

# Impact of COVID-19 on college student diet quality and physical activity

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## Abstract

**Background:** The COVID-19 pandemic can cause an increase in stress experienced by college students and consequently, potentially adversely affect their health behaviours. **Aims:** The aim of this study was to investigate how COVID-19 impacted college-attending young adults' diet quality and physical activity. **Methods:** Students attending an Appalachian university in spring 2020 participated in this cross-sectional study. Participants were surveyed on their eating habits, diet quality, and physical activity before and since COVID-19. Frequencies of responses were analyzed and Bowker's test was used to determine differences in responses before and since COVID-19. Alpha was set at 0.05. **Results:** Almost one third (32.6%) of students reported eating somewhat more since COVID-19 and 67.9% of these students stated it was due to boredom. Students showed a significant increase in frequency of eating and in consumption of almost every food group. The number of students engaging in low physical activity increased from 27.8% to 51.9% and the number of students engaging in high physical activity decreased from 59.5% to 34.0% ( $p < .0001$ ) and many switched to the use of at-home workouts. **Conclusion:** Results indicate the effects of campus closure on college students' lifestyles and the risk of developing health problems due to the COVID-19 pandemic, potentially inhibiting their academic progress and well-being.

## Keywords

Diet, exercise, students, young adult, coronavirus, stress, eating, healthy lifestyle, public health, behaviour

## Introduction

The novel coronavirus-2019 (COVID-19) first appeared in the Chinese city of Wuhan in December 2019 (Fan, Liu, Pan, Douglas, & Bao, 2020). Since the original outbreak, almost every country, area or territory has reported cases of the COVID-19 virus (World Health Organization, 2020a) due to the highly contagious disease transmission through respiratory droplets produced when an infected person coughs, sneezes or talks (Centers for Disease Control and Prevention, 2020). On March 11, 2020 the World Health Organization (WHO) began characterizing COVID-19 as a pandemic and urged all countries to "take urgent and aggressive action (World Health Organization, 2020b)." Many local and state governments within the United States (US) took action against the spread of the virus through the implantation of stay at home orders (World Health Organization, 2020b). The stay at home order mandated all individuals to remain at home unless travelling to an essential job or shop for essential needs, thus disrupting normalcy for individuals in numerous ways such as job losses, reduced incomes, closings of educational institutions, exercise facilities and restaurants and bars. Mandates have continually changed throughout the course of the pandemic, but at the time of this study, individuals were required to wear masks

at most facilities, many college students moved back home as classes transitioned completely online, and the majority of restaurants were only offering takeout orders. The mandate resulted in self-isolation which produced negative effects on mental health and stress (Antunes et al., 2020). Although the stay at home order and isolation period were necessary in initially combating COVID-19, it altered physical activity and eating behaviours that further compromised health (Achraf Ammar *et al.*, 2020).

The pandemic significantly impacted the college aged population as they transitioned to an online learning platform and away from the college setting. The college years inflict tremendous stress on attendees, and those stress levels were heightened during the COVID-19 pandemic

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as routines were changed (Mathilde, Viviane, & Joel, 2020). During the pandemic, higher values for anxiety were found in individuals aged 18–34 (Antunes et al., 2020), with the largest stressor being the uncertainty and abrupt disruption to the semester (Zhai & Du, 2020). However, negative emotions imposed by COVID-19 was alleviated by an increase in physical activity (Zhang, Zhang, Ma, & Di, 2020). Consistent findings in multiple countries indicate the pandemic has negatively impacted population health (Kufahl, 2020; Scarmozzino & Visioli, 2020; Shader, 2020; Zeigler Zachary et al., 2020). As the pandemic furthers, COVID-19 will continue impacting collegiate wellbeing, making it important to understand that diet quality and physical activity serves as a crucial role in combating the pandemic (Zhai & Du, 2020).

Diet and physical activity among college students has been linked to their mental health and serves as an outlet for stress. However, as students transition to college and gain a new sense of independence, they report having difficulties with maintaining a healthy diet, whether time or finances restrict them (Merhout & Doyle, 2019). Having a well-balanced diet is important in a college aged population, affecting both physical and mental health (Lesani, Mohammadpoorasl, Javadi, Esfeh, & Fakhari, 2016). Poor dietary habits increase college students subsequent risk of degenerative diseases such as obesity, diabetes, and cardiovascular pathologies; all possible underlying factors to exacerbate the onset of COVID-19 (Ruiz-Roso et al., 2020). Further, physical activity is an influential part of a healthy college routine. Students engaging in the recommended amounts of physical activity have a lower rate of chronic diseases, cardiovascular disease, respiratory disease, type 2 diabetes, and depression (United States Department of Health and Human Service, 2008). The social atmosphere of college helps encourage students to engage in physical activity as a significant correlation has been found between an individual's physical activity level and perceived friend support (Kim et al., 2015).

Currently, there is a lack of research regarding how diet quality and physical activity of college-attending young adults in the US has changed due to the COVID-19 pandemic. COVID-19 caused disruptions in routines, lifestyles, and access to food and exercise opportunities, which may negatively impact college student diet quality and exercise levels. The aim of this study was to identify how the self-isolation period during the COVID-19 pandemic affected the dietary habits and physical activity routines of college attending individuals. It was hypothesized that students would have poorer diet quality and less physical activity as a result of COVID-19.

## Methods

### Design

This cross-sectional study investigated a convenience sample of college-attending young adults in late March to

early April 2020. Participants had to be currently enrolled at the university and at least 18 years of age to be eligible. This study was approved by West Virginia University's Institutional Review Board (#2003924134). All subjects gave their informed consent before participating.

### Participants and procedures

Students attending a public, land-grant university in Appalachia in spring 2020 were recruited using the university listserv. Students were emailed an invitation to complete an online survey with a link that directed them to Qualtrics, an online survey platform. Participants read the informed consent and if they accepted, they completed the survey. Students who took the survey had the chance to win one of six \$100 American Express gift cards. Contact information remained separate from the results of the survey to maintain confidentiality.

### Survey design

This 161-item survey was developed through compilation of validated tools from literature covering a vast range of health behaviours as well as researcher-generated questions that were adapted for the COVID-19 situation. In order to try to capture how behaviours may have changed since COVID-19 from before COVID-19, respondents were asked to indicate their answer to each question for both before and since COVID-19. Essentially, they had two responses to each question to indicate behaviour changes. An example question to demonstrate how some questions had to be formatted to reflect this is provided below (Figure 1). Only variables related to diet and physical activity were used in this study.

**Demographics.** Participants were asked to self-report their age, race/ethnicity, year in school, and gender identity.

**Eating patterns.** Participants were asked a variety of questions related to their diet and eating patterns before and since COVID-19. Questions included if they had a meal plan before COVID-19, how often they ate on campus, how their eating and cooking frequency has changed since COVID-19, their motivation to cook, and the healthiness of their meals prepared. Participants were also asked how many meals they consumed per day and the size of their meals before and since COVID-19. Because of the unique situation of COVID-19, questions were created by the research team in order to capture relevant data.

**Diet quality.** Participants were asked about their daily consumption of servings of fruit, vegetables, red meat, processed meat, lean protein, legumes, whole grains, dairy, and oil and fat additives before and since COVID-19. Participants were provided with descriptions of foods from each group and what a serving size is for that food

group. Questions were again created by the research team in order to capture relevant data specific to COVID-19.

**Physical activity.** Students were asked how often they participated in a variety of exercise activities before and since COVID-19. Students were also screened for physical activity levels using the International Physical Activity Questionnaire (IPAQ) (Hallal & Victora, 2004). The IPAQ asks participants to report the number of days per week they participate in vigorous and moderate physical activity as well as walking. Participants report the time they spend participating in each activity level. Responses are converted to MET minutes per week which represent energy expended carrying out physical activity. Responses can be analyzed categorically, with low physical activity (less than 600 MET minutes per week), moderate physical activity (between 600 and 1500 MET minutes per week), and high physical activity (greater than 1500 MET minutes per week).

### Statistical analysis

All data was analyzed using JMP Pro Version 14.0 to calculate frequencies of responses. Bowker's test was used to determine differences in responses before and since COVID-19. Alpha was set at 0.05.

## Results

Respondents ( $n=2,018$ , response rate = 5.1%) were primarily female (70.7%), white (83.1%), and in graduate/professional school (29.3%), with a mean age of  $24.9 \pm 5.54$  years (Table 1).

### Eating patterns

Most did not have a meal plan (75.8%) and never ate on campus (48.5%) prior to COVID-19 (Table 2). About one-third (32.6%) reported eating somewhat more since COVID-19. Of those who reported eating somewhat more or a lot more, 38.8% and 67.9% agreed it was due to stress and boredom, respectively (Figure 2 and Table 3). Of those who reported eating less, 27.2% agreed that it was due to stress and 13.7% agreed that it was due to financial limitations (Figure 2 and Table 3). Twenty-nine percent of respondents reported that their cooking has increased a lot since COVID-19, with the top motivations to cook being to be healthy (54.1%), it's cheaper (49.1%), and to pass the time (46.0%), and most rated their meals as healthy (44.8%) (Tables 2 and 3).

### Diet quality

Respondents showed a significant increase in daily consumption of fruit ( $p < .0001$ ), vegetables ( $p = .04$ ), red meat ( $p < .0001$ ), processed meat ( $p < .0001$ ), dairy ( $p < .0001$ ), legumes ( $p = .03$ ), and oil and fat additives ( $p <$

$.0001$ ). There was a significant decrease in consumption of whole grains ( $p < .0001$ ). There was a significant increase in the size of meals consumed ( $p < .0001$ ), and in frequency of eating ( $p = .0002$ ) (Figures 3 and 4 and Table 4).

### Physical activity

There was a significant decrease in the use of gyms ( $p < .0001$ ), the student recreation centre ( $p < .0001$ ), outdoor activities ( $p < .0001$ ), and running outside ( $p < .0001$ ) and inside ( $p < .0001$ ). There was a significant increase in the use of self-created ( $p < .0001$ ) and guided ( $p < .0001$ ) at-home workouts, as well as the use of workout apps ( $p < .0001$ ). There was an increase in moderate physical activity from 12.8% to 14.7%, but the amount of respondents with low physical activity significantly increased from 27.8% to 51.9%, and the amount of respondents with high physical activity significantly decreased from 59.5% to 34.0% ( $p < .0001$ ) (Table 5).

## Discussion

The aim of this study was to investigate how the COVID-19 pandemic impacted the diet quality and physical activity of college students. Students most often reported eating "somewhat more" (32.6%) since the COVID-19 pandemic. Of those who reported eating more, the most common reason was boredom, with 67.9% agreeing that that was the reason, and 38.8% agreeing that stress was causing them to eat more. About one-quarter (25.7%) of respondents reported eating less since COVID-19, with 23.9% agreeing that it was due to stress, and only 13.7% agreeing that it was due to financial limitations. While there are few studies to date investigating the diet changes of college students during COVID-19, studies in other populations have also found that most individuals are eating more, with 46.1% of an Italian sample and 43.0% of a Polish sample reporting increased consumption of food during home confinement (Scarmozzino & Visioli, 2020; Sidor & Rzymiski, 2020). Beyond the significant increase in the number of meals and snacks consumed per day, the size and frequency of meals consumed also changed. This is consistent with other studies investigating dietary habits since COVID-19 in a variety of populations (A. Ammar *et al.*, 2020; Di Renzo *et al.*, 2020; Sidor & Rzymiski, 2020). Few studies have examined reasoning for the increased consumption of food, but one study with an Italian sample found it was largely attributable to increased anxiety (Scarmozzino & Visioli, 2020) and other study finding it to be largely due to stress (Z. Zachary *et al.*, 2020), contrasting with our findings that it was largely due to boredom. This may be due to our sample consisting of college students, who are consistently living a high stress lifestyle (Jin & Collins, 2018; Yzer & Gilasevitch, 2019), but who may not be used to their newfound boredom due to disruption of their normal routine. One of the most common reasons for increased cooking in this study was in order to pass the time, again

Q117 How many servings of red meat, on average, did/do you consume a day? A serving of red meat is about the size of your palm or a deck of cards

	0 servings (1)	1 serving (2)	2 servings (3)	3 servings (4)	4 servings (5)	5 or more servings (6)	Choose not to answer (7)
Before COVID-19 (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Since COVID-19 (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Figure 1.** Example of changes to survey questions to capture before and since COVID-19 behaviours.

**Table 1.** Demographics of respondents.

Variable	Frequency N(%)
Gender Identity	
Male	553 (27.6%)
Female	1416 (70.7%)
Transgender Female	20 (0.9%)
Transgender Male	2 (0.1%)
Nonbinary/nonconforming	2 (0.1%)
Other	8 (0.4%)
Choose not to answer	3 (0.1%)
Race	
White	1665 (83.1%)
Black or African American	52 (2.6%)
American Indian or Alaska Native	3 (0.1%)
Asian	85 (4.2%)
Native Hawaiian or Pacific Islander	2 (0.1%)
Other	50 (2.5%)
Multiple	112 (5.6%)
Class Standing	
Freshman	399 (15.1%)
Sophomore	425 (16.1%)
Junior	482 (18.3%)
Senior	557 (21.1%)
Graduate/Professional School	773 (29.3%)
<b>Variable</b>	<b>Mean <math>\pm</math> SD (95% CI)</b>
Age (Years)	24.9 $\pm$ 5.54 (23.6, 26.2)

Frequency of responses reported for all categorical variables. Mean and standard deviations reported for continuous variables.

pointing towards the role boredom has played in influencing dietary patterns during the pandemic.

When examining changes in consumption of individual food groups, there was a significant increase in consumption of fruits, vegetables, red meat, processed meat, lean proteins, dairy, legumes, and oil and fat additives, with a decrease in consumption of whole grains. An increase in consumption of all groups due to COVID-19 has been a consistent finding. A study investigating the changes in dietary habits of adolescents in Spain, Italy, Colombia, Chile, and Brazil found an increased consumption of fried

**Table 2.** Diet characteristics of participants.

Variable	Frequency N (%)
Campus Meal Plan Before COVID-19	
Yes	470 (23.9%)
No	1489 (75.8%)
Frequency of Eating on Campus	
Never	966 (48.5%)
1-2 meals per week	461 (23.2%)
3-6 meals per week	262 (13.2%)
7+ meals per week	301 (15.1%)
Eating Frequency Since COVID-19	
A lot less	201 (10.1%)
Somewhat less	513 (25.7%)
The same	424 (21.3%)
Somewhat more	649 (32.6%)
A lot more	206 (10.3%)
Cooking Frequency Since COVID-19	
Increased a lot	562 (29.0%)
Increased a little	589 (30.3%)
Stayed the same	485 (25.0%)
Decreased a little	166 (8.6%)
Decreased a lot	139 (7.2%)
Healthiness of Meals	
Very healthy	184 (9.4%)
Healthy	877 (44.8%)
Neutral	745 (38.0%)
Unhealthy	122 (6.2%)
Very unhealthy	21 (1.1%)
There are no meals being prepared in my home	10 (0.5%)

Frequency of responses reported.

foods, sweet foods, fruits, vegetables, and legumes (Ruiz-Roso et al., 2020). In an Italian sample, an increase in consumption of fruits and vegetables was seen (Scarmozzino & Visioli, 2020). While our sample increased intake of healthy foods such as fruits, vegetables, and legumes, there was also an increase in unhealthy foods, such as red and processed meats, and oil and fat additives. This along with the reported increase in frequency of eating

**Table 3.** Motivations and causes of diet changes.

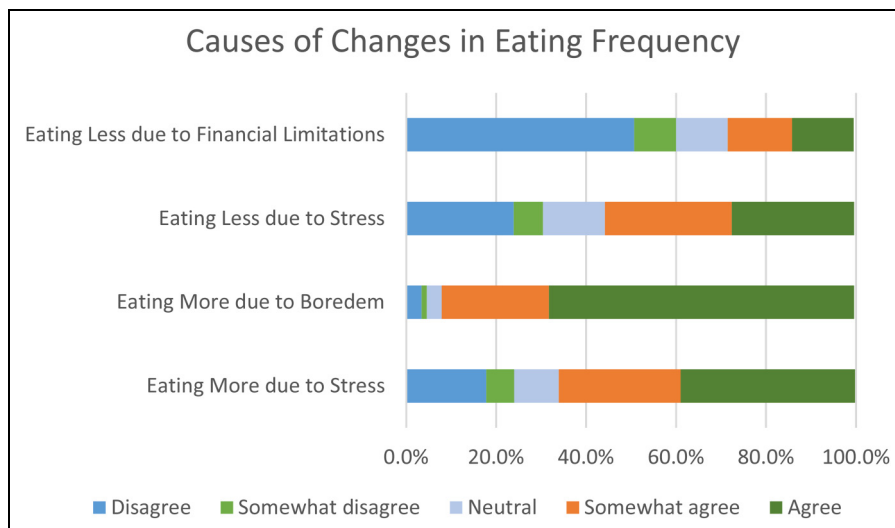
Variable	Frequency N (%)
I find myself eating more because of stress	
Disagree	149 (17.8%)
Somewhat disagree	52 (6.2%)
Neutral	83 (9.9%)
Somewhat Agree	227 (27.1%)
Agree	325 (38.8%)
I find myself eating more than usual because of boredom	
Disagree	29 (3.4%)
Somewhat disagree	10 (1.2%)
Neutral	28 (3.3%)
Somewhat Agree	201 (23.8%)
Agree	573 (67.9%)
I find myself eating less than usual because of stress	
Disagree	166 (23.9%)
Somewhat disagree	45 (6.5%)
Neutral	96 (13.8%)
Somewhat Agree	196 (28.2%)
Agree	189 (27.2%)
I find myself eating less than usual because of financial limitations	
Disagree	348 (50.7%)
Somewhat disagree	64 (9.3%)
Neutral	79 (11.5%)
Somewhat Agree	98 (14.3%)
Agree	94 (13.7%)
Cooking Motivation	
To be healthy	1059 (54.1%)
To pass the time	899 (46.0%)
To try new recipes	819 (41.9%)
It's cheaper	961 (49.1%)
I don't have other options	607 (31.0%)
I am afraid to order food due to COVID-19	403 (20.6%)
I do not cook	147 (7.5%)

Frequency of responses reported.

suggest that respondents are consuming more calories overall due to COVID-19. Further, 29.0% of our sample reported that their cooking has increased a lot, and although 54.1% of those respondents stated it was to be healthy, another significant amount stated it was because it is cheaper. This paired with the overall increase in consumption of food may indicate that since preparing food is cheaper, students are eating more of it.

The physical activity habits of respondents significantly changed due to COVID-19. As could be expected, there was a significant decrease in the use of gyms and the student recreation centre. There was a significant increase in the use of at-home workouts, both self-created and guided, as well as the use of workout apps. However, overall amounts of physical activity decreased, with a significant number of individuals who engaged in low levels of physical activity increasing, and a significant number of individuals with high levels of vigorous activity decreasing. This is consistent with other studies finding a decrease in levels of physical activity (A. Ammar *et al.*, 2020; Deschasaux-Tanguy *et al.*, 2021; Robert *et al.*, 2020; Zenic *et al.*, 2020; Zhang *et al.*, 2020). The decrease in physical activity levels combined with the increased consumption of foods puts students at risk of weight gain and metabolic disorders. Exercise among college students during COVID-19 has shown to influence healthier diet choices (Amatori *et al.*, 2020). Further, it has shown to be important in combatting the mental health effects of the pandemic (Amatori *et al.*, 2020).

The college period is an important time for establishing important lifelong lifestyle behaviours (Deliens, Clarys, De Bourdeaudhuij, & Deforche, 2014; Gaines, Robb, Knol, & Sickler, 2014; Jang & Hong, 2018). The high stress of the college environment can lead to individuals developing unhealthy health behaviours, such as poor diet and physical inactivity (Kim *et al.*, 2015; Merhout & Doyle, 2019). These put an individual at risk of the development of



**Figure 2.** Causes of changes in eating frequency.

chronic diseases such as type 2 diabetes and cardiovascular disease, and other negative health outcomes such as mental health disorders (Kim et al., 2015; F. Xu, Liu, Chepyator-Thomson, & Schmidlein, 2018). Findings from this study indicate students are eating more and exercising less, putting them at risk of the development of these disorders, which can put them at an increased vulnerability to contracting COVID-19 and having severe complications from it (Martinez-Ferran, de la Guía-Galipienso, Sanchis-Gomar, & Pareja-Galeano, 2020). Physical activity has been found to have a positive role in mitigating stress and mental health disorders (F. Xu et al., 2018; Y. Xu,

Qi, Yang, & Wen, 2016; Zhang et al., 2020), and students' lack of physical activity during the combined stressful periods of college and the current pandemic can exacerbate their mental health problems. Further, diet quality is associated with mental health status (Felice, 2017; Sadeghi, Keshteli, Afshar, Esmailzadeh, & Adibi, 2019; Wattick, Hagedorn, & Olfert, 2018). The potential for worsening mental health during the COVID-19 pandemic can inhibit student's academic progress (Hartley, 2011). Results from this study indicate that students lifestyle habits have significantly changed since campus activities were disrupted and there is the potential that students heavily rely on campus

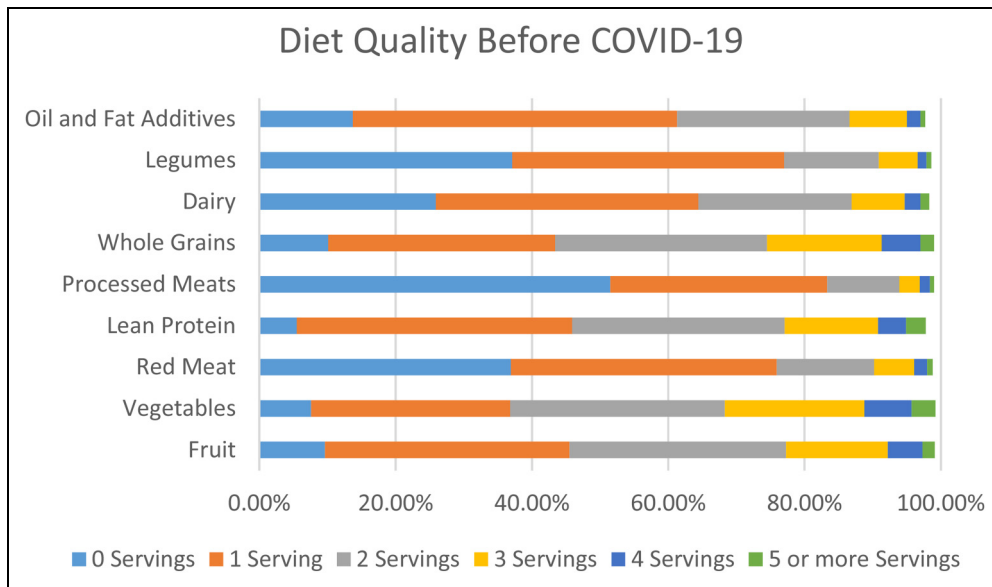


Figure 3. Diet quality before COVID-19.

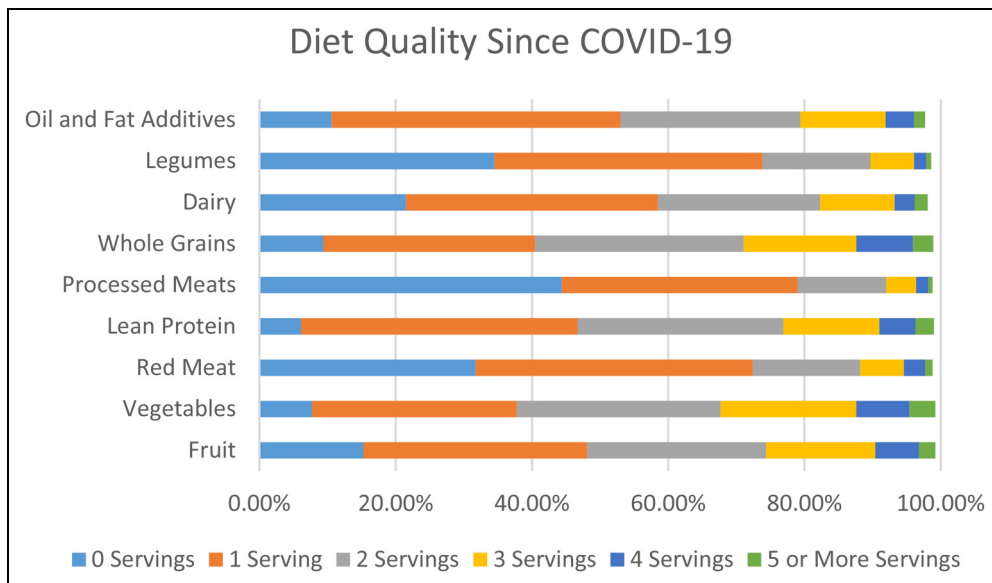


Figure 4. Diet quality since COVID-19.

**Table 4.** Diet quality before and since COVID-19.

Variable	Frequency N(%)		P Value
	Before COVID-19	Since COVID-19	
<b>Fruit</b>			<.0001*
0 servings	184 (9.6%)	293 (15.3%)	
1 serving	691 (35.9%)	628 (32.8%)	
2 servings	611 (31.8%)	502 (26.3%)	
3 servings	287 (14.9%)	305 (16.0%)	
4 servings	98 (5.1%)	123 (6.4%)	
5 or more servings	34 (1.8%)	45 (2.4%)	
<b>Vegetables</b>			0.04*
0 servings	146 (7.6%)	148 (7.7%)	
1 serving	560 (29.2%)	577 (30.1%)	
2 servings	604 (31.5%)	573 (29.9%)	
3 servings	393 (20.5%)	382 (19.9%)	
4 servings	132 (6.9%)	149 (7.8%)	
5 or more servings	67 (3.5%)	73 (3.8%)	
<b>Red Meat</b>			<.0001*
0 servings	706 (36.9%)	606 (31.7%)	
1 serving	747 (39.0%)	779 (40.7%)	
2 servings	273 (14.3%)	301 (15.8%)	
3 servings	113 (5.9%)	123 (6.4%)	
4 servings	37 (1.9%)	59 (3.1%)	
5 or more servings	17 (0.8%)	21 (1.1%)	
<b>Lean Protein</b>			0.06
0 servings	106 (5.5%)	116 (6.1%)	
1 serving	774 (40.4%)	776 (40.6%)	
2 servings	621 (31.2%)	577 (30.2%)	
3 servings	264 (13.7%)	269 (14.1%)	
4 servings	78 (4.1%)	102 (5.3%)	
5 or more servings	55 (2.9%)	52 (2.7%)	
<b>Processed Meats</b>			<.0001*
0 servings	985 (51.5%)	848 (44.4%)	
1 serving	609 (31.8%)	662 (34.6%)	
2 servings	202 (10.6%)	248 (13.0%)	
3 servings	57 (3.0%)	84 (4.4%)	
4 servings	28 (1.5%)	35 (1.8%)	
5 or more servings	11 (0.6%)	12 (0.6%)	
<b>Whole Grains</b>			<.0001*
0 servings	192 (10.1%)	179 (9.4%)	
1 serving	635 (33.3%)	594 (31.1%)	
2 servings	594 (31.1%)	583 (30.6%)	
3 servings	320 (16.8%)	314 (16.5%)	
4 servings	108 (5.7%)	159 (8.3%)	
5 or more servings	38 (2.0%)	58 (3.0%)	
<b>Dairy</b>			<.0001*
0 servings	494 (25.9%)	410 (21.5%)	
1 serving	735 (38.5%)	704 (37.0%)	
2 servings	430 (22.5%)	454 (23.8%)	
3 servings	148 (7.8%)	208 (10.9%)	
4 servings	44 (2.3%)	58 (3.0%)	
5 or more servings	24 (1.3%)	37 (1.9%)	
<b>Legumes</b>			0.03*
0 servings	708 (37.1%)	657 (34.5%)	
1 serving	761 (39.9%)	748 (39.3%)	
2 servings	266 (13.9%)	302 (15.9%)	
3 servings	109 (5.7%)	122 (6.4%)	
4 servings	24 (1.3%)	35 (1.8%)	
5 or more servings	13 (0.7%)	14 (0.7%)	

(continued)

**Table 4.** (continued)

Variable	Frequency N(%)		P Value
Oil and Fat Additives			<.0001*
0 servings	262 (13.7%)	201 (10.6%)	
1 serving	907 (47.6%)	805 (42.4%)	
2 servings	482 (25.3%)	502 (26.4%)	
3 servings	160 (8.4%)	237 (12.5%)	
4 servings	39 (2.0%)	80 (4.2%)	
5 or more servings	14 (0.7%)	30 (1.6%)	
Number of Meals Per Day			<.0001*
0, just snacks	8 (0.4%)	27 (1.4%)	
1 meal	125 (6.5%)	196 (10.3%)	
2 meals	775 (40.5%)	705 (37.0%)	
3 meals	887 (46.4%)	774 (40.6%)	
4 meals	101 (5.3%)	159 (8.3%)	
5 or more meals	17 (0.9%)	47 (2.5%)	
Size of Meals			.0002*
Mainly snacks	58 (3.5%)	95 (5.6%)	
Small	324 (19.2%)	354 (21.0%)	
Mid-size	1121 (66.4%)	1008 (59.9%)	
Large	185 (11.0%)	227 (13.5%)	
Eating Frequency			<.0001*
Hourly	11 (0.6%)	58 (3.1%)	
Every couple of hours	220 (11.5%)	398 (21.0%)	
Every 3 to 4 h	705 (36.7%)	648 (34.2%)	
Every 5 to 6 h	748 (38.9%)	498 (26.3%)	
Every 7 to 8 h	182 (9.5%)	210 (11.1%)	
Every 10 to 12 h	55 (2.9%)	82 (4.3%)	

Frequency of responses before and since COVID-19 are reported. P-values indicate results of Bowker's test for differences between groups before and since COVID-19. Asterisks denote significance.

**Table 5.** Physical activity before and since COVID-19.

Variable	Frequency N(%)		P-Value
	Before COVID-19	Since COVID-19	
Gym Use			<.0001*
Never	710 (36.0%)	1553 (94.5%)	
Rarely	257 (13.0%)	39 (2.4%)	
Sometimes	436 (22.2%)	16 (0.9%)	
Often	568 (28.8%)	36 (2.2%)	
Student Recreation Centre Use			<.0001*
Never	740 (37.7%)	1615 (98.5%)	
Rarely	359 (18.3%)	16 (0.9%)	
Sometimes	408 (20.8%)	4 (0.2%)	
Often	457 (23.2%)	4 (0.2%)	
Outdoor Activities			<.0001*
Never	511 (26.0%)	738 (44.8%)	
Rarely	543 (27.6%)	303 (18.4%)	
Sometimes	655 (33.3%)	373 (22.6%)	
Often	259 (13.2%)	233 (14.1%)	
Running Outside			<.0001*
Never	1030 (52.5%)	921 (56.1%)	
Rarely	447 (22.8%)	255 (15.5%)	
Sometimes	348 (17.8%)	267 (16.3%)	
Often	137 (7.0%)	198 (12.1%)	
Running Inside			<.0001*
Never	1037 (52.7%)	1369 (83.6%)	

(continued)



**Table 5.** (continued)

Variable	Frequency N(%)		P-Value
Rarely	345 (17.5%)	108 (6.6%)	
Sometimes	369 (18.8%)	105 (6.4%)	
Often	217 (11.0%)	57 (3.5%)	
Self-Led At-Home Workouts			<.0001*
Never	827 (42.1%)	626 (37.9%)	
Rarely	506 (25.8%)	295 (17.9%)	
Sometimes	424 (21.6%)	334 (20.2%)	
Often	206 (10.5%)	393 (24.0%)	
Guided at Home Workouts			<.0001*
Never	1107 (56.5%)	829 (50.2%)	
Rarely	365 (18.6%)	228 (13.8%)	
Sometimes	320 (16.3%)	264 (16.0%)	
Often	166 (8.5%)	329 (19.9%)	
Workout Apps			<.0001*
Never	1328 (67.7%)	1138 (69.1%)	
Rarely	300 (15.3%)	174 (10.6%)	
Sometimes	222 (11.3%)	157 (9.5%)	
Often	112 (5.7%)	179 (10.9%)	
Physical Activity Levels (IPAQ)			<.0001*
Low	561 (27.8%)	1048 (51.9%)	
Moderate	257 (12.7%)	284 (14.1%)	
High	1200 (59.5%)	686 (34.0%)	

Frequency of responses before and since COVID-19 are reported. P-values indicate results of Bowker's test for differences between groups before and since COVID-19. Asterisks denote significance.

resources, such as the student recreation centre, in order to achieve adequate physical activity levels. Further, the disruption of routine leading to increased boredom has negatively impacted student eating habits.

There are several limitations to this study. First, dietary data was not collected using a validated tool. Due to the nature of asking participants about habits before and since COVID-19, researchers felt it necessary to modify questions to reduce respondent burden. Second, no data was collected on weight gain since COVID-19, and other studies have found that individuals did gain weight in a relatively short time period during COVID-19 home confinement (Scarmozzino & Visioli, 2020; Sidor & Rzymiski, 2020; Z. Zachary *et al.*, 2020). Additionally, data were only collected from one university within the Appalachian region, thus results may lack generalizability among college students in other regions and further research is needed. There are also several strengths to this study. To our knowledge, there are few studies examining the effects of COVID-19 on the lifestyle habits of college students. Further, most studies on eating habits during COVID-19 have not examined reasons for these changes like we did in this study. In addition, we collected data on the type of physical activity engaged in as well as the amount, which is important in further understanding how college student's habits are changing during this pandemic.

Although home confinement and campus closures are important for public health (A. Ammar *et al.*, 2020), they undoubtedly lead to negative behaviours in a health compromising way. This is important for college students who are at a time period where their health is especially

important to maintain success and long-term well-being. Universities should be prepared to offer students resources to combat these negative changes and be understanding of their potential difficulty in achieving academic success.

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### Availability of data and materials

Data is available upon request to the corresponding author.

### Authors' contributions

MDO, RAW, and RLH completed initial study idea and drafted study design. RAW, RLH, and EGS facilitated data collection. RAW and EGS conducted data analysis. MDO, RAW, and EGS drafted the manuscript. All authors read, critiqued, edited, and approved the final manuscript.

### Consent for publication

All authors consent to publication.

### Ethical approval

This study was approved by West Virginia University's Institutional Review Board (#2003924134).

### Declaration of conflicting interests

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