]. Thus, this showed that there were increases in both healthy and unhealthy food consumption. Moreover, a 2020 study

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examining the general population in the United States found that 43.6–87.4% of their participants (n=3,133) had "indicated no change in dietary habits yet they reported increased consumption of sweets (43.8%) and salty snacks (37.4%)" [5]. Even though there have been studies looking at the changes in dietary consumption in adolescents in other countries, and the general population in the United States, no studies at this time have looked at those most afflicted by the COVID-19 pandemic. Further, as of August 2022, the Center of Disease Control and Prevention (CDC) reported 1,019,432 confirmed deaths as a result of COVID-19, of which numerous patients had one or more chronic medical conditions (CMCs). For example, among the 1,019,432 deaths, 187,745 patients had hypertensive disease, 153,198 patients had experienced diabetes, 114,534 had renal failure, 109,378 had an ischemic heart disease, and 50,432 patients were classified as having a body mass index (BMI) greater than 30 via the CDC definition [1]. It should be noted that this database did not distinguish which of these patients had one or more of the CMCs.

Considering that a large majority of individuals afflicted by COVID-19 have CMCs, it is vital to understand how the dietary patterns of this group have been affected by the COVID-19 pandemic [6]. This study will examine and compare the differences between those with CMCs and those without CMCs (non-CMCs) to differential changes in dietary habits during the pandemic. This study will assess changes in lifestyle, diet, food consumption and habits, and perceptual changes in dietary attitudes due to the COVID-19 restrictions. Diet plays a monumental role in helping patients manage their CMCs. For example, patients with a BMI of 25.0 and higher need to manage their diet because it can predispose them to type 2 diabetes and heart disease. Moreover, patients at risk for heart disease and stroke must manage their sodium intake, which is tied to increased blood pressure, and must monitor their cholesterol levels [7]. Lastly, patients with type 2 diabetes must monitor their sugar intake and make efforts to maintain a normal body weight. Overall, patients with CMCs must take an active role to consume foods that aid in maintaining their condition and ensure adequate nutrition for their daily functioning. Given the extensive rigid dietary stipulation that this population has on their daily intake, it is hypothesized that participants with CMCs will have no to lesser frequent instances of change in their dietary intake compared to non-CMC patients. However, considering the major societal changes that were caused by the COVID-19 pandemic, it is likely that patients with CMCs had negative changes pertaining to their lifestyle habits, food consumption, and access to food compared to non-CMC participants. With this understanding in mind, it is vital to understand how the COVID-19 pandemic has led to changes in the dietary behaviors of those with CMCs and how this has affected their health management.

Methods

Study design and participants

This cross-sectional study was conducted online through the online survey platform Qualtrics (Qualtrics, Provo, UT) from May to July 2021. Recruitment was voluntary and anonymous and occurred through social media platforms and in person at the cardiology practice, Cardiology Associates (Lanham, MD) and at American Diversity Group Events (Columbia, MD). Cardiology Associates is a group of practitioners that sees individuals with cardiac conditions and other comorbidities affecting their cardiovascular health. All patients that came to the practice between June 1st and June 25th were asked to participate in the survey and were given the option to not participate. The American Diversity Group is a nonprofit group based in the Washington D.C., Maryland, and Virginia region that focuses on promoting the health of communities via free health care screenings, food drives, and flu shot clinics. Individuals attending these events were asked to fill out the survey if they wanted, while waiting to be seen by a practitioner or waiting to receive their flu shots. Moreover, all in-person participants took the survey by scanning a QR code or on an iPad with the survey preloaded on it. Adults were eligible to participate if they were above the age of 18 and were able to read in the English language and lived in the United States during COVID-19. All subjects gave their informed consent for inclusion before they participated in the study, via electronic forms. A total of 339 adults initially participated: after excluding nonresponses or incomplete surveys, the final data set included 299 participants. All study protocols were granted ethical approval by Rowan University School of Osteopathic Medicine Institutional Review Board (PRO-2021-434) via exempt review.

Questionnaire

Participants responded to a 58-item questionnaire (Appendix A) regarding demographics (n=9), health information (n=8), lifestyle habits (n=7), dietary habits (n=28), and food attitudes (n=6) [5]. This questionnaire was developed by previous researchers at the University of Florida, who examined general trends in changes in dietary habits during the COVID-19 pandemic [5]. This research group also provided modifications to provide clarity for certain questions and measures utilized. This study aimed to replicate the previous study with the added emphasis on participants with CMCs. The total length of time to complete the questionnaire was estimated at 15 min. The demographic questions (n=9) included age, sex, race/ethnicity, education level, marital status, employment status, number of household residents, geographic location of residence, and time spent at home since COVID-19. The definition of a CMC for this study was defined as those conditions accepted as CMCs by the Centers for Medicare and Medicaid Services [8]. These conditions, in conjunction with those provided from the CDC provisional data, were provided to participants to select which conditions they did or did not have. Health information questions (n=8) that were self-reported by the participants included current height reported in feet and inches and weight reported in pounds. Utilizing the CDC classification for BMI, participant metrics were then utilized to calculate the BMI (body mass [kg]/height [m^2]) of each participant [9]. Additional health questions were related to weight changes, health conditions, supplement use, supplements taken, and if participants followed or started a diet since COVID-19 (Table 2).

Lifestyle habits

Questions about lifestyle habits pertained to understanding how physical and social activities were affected during COVID-19. Participants indicated whether they experienced an increase (+1), decrease (−1), or no change (0) for these associated statements. Total scores for unfavorable health practices were generated based on whether the statement was associated with an increase in a negative lifestyle habit, such as eating, watching TV, or smoking, or with a decrease in positive lifestyle habits, such as exercising, physical activity, sleep amount/quality, reading/studying, or socialization, each of which was given a score of −1. Total scores for favorable health practices were generated based on whether the statement was associated with a decrease in a negative lifestyle habit, such as eating, watching TV, or smoking, or with an increase in positive lifestyle habits, such as exercising, physical activity, sleep amount/quality, reading/studying, or socialization, each of which was given a score of +1. These values were scored on a scale from −7 to +7. This lifestyle habits questionnaire has been utilized in previous studies in different adaptations, but no clear validated version of this questionnaire existed at the moment [5, 10].

Dietary habits

Participants completed a section about dietary habits based on foods/beverages consumed during the COVID-19 pandemic. The foods and beverages listed were based on the Dana-Farber Cancer Institute Eating Habits Questionnaire [11]. The questionnaire originally contained 61 food/beverage items, which was later modified by other researchers to contain 37 grouped food/beverage items [5]. These 37 grouped food/beverage items were assessed in 28 questions that the participants answered. The intent of this change was to prevent survey exhaustion [12, 13]. This modified questionnaire was utilized during this study to control the same factors. For dietary habits, total scores were determined based on whether the participant selected increased (+1), decreased (−1), or no change (0) in these habits since COVID-19 [5]. The first general category was energy-dense food items (i.e., high in sodium, added sugars, and total fat), which included: cheese, butter/margarine, fruit juice, vegetable/tomato juice, processed meats, red meats, refined grains (e.g., white bread/rice), chips, sweets, alcohol (e.g., beer, wine, spirits), and carbonated added-sugar beverages [14, 15]. Selecting an increase in an energy-dense food item was given a score of −1 and a decrease in an energy-dense food item was given a score of +1. The second general category was nutrient-dense food items (i.e., low in sodium, added sugars, and total fat), which included: milk and yogurt, fresh/frozen/canned fruits and vegetables, chicken and fish, whole grains (e.g., whole wheat/brown bread/rice), water, noncarbonated beverages with no added sugar, immune-enhancing beverages, coffee/tea, and protein shakes [14, 15]. Selecting increase in nutrient dense food/beverage items were given a score of +1, and a decrease in these items was given a score of −1. Total scores ranged from −28 to +28 points. An additional variable was generated from the Dietary habit questionnaire. This variable was referred to as 'Frequency of no change,' and this variable noted the number of instances a participant selected that no change resulted in a score of 0. This metric was utilized to assess the relative status in a participant's dietary habits based on the frequency of no change occurring during a participant's responses. The total scores ranged from 0 to +28 points.

Food attitudes

Participants indicated an increase, decrease, or no change (never had these thoughts) in eight statements regarding food attitudes since COVID-19 [5]. This portion of the survey was derived from the Yale Food Addiction Scale and included statements about eating much more than planned, overeating, lethargy after eating, and stress behaviors [16]. The original addiction scale had 16 statements and was reduced to 6 statements. The score ranged from 1 (never) to 5 (4 or more times daily) during the past 12 months. Previous researchers have confirmed the validity of this questionnaire. An increase was given a score of +1, a decrease in these statements was given a −1, and a no change was given a score of 0. The total score ranged from −6 to +6.

Statistical analysis

Data were analyzed utilizing frequencies, descriptive statistics, independent sample t-tests, and ANOVA with post hoc Tukey's tests. The level of significance for all tests was $p \leq 0.05$. With regard to a power analysis, the software G*Power was utilized to estimate the necessary sample size. Given the following criteria of having a two-tailed independent t-test, with an effect size of 0.5, an alpha value of 0.5, a power of 0.8 and a group ratio of 5:1, the sample size (n) of each CMC and non-CMC group of patients was well over the necessary number of participants needed to examine the population of interest. The normality of the distribution and the homogeneity of variance were conducted, and when skewness was calculated, there were variables less than 1.0–2.0, which indicated that the data were robust with respect to deviations from normality. Independent-sample t-tests were utilized to examine differences between patients with CMCs and non-CMC patients for the following variables: weight change, diet and nutritional supplement implementation, food attitudes, lifestyle habits, dietary habit scores, and frequency of no change in diet. ANOVA with post hoc Tukey's tests were utilized to examine the differences between different racial/ethnic groups for the following variables: weight change, diet and nutritional supplement implementation, food attitudes, lifestyle habits, dietary habit scores, and frequency of no change in diet. The only variables that were recoded or modified were those based on the patients that indicated that they were diagnosed with "obesity/a BMI over 30." Participants indicated that this is their CMC, but those that did not meet the CDC criteria for the diagnosis were changed to non-CMC participants. Non-CMC participants who had a BMI greater than 30 but stated they had not been diagnosed with a CMC were reassigned to the CMC participant pool. No other variables were recoded or modified.

Results

Study population

The sample consisted of 299 respondents, and all participants responded to demographic or health statements. For those who responded to these statements, 44.5% were African American (133), 52.2% were female (156), 29.8% held a bachelor's degree (89), and 52.5% were employed

Table 1: Participant demographics.

Variables	No. of responses (%)
Sex	**n=299**
Male	143 (47.8%)
Female	156 (52.2%)
Other	0 (0.0%)
Race and ethnicity	**n=299**
African American	133 (44.5%)
Asian American	70 (23.4%)
White	50 (16.7%)
Hispanic	40 (13.4%)
Native American	0 (0.0%)
Other	6 (2.0%)
Age	**n=299**
18–24 years	36 (12.0%)
25–29 years	22 (7.4%)
30–49 years	55 (18.4%)
50–59 years	70 (23.4%)
60–69 years	66 (22.1%)
>70 years	50 (16.7%)
Education level	**n=299**
No schooling completed	9 (3.0%)
Nursery school to 8th grade	2 (0.7%)
Some high school, no diploma	18 (6.0%)
High school graduate, diploma, or the equivalent (for example, GED)	74 (24.7%)
Some college credit, no degree	29 (9.7%)
Trade/technical/vocational training	15 (5.0%)
Associate's degree	22 (7.4%)
Bachelor's degree	89 (29.8%)
Master's degree	25 (8.4%)
Professional degree	10 (3.3%)
Doctorate degree	6 (2.0%)
Current employment status	**n=299**
Full-time	157 (52.5%)
Part-time	50 (16.7%)
Unemployed	52 (17.4%)
Other	40 (13.4%)
Marital status	**n=299**
Married	160 (53.5%)
Single	94 (31.4%)
Widowed	26 (8.7%)
Divorced	13 (4.3%)
Other	6 (2.0%)
People that live in the household besides yourself	**n=299**
None	12 (4.0%)
1	48 (16.1%)
2	80 (26.8%)
3	72 (24.1%)
4	53 (17.7%)
5 or more	34 (11.3%)
Currently staying at home X% of the time	**n=299**
Less than 25.0%	42 (14.0%)
50.0–74.0%	123 (41.1%)
75.0–95.0%	126 (42.1%)
Never left the house	8 (2.7%)
Residence	**n=299**
New England (Connecticut, Maine, Massachusetts, Rhode Island, Vermont)	4 (1.3%)
Mid-Atlantic (New Jersey, New York, Pennsylvania)	76 (25.4%)
South Atlantic (Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, Washington DC, West Virginia)	203 (67.9%)
East North Central (Illinois, Indiana, Michigan, Ohio, Wisconsin)	8 (2.7%)
East South Central (Alabama, Kentucky, Mississippi, Tennessee)	2 (0.7%)
West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota)	5 (1.7%)
West South Central (Arkansas, Louisiana, Texas)	1 (0.3%)
Mountain (Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming)	0 (0.0%)
Pacific (Alaska, California, Hawaii, Oregon, Washington)	0 (0.0%)

GED, general educational diploma.

full-time (157). The sample's age range varied, with 23.4% between the ages of 50–59 years old (70). Among the participants, 53.5% were married (160), 67.9% lived in the South Atlantic region (203), 26.8% lived with at least two persons (80), and 42.1% had stayed in their homes 75.0–95.0% of the time during the pandemic (126) (Table 1).

Comparison between participants with and without chronic medical conditions

The independent-sample t-test of the seven variables —weight change, diet started, nutritional supplement consumption, food attitudes, lifestyle habits, dietary habits, and frequency of no change in dietary habits—was conducted between those with CMCs and without CMCs (non-CMCs) (Table 3).

There was no statistically significant difference (p=0.187) when comparing the weight experienced by non-CMC participants (n=61; mean=0.33; standard

Table 2: Participants' general health characteristics and anthropometrics.

Variables	No. of responses (%)
BMI, kg/m^2	**n=299**
<18	4 (1.3%)
18.5–24.9	103 (34.3%)
25–29.9	100 (33.4%)
30–34.9	69 (23.1%)
35–39.9	15 (5.0%)
40–44.9	3 (1.0%)
>45	5 (1.7%)
Weight change	**n=299**
No change	106 (35.5%)
Increased	128 (42.8%)
Decreased	65 (21.7%)
Tried a diet	**n=299**
No	159 (53.2%)
Yes	140 (46.8%)
Nutritional supplement intake	**n=299**
No	161 (53.8%)
Yes	138 (46.2%)
Supplements currently taking	**n=138**
Calcium	5 (3.6%)
Magnesium	2 (1.4%)
Multivitamin	38 (27.5%)
Iron	3 (2.2%)
Omega 3	9 (6.5%)
Omega 6	7 (5.1%)
Protein (bars, shakes, powder)	13 (9.4%)
Vitamin B complex	18 (13.0%)
Vitamin C	6 (4.3%)
Vitamin D	30 (21.7%)
Other	7 (5.1%)
Medical conditions	**n=299**
Chronic kidney disease	20 (6.7%)
COPD (chronic obstructive pulmonary disease)	8 (2.7%)
Obesity (BMI of 30 or higher)	32 (10.7%)
Immunocompromised state (weakened immune system) from solid organ transplant	9 (3.0%)
Serious heart conditions (heart failure, coronary artery disease, or cardiomyopathy)	79 (26.4%)
Sickle cell disease	6 (2.0%)
Type 2 diabetes	65 (21.7%)
None of the above	61 (20.4%)
Other	19 (6.4%)

BMI, body mass index; COPD, chronic obstructive pulmonary disease.

deviation [SD]=0.811; range, −1 to +1) and CMC participants (n=237; mean=0.18; SD=0.766; range, −1 to +1). There was no statistically significant difference (p=0.655) when comparing the diet started between non-CMC participants (n=61; mean=0.44; SD=0.501; range, 0 to +1) and CMC participants (n=237; mean=0.47; SD=0.500; range, 0 to +1). There was no statistically significant difference (p=0.597) when comparing the nutritional supplement consumption started between non-CMC participants (n=61; mean=0.49; SD=0.504; range=0 to +1) and CMC participants (n=237; mean=0.45; SD=0.499; range, 0 to +1). There was no statistically significant difference (p=0.082) when comparing the Dietary Habit scores between non-CMC participants (n=61; mean=2.41; SD=5.248; range, −28 to +28) and CMC participants (n=237; mean=3.69; SD=5.086; range, −28 to +28). There was no statistically significant difference (p=0.756) when comparing the Lifestyle Habit scores between non-CMC participants (n=61; mean=−0.87; SD=2.947; range, −7 to +7) and CMC participants (n=237; mean=−1.0; SD=2.816; range, −7 to +7). CMC participants (n=237; mean=−0.71; SD=3.450; range, −6 to +6) had statistically significantly lower Food Attitude scores (p=0.014) compared to non-CMC participants (n=61; mean=0.48; SD=3.031; range, −6 to +6). CMC participants (n=237; mean=11.75; SD=7.545; range, 0 to +28) had a statistically significant fewer Frequency of No Change scores (p=0.024), indicating less instances of changes in consumption of certain dietary food items when compared to non-CMC participants (n=61; mean=14.30; SD=8.878; range, 0 to +28).

When evaluating each food item, there were notable differences in several items that were consumed (Table 4). CMC participants (n=237; mean=−0.33; SD=0.701; range, −1 to +1) had a statistically significant (p=0.002) decrease in consumption of French fries and potatoes compared to non-CMC participants (n=61; mean=0.02; SD=0.719; range, −1 to +1). CMC participants (n=237; mean=−0.25; SD=0.732; range, −1 to +1) had a statistically significant (p=0.002) decrease in consumption of potato chips and salty snacks compared to non-CMC participants (n=61; mean=0.08; SD=0.759; range, −1 to +1). CMC participants (n=237; mean=−0.30; SD=0.706; range, −1 to +1) had a statistically significant (p=0.020) decrease in the consumption of sweets compared to non-CMC participants (n=61; mean=−0.07; SD=0.704; range, −1 to +1). CMC participants (n=237; mean=−0.08; SD=0.713; range, −1 to +1) had a statistically significant (p=0.043) decrease in the consumption of peanut butter and nut spreads compared to

Table 3: Independent-sample t-test for non-CMC and CMC participants.

	Non-CMC n=61		CMC n=238					
Variable	**Mean**	**SD**	**Mean**	**SD**	**T**	**Df**	**p-Value**	**Cohen's D point estimate**
Weight change	0.33	0.811	0.18	0.766	1.322	297	0.187	0.190
Diet started	0.44	0.501	0.47	0.500	−0.448	297	0.655	−0.064
Nutritional supplement consumption	0.49	0.504	0.45	0.499	0.530	297	0.597	0.076
Food attitudes	0.48	3.031	−0.71	3.450	2.460	297	0.014	0.353
Lifestyle habits	−0.87	2.947	−1.00	2.816	0.311	297	0.756	0.045
Dietary habits	2.41	5.248	3.69	5.086	−1.747	297	0.082	−0.251
Frequency of no change in diet	14.30	8.878	11.75	7.545	2.62	297	0.024	0.325

Summary of Independent T test. Variables that were compared to each of the seven major questions pertaining to changes in weight, implementation of a new diet, consumption of nutritional supplements, food attitudes, lifestyle habits, dietary habits, and no change in diet. The findings for the non-CMC and CMC groups are found in columns 2–5. The p value and Cohen's D point estimate are found in columns 8 and 9.

non-CMC participants (n=61; mean=0.13; SD=0.695; range, −1 to +1). CMC participants (n=237; mean=−0.16; SD=0.614; range, −1 to +1) had a statistically significant (p=0.002) decrease in the consumption of low-calorie beverages compared to non-CMC participants (n=61; mean=0.13; SD=0.695; range, −1 to +1). CMC participants (n=237; mean=−0.19; SD=0.744; range, −1 to +1) had a statistically significant (p=0.307) decrease in the consumption of margarine and butter compared to non-CMC participants (n=61; mean=0.03; SD=0.752; range, −1 to +1). CMC participants (n=237; mean=0.41; SD=0.722; range, −1 to +1) had a statistically significant (p≤0.001) increase in the consumption of vegetable and tomato juice compared to non-CMC participants (n=61; mean=0.07; SD=0.704; range, −1 to +1). All other food items that were examined showed no statistically significant differences (p>0.05) between those with CMCs and those without CMCs (non-CMCs).

Demographic analysis of age, race, and ethnicity

Independent-sample t testing was completed for age range. When evaluating the age range, participants were grouped into two conditions: those who are 18–49 years old and those that are 50 years and older. For all seven major variables, there were no statistically significant differences in weight change, nutritional supplement consumption, food attitudes, and lifestyle habits.

However, it was found that participants 18–49 years old (n=113; mean=0.58; SD=0.495; range, −1 to +1) had statistically significant (t [297]=3.171, p=0.002) increases in more instances of starting a new diet compared to participants 50 years and older (n=186; mean=0.40; SD=0.491; range, −1 to +1). Participants 50 years and older (n=186; mean=4.01, SD=4.738; range −28 to +28) had statistically significant (t [209.587]=−2.433, p=0.016) an increase in the consumption of healthier foods, i.e., higher dietary habit scores, compared to participants 18–49 years old (n=113; mean=2.48; SD=5.563; range −37 to +37). Participants 50 years and older (n=186; mean=13.46, SD=7.914; range 0 to +28) had a statistically significant (t [297]=−3.411, p=0.001) higher frequency of no change in dietary habit scores, compared to participants 18–49 years old (n=113; mean=10.31; SD=7.468; range 0 to +28).

There were differences in the consumption of certain food items between those who are 18–49 years old and those that are 50 years and older. Participants 50 years old and older (n=186; mean=−0.22; SD=0.705; range, −1 to +1) had a statistically significant (p=0.009) decrease in the consumption of white rice and pasta compared to participants 18–49 years old (n=113; mean=0.04; SD=0.876; range, −1 to +1). Participants 50 years old and older (n=186; mean=−0.05; SD=0.711; range, −1 to +1) had a statistically significant (p=0.019) decrease in the consumption of milk compared to participants 18–49 years old (n=113; mean=0.16; SD=0.786; range, −1 to +1). Participants 50 years old and older (n=186; mean=−0.32; SD=0.660; range, −1 to +1) had a statistically significant (p=0.033) greater decrease in the consumption of sweets compared to participants 18–49 years old (n=113; mean=−0.14; SD=0.778; range, −1 – +1). Participants 50 years old and older (n=186; mean=−0.15; SD=0.611; range, −1 to +1) had a statistically significant (p=0.039) decrease in the consumption of beer and wine compared to participants 18–49 years old (n=113; mean=0.02; SD=0.732; range, −1 to +1). Participants 50 years old and older (n=186; mean=0.45=SD, 0.721; range= −1 to +1) had a statistically significant (p=0.014) increase in the consumption of nonstarchy vegetables

Table 4: Independent-sample t-test for food items that were different between CMC and non-CMC participants.

	Non-CMC		CMC					
	n=61		n=238					
Food item	**Mean**	**SD**	**Mean**	**SD**	**T**	**Df**	**p-Values**	**Cohen's D point estimate**
French fries and potatoes	0.02	0.719	−0.31	0.701	3.194	297	0.002	0.458
Potato chips salty snacks	0.08	0.759	−0.25	0.732	3.157	297	0.002	0.453
Sweets	−0.07	0.704	−0.30	0.706	2.339	297	0.020	0.336
Peanut butter and nut spreads	0.13	0.695	−0.08	0.713	2.030	297	0.043	0.291
Low calorie beverages	0.13	0.695	−0.16	0.614	3.166	297	0.002	0.454
Margarine and butter	0.03	0.752	−0.19	0.744	2.113	297	0.307	0.303
Vegetable and tomato juice	0.07	0.704	0.41	0.722	−3.367	94.938	<0.001	−0.476

Summary of Independent T test showing the foods that were statistically significantly different between CMC and non-CMC. Variables in column 1 are the specific food items that differed. The means and standard deviations for non-CMC and CMC are shown in columns 2–5 and these means range from −1 (decreased), 0 (no change), or +1(increased). The p-value and the Cohen's D point estimate are found in columns 8–9.

compared to participants 18–49 years old (n=113; mean=0.21; SD= .860; range, –1 to +1). Participants 50 years old and older (n=186; mean=–0.18 SD=0.605; range, –1 to +1) had a statistically significant (p=0.003) decrease in the consumption of hard liquor compared to participants 18–49 years old (n=113; mean=0.04; SD=0.699; range, –1 to +1).

ANOVA test with post hoc Tukey's test for race and ethnicity

Participants self-identified their ethnicity or race, which was designated and given by the survey from prior research teams [5]. The participants chose from a traditional group of racial categories and reported all values for race/ethnicity, and were given the option to answer in free text. The impact of race and ethnicity was vital for this study because African Americans and Latinos have been disproportionally affected during the COVID-19 pandemic [17]. For example, 97.9 out of 100,000 African Americans have died from COVID-19. This mortality statistic is one-third higher than that of Latinos (64.7 per 100,000) and more than double that of whites (46.6 per 100,000) and Asians (40.4 per 100,000). Given these vast differences in various groups, it is important to understand the differences within these groups. The goals of examining race and ethnicity were to increase the generalizability and to reveal any significant differences between the groups.

Completion of ANOVA tested yielded varying results for the following variables when compared to the race and ethnicity of the participants: Asian American, African American, white, and Hispanic.

5There was a significant difference between race and ethnicity and lifestyle habits [F [3, 299]=4.000, p=0.008], dietary habits [F [3, 299]=4.044, p=0.008], and frequency of no change in diet habit scores [F [3, 299]=4.454, p=0.004]. The findings for diet implementation, nutritional supplement consumption, weight change, and food attitudes were insignificant when examining race and ethnicity. A post hoc Tukey's honestly significant difference (HSD) test was then performed, which generated mean differences between the race and ethnicity groups for each variable. Regarding lifestyle habits, white participants (n=50; mean=–2.06; SD=3.020; range –7 to +7) had statistically significant lower lifestyle habit scores (p=0.036) when compared to African American participants (n=133; mean=–0.77; SD=2.680; range, –7 to +7) and statistically significant lower lifestyle habit scores (p = .01) when compared to Asian American participants (n=70; mean=–0.40; SD=2.876; range, –8 to +8). Regarding dietary habit scores, African American participants (n=133; mean=4.58; SD=5.061; range, –28 to +28) had a statistically significant higher dietary habit score (p=0.034) when compared to Hispanic participants (n=40; mean=–1.40; SD=2.876; range, –28 to +28). Regarding the frequency of no change in dietary habit scores, Hispanic participants (n=40; mean=8.13; SD=6.102; range, 0 to +28) had statistically significant lower frequencies of no change in dietary habit scores (p=0.010) when compared to African American participants (n=133; mean=12.56; SD=7.645; range, 0 to +28) and statistically significant lower scores (p=0.003) when compared to Asian American participants (n=70; mean=13.46; SD=7.623; range, –28 to +28), and statistically significant lower scores (p=0.045) when compared to white participants (n=50; mean=12.54; SD=9.108; range, 0 to +28).

There was a significant different between race and ethnicity and the consumption of certain food items such as cold breakfast cereal (F [3, 299]=2.663, p=0.048), French fries (F [3, 299]=3.797, p=0.011), white rice/pasta (F [3, 299] =3.599, p=0.014), nuts and seeds (F [3, 299]=2.823, p=0.039), sweets (F [3, 299]=3.220, p=0.023), margarine/ butter (F [3, 299]=2.940, p=0.034), and nonstarchy vegetables (F [3, 299]=2.718, p=0.045). Regarding cold breakfast cereal consumption, Asian American participants (n=70; mean=0.10; SD=0.684; range, −1 to +1) had statistically significant higher consumption (p=0.039) of cold breakfast cereal compared to Hispanic participants (n=40; mean=−0.30; SD=0.823; range −1 to +1). Regarding French fries and potatoes consumption, African American participants (n=133; mean=−0.32; SD=0.702; range, −1 to +1) had statistically significant lower (p=0.013) consumption of French fries and potatoes compared to Asian American participants (n=70; mean=0.00; SD=0.702; range, −1 to +1). Regarding the consumption of sweets, African American participants (n=133; mean=−0.35; SD=0.675; range, −1 to +1) had a statistically significant lower consumption (p=0.036) of sweets compared to Asian American participants (n, 70; mean, −0.06; SD, 0.740; range, −1 to +1). Regarding nonstarchy vegetable consumption, African American participants (n=133; mean=0.48; SD=0.734; range, −1 to +1) had statistically significant higher consumption (p=0.042) of nonstarchy vegetables when compared to Hispanic participants (n=40; mean=0.10; SD=0.841; range, −1 to +1). However, due to the differences in sample size in each racial and ethnic group, the SPSS data analysis was unable to elucidate the true statistically significant differences between race and ethnicity for white rice/pasta, nuts and seeds, and margarine/butter.

Discussion

Data analysis revealed a statistically significant difference between participants with CMCs and without CMCs (non-CMCs) as it pertained to their ‘food attitudes’ and to ‘no change in their ‘dietary habits’. CMC participants had more negative food attitudes scores compared to non-CMC participants, indicating that during the COVID-19 pandemic CMC participants had better relationships with how they consumed food than non-CMC participants. This finding may be attributed to CMC participants being more cognizant of their consumption habits or due to the education they receive from their healthcare providers about how to responsibly manage these habits [18, 19]. Moreover, CMC participants had statistically significant higher Frequency of No Change scores, i.e., total score of no change for both healthy and unhealthy food items, when compared to non-CMC participants, indicating that those with CMCs made more changes in their diet during COVID-19. Even though Dietary Habit scores were not statistically significant, when they are contextualized with the Frequency of No Change scores, it may have indicated that CMC participants may have had higher Dietary Habit scores compared to those without medical conditions, indicating that one population had better habits. Considering that CMC participants made more changes in their diet, it is important to understand for which particular food items they made changes.

When comparing the specific energy-dense food items with unhealthier foods, participants with CMCs had statistically significant decreased consumption in French fries and potatoes, salty snacks, sweets, peanut butter and nut spreads, margarine, and butter compared to those without medical conditions. In addition, for energy-dense food items, CMC participants had statistically significant higher consumption of tomato juice and vegetable juice. Lastly, participants with CMCs had less consumption of low-calorie beverages, a nutritionally dense food item, compared with non-CMC participants. Low-Calorie Beverages are referred to as a nutrient-dense food, making it possible for participants to have opted to drink water, which was not statistically significant, or some other type of beverage.

Examination from a macroscopic level, such as simply looking at the dietary habit score, may hide these findings, which indicate that overall, those with CMCs made positive changes in their diet during the COVID-19 pandemic when compared to those without medical conditions. Moreover, pairing these findings to those of the ‘frequency of no change in diet’ provided a deeper understanding of changes in this population. Those with CMCs made fewer changes in their diet, and even when changes were made, they were positively correlated with the consumption of healthier food items. This supports the hypothesis that CMC patients may have less changes in their Dietary habits, and this may likely be due to their preexisting rigid dietary restriction and regimens [20].

The age range, those 18–49 vs. 50+ years old, showed that those 50 years and older had more instances of starting a new diet. In addition, those 50 years and older also had better dietary habits and made fewer changes in their overall diet during COVID-19. These findings highlight that those 50 years and older had relatively healthier diets during this time and made fewer changes in their diets. However, when a change was made, it was overall better and involved increased consumption of healthier foods. This finding is consistent with the literature because it stresses that as participants age, they must make better changes in their diet to maintain an overall healthy lifestyle [21].

Analysis of race and ethnicity, specifically between Asian American, African American, white, and Hispanic participants, showed statistically significant differences in lifestyle habits, dietary habits, and 'frequency of no change' in dietary habits. When looking at lifestyle habits, African American participants had much higher scores compared to white and Asian American participants. Moreover, it was found that African American participants had statistically significant better dietary habit scores compared to Hispanic participants. Furthermore, when looking at the raw means for the dietary habit scores, it is evident that African American participants had the highest scores compared to all other groups, indicating overall consumption of healthier food items. This finding was not statistically significant with whites and Asian Americans, and it is also inconsistent with the current literature [22]. It was found that Hispanic or Latino participants were the least likely of all groups to change their dietary habits.

Further analysis of the individual food items consumed further highlights statistically significant differences between these racial and ethnic groups. For example, it was found that Hispanic participants had less cold breakfast, and nutrient-dense, consumption than Asian American participants. Moreover, African American participants demonstrated some of the healthiest consumption practices during this time period, showing that they had lower consumption of French fries, potatoes, and sweets than Asian American participants, and higher nonstarchy vegetable consumption than Hispanic participants. Overall, these findings highlight that African American participants made significantly beneficial dietary changes in their diets during the pandemic. This is overall very divergent from the current literature because many studies have found that African American populations have some of the worst health outcomes and diets [22, 23]. It is evident to point out that these differences between racial groups were done with a sample size that can be considered too small to make direct conclusions about the population as a whole. Therefore, future studies should be placed at a larger scale to see if these conclusions still hold.

Osteopathic medical providers often consider all the extrinsic factors that may be affecting the overall health of their patients. This study aimed to examine how dietary changes occur during a time with new societal restrictions on social activity and how changes in this aspect of life could have impacted the health of those most vulnerable to the COVID-19 virus. Looking at the extrinsic factors of good health allows providers to consider not only the diseases and disorders they are treating but also the whole person. For providers that see patients with CMCs, these results may help providers to ask questions that make sure to address the dietary needs of their patients. The findings of this study can aid providers in learning more about how demographic factors, such as those examined in this study, played a role in overall dietary habits of participants during the COVID-19 pandemic. As more patients move from being seen via telemedicine visits and back to in-office visits, it is crucial to examine how their diet has changed and to learn more about how providers can address the nutritional concerns of their patients by considering the external factors affecting overall health.

Limitations

Given these findings, there are some possible limitations to this study that must be considered. This was a self-reported study, which may have affected the ability to obtain truthful responses to each of the questions asked. Moreover, the population was predominantly made up of African American participants, which could impact the generalizability of the study. This study was also conducted in a hybrid online and in-person fashion, which may have added to the differences in the results attained. This study was also conducted amid vaccination efforts, and the status of the participants was unknown. This factor may have also played a role in normalizing the behaviors and consumption habits in this population. Lastly, data on socioeconomic status were not collected in this study and could have given an in-depth analysis of differences between consumption habits between the different populations.

Furthermore, this study built the survey via the use of previous surveys and questionnaires to provide validity to the variables being examined. However, while conducting this study, there were some areas where changes needed to be made to the questionnaires for better sampling practices. For example, there was no "I do not consume or have not consumed this item" option, which would be necessary in instances where participants may not have consumed certain food items and thus may have had no change in the consumption of that food. In addition, 'Tomato juice/vegetable juice' was classified as a nutritionally dense food item, but it may be considered an energy-dense food item that could be viewed negatively and thus played a role in influencing dietary habit scores. Revisions should be made to properly categorize foods more consistently and broadly to further limit survey fatigue.

Previous studies also utilized ambiguous categorizations for race and ethnicity, which should be amended in future studies. Future studies should provide more options and more inclusive options instead of relying on predetermined groups and categorizations. Because race and ethnicity are at times separate and nonoverlapping, it is important to make these distinctions to properly examine each of these categories separately.

Compared to previous research groups, the Food Security portion associated with the questionnaire was not conducted to prevent survey exhaustion. This section of the questionnaire could have provided more information as it pertains to the current findings. Subsequent research groups should consider exploring this as they examine dietary trends. Further research should be aimed at analyzing the impacts of consumption pre- and post-vaccination status because this may have changed perception and willingness to reengage in daily activities. In addition, further subanalysis should investigate differences between specific patient populations, such as comparing those with certain types of CMCs. Moreover, one additional factor to consider and examine in future studies may involve asking the patients about how often they meet with their primary care provider, because this may affect their understanding of the importance of a diet to meet their nutritional needs.

Further limitations for this cross-sectional study design include addressing recall bias and social desirability. With self-report studies, it is always important to consider such biases because patients are reporting information after being exposed to a certain situation. For example, one bias to consider is recall bias, which is when there are differences in accuracy and completeness to recall a memory of a past event or experience [24]. This bias may affect patients with CMCs because they may pay more attention to their health during a time when they must take more and greater care of their health compared to other populations. Moreover, with self-report studies, it is vital to consider social desirability because participants may answer in a manner that allows the researchers to hear and see what they want them to see, for example, considering that these surveys were conducted in a doctor's office and that its healthcare participants may state that they are healthier than they actually are.

Conclusions

After careful analysis of the results, it was found that participants with CMCs overall had less change in their diets, consumed better foods, and had better relationships toward consumption habits during the COVID-19 pandemic. When further analyzing the demographics of the study population, it was found that multiple factors were associated with changes in lifestyle habits, dietary habits, consumption of healthier or unhealthier foods, and implementation of diet and nutritional supplement intake. The findings from this study help us to understand the impact and influence that restrictive social situations, such as the COVID-19 pandemic, have placed on this population. Even though COVID-19 has had widespread impacts on the social and mental aspects of individuals lives, it was unable to negatively impact the consumption habits and diet quality, as seen in food item consumption, of participants with CMCs. Although this was found in the study, it is still vital for providers to continue examining the extrinsic factors that may be affecting the overall health of their patient population.

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