

Associations among Self-Reported Mental Health, Physical Activity, and Diet during the COVID-19 Pandemic

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Abstract

Background: Understanding the relationship between physical activity, diet, and mental health during the COVID-19 pandemic may help inform resources encouraging healthy lifestyle choices during the time of an increased threat to health and wellbeing. **Aim:** Our objective was to examine how self-rated mental health was associated with engagement in physical activity and consumption of fruits and vegetables during the COVID-19 pandemic. **Methods:** The study utilized cross-sectional survey data from adults (≥ 18 years of age) living, working, and/or receiving healthcare in Arkansas ($n = 754$). Multivariable regression models were used to examine the associations between self-rated mental health and the number of days respondents engaged in 30 min of physical activity and the number of days respondents consumed five or more servings of fruits and vegetables. **Results:** Respondents who reported somewhat poor/poor mental health reported engaging in at least 30 min of physical activity fewer days per week ($\beta = -.77$, $p = .018$) compared with those reporting excellent mental health, after controlling for sociodemographic factors and self-rated health. The significant association observed in the first two models between mental health and number of days consuming five or more servings of fruits and vegetables became non-significant after inclusion of self-rated health. **Conclusion:** The relationship between mental health and physical activity and diet reaffirms a need for healthcare providers to promote the importance of maintaining both a healthy physical activity level and a nutrient-rich diet in the face of challenging circumstances, such as a global pandemic.

Keywords

Dietary consumption, mental health assessment, self-reported health, pandemic, physical activity

In January 2020, the World Health Organization (WHO) declared COVID-19, the disease caused by novel coronavirus SARS-Cov-2, a Public Health Emergency of International Concern (Sohrabi et al., 2020). In response, government and public health entities implemented precautionary measures (i.e., the shutdown of businesses and schools, quarantine, self-isolation, and social distancing) to prevent the spread of the disease. While crucial for protecting global health, epidemiological mitigation efforts significantly altered social and economic patterns and introduced a variety of new and unforeseen stressors into everyday life. In addition to fears of contracting COVID-19, other significant COVID-19-related stressors have been reported, such as the need to modify behaviors during the pandemic and the psychological effects of quarantine and self-isolation, food and job insecurity, and financial destabilization (Wilson et al., 2020; Coley and Baum, 2021;

Ganson et al., 2021; Benke et al., 2020; Knell et al., 2020). Many of these stressors have led to an increased prevalence of mental health issues, such as anxiety and depression, among people with and without prior mental health symptoms and particularly among

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individuals with fewer social and economic resources (Ettman et al., 2020; Wilke et al., 2021; Cai et al., 2021).

The relationship between mental health, physical activity (PA), and diet are well established; pre-pandemic research has shown that adequate PA and a healthy diet may help to improve mental health (Zaman et al., 2019; Null and Pennesi, 2017; Głabska et al., 2020; Marx et al., 2017; World Health Organization, 2020; Tamminen et al., 2020; Hallgren et al., 2020). However, current pandemic research has shown that COVID-19 has caused significant disruptions to many peoples' PA and diet patterns (Faulkner et al., 2021; Ingram et al., 2020; Wolf et al., 2021; Jacob et al., 2020; Knell et al., 2020). People who reported a negative change in PA from before the pandemic to during the pandemic reported worse mental health and well-being compared with people whose behaviors changed positively or did not change at all (Faulkner et al., 2021). Additionally, engagement in less PA and poorer diet quality during the pandemic was associated with a more negative mood (Ingram et al., 2020). People who regularly engaged in PA with higher volume and frequency and maintained stable PA routines showed fewer symptoms of anxiety and depression (Wolf et al., 2021), which may lead to a more positive assessment of overall mental health (Jacob et al., 2020).

Anxiety and depression have been linked to increased hunger, emotional overeating, food and satiety responsiveness, and food selectivity (Coakley et al., 2021), all of which may result in a reduction in consumption of nutrient dense foods, such as fruits and vegetables (F&V). Some individuals consumed more comfort foods during the pandemic in an attempt to reduce feelings of anxiety and depression (Di Renzo et al., 2020). Some individuals experienced food insecurity, which is accompanied by a higher risk of anxiety and depression and has been linked to lower consumption of nutrient dense foods (Leung et al., 2014; Fang et al., 2021).

This study examined how self-rated mental health during the COVID-19 pandemic was related to the number of days people engaged in at least 30 min of PA and the number of days they consumed five or more servings of F&V among adults (≥ 18 years of age) living, working, and/or receiving healthcare in Arkansas. Although similar studies have been done in Europe early in the pandemic, understanding the relationship between PA, diet, and mental health in the United States (US) during a global pandemic may help to inform specific guidelines and resources encouraging healthy lifestyle choices during an increased threat to health and wellbeing.

Methods

Patients from six clinical sites across the state of Arkansas were recruited between October 30, 2020 and January 16, 2021 by email. Research Electronic Data Capture (REDCap) was used to administer the consent and survey. Inclusion criteria consisted of being an adult (age ≥ 18 years) and living, working, and/or receiving healthcare

in the state of Arkansas during the study period. A total of 876 responses to the survey were collected. Of those, 809 met the inclusion criteria, and the final analytic sample of 754 were determined to be non-duplicates who responded to items beyond the eligibility screener. All 754 participants were receiving healthcare in the state of Arkansas. A \$20 gift card was provided after survey completion as compensation for respondents' time. The study was approved by the University of Arkansas for Medical Sciences Institutional Review Board (IRB#261226).

The PA and diet variables were measured as a count of the number of days over the past week the respondent engaged in at least 30 min of a specific exercise session (e.g., swimming, walking specifically for exercise, biking, etc.) over what they would normally do during the course of a normal day (Toobert et al., 2000) and an adapted measure of F&V consumption which asked the number of days over the past week the respondent reported eating five or more servings of F&V (Toobert et al., 2000). The independent variable, self-rated mental health over the past two weeks, was assessed using the question, "Over the last two weeks how would you rate your mental health?" and included response categories of *excellent*, *somewhat good*, *average*, *somewhat poor*, and *poor* (Ahmad et al., 2014; Mawani and Gilmour, 2010). The *somewhat poor* and *poor* categories were combined due to the low number of *poor* responses. Sociodemographic factors included as control variables were age, sex, education, race/ethnicity, income, and food insecurity. Food insecurity was measured using a validated 2-item screener, modified to focus on the past 30 days rather than the standard 12 months (Hager et al., 2010). Self-rated health as a measure of general physical health was also included as a control variable and was measured with the question "Would you say that in general your health is...?" with response options of *excellent*, *good*, *fair*, and *poor* (Idler and Benyamini, 1997; Lundberg and Manderbacka, 1996). Prior work has shown that self-rated health includes not only health behaviors and physical functioning, but comparisons to relevant 'others', and was chosen over a count of chronic illness to incorporate a holistic measure of a respondent's physical health (Garbarski et al., 2017).

The descriptive statistics report means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Multivariable regression, using full information maximum likelihood estimation to account for missing data, was used to determine the association between self-rated mental health and the number of days respondents engaged in at least 30 min of PA and the number of days respondents consumed five or more servings of F&V. Separate models for PA and diet were created in three steps: 1) self-rated mental health, 2) self-rated mental health and sociodemographic controls, and 3) self-rated mental health, sociodemographic controls, and self-rated health. Analyses were completed using STATA 17 (STATA Corp, 2021), and a *p*-value of .05 or less was considered statistically significant.

Results

Descriptive statistics

Table 1 presents the characteristics of the respondents. The mean age of the participants was 47.4 years (± 16.3 years). The majority of the respondents were female (70.6%) and White (72.4%). One-third (35.4%) had at least some college education or a technical/vocational degree; half (49.4%) reported making less than \$25,000 per year, and 40% of respondents were food insecure. The majority of respondents reported being in good (50.1%) or fair (29.3%) health. The mean number of days per week respondents reported engaging in at least 30 min of PA was 2.42 (± 2.38), and the mean number of days per week respondents consumed five or more servings of F&V was 3.12 (± 2.34). Nearly one-fifth (17.5%) rated their mental health as excellent, 21.8% somewhat good, 31.7% average, and 29% somewhat poor/poor.

Self-rated mental health and PA

Table 2 reports the results of the multivariate regression models for the association between self-rated mental health over the past two weeks and the number of days in the past week the respondent engaged in at least 30 min of PA. Model 1 shows the association between self-rated mental health and the reported number of days of PA, without sociodemographic factors or self-rated health included in the model. As self-rated mental health declined, so too did the number of days per week respondents reported engaging in at least 30 min of PA. Respondents reporting somewhat good ($\beta = -.75$, $p = .017$), average ($\beta = -1.29$, $p < .001$), and somewhat poor/poor ($\beta = -1.75$, $p < .001$) mental health reported fewer days of engaging in at least 30 min of PA compared with those who rated their mental health as excellent over the prior two-week period. The relationship held with the addition of the sociodemographic factors in Model 2, where males engaged in slightly more days of PA ($\beta = .62$, $p = .004$) than females, and college-educated respondents engaged in more days of PA ($\beta = .66$, $p = .015$) than those with a high school diploma or less.

Model 3 reports the association between self-rated mental health and the number of days respondents engaged in at least 30 min of PA, including both sociodemographic factors and self-rated health in the model. With the addition of self-rated health, only those with somewhat poor/poor self-rated mental health reported a statistically significant reduction in the number of days they engaged in at least 30 min of PA ($\beta = -.77$, $p = .018$) compared with those self-reporting excellent mental health. Males continued to report more days of PA ($\beta = .60$, $p = .004$). Self-rated health was associated with the number of days respondents reported engaging in at least 30 min of PA. Those who reported good ($\beta = -1.22$, $p < .001$), fair ($\beta = -2.03$, $p < .001$), and poor ($\beta = -2.58$, $p < .001$)

Table 1. Descriptive statistics.

	N (%) or M (SD)	Range
Age (in years)	47.4 (16.3)	18.2–90.6
Sex		
Female	531 (70.6)	
Male	221 (29.4)	
Education		
High school or less	212 (28.3)	
Some college/technical degree	265 (35.4)	
College degree or more	271 (36.2)	
Race/Ethnicity		
Black	134 (18.0)	
White	539 (72.4)	
Other race/ethnicity	72 (9.7)	
Income		
Under \$25,000	281 (49.4)	
\$25,000 to under \$50,000	133 (23.4)	
\$50,000 or more	155 (27.2)	
Food insecurity		
Food secure	338 (60.1)	
Food insecure	224 (39.9)	
Self-rated physical health		
Excellent	53 (8.8)	
Good	306 (50.1)	
Fair	176 (29.3)	
Poor	66 (11.0)	
Number of days in the past week reported engaging in at least 30 min of physical activity	2.42 (2.38)	0 - 7
Number of days in the past week reported consuming five or more servings of fruits and vegetables	3.12 (2.34)	0 - 7
Self-rated mental health (in the prior two weeks)		
Excellent	104 (17.5)	
Somewhat good	130 (21.8)	
Average	189 (31.7)	
Somewhat poor/poor	173 (29.0)	

Note: M = Mean, SD = Standard Deviation.

health reported fewer days with at least 30 min of PA compared with those self-reporting excellent physical health.

Self-rated mental health and F&V consumption

Table 3 reports the multivariate regression models of the association between self-rated mental health and respondents' reported number of days consuming five or more servings of F&V. In Model 1, respondents who rated their mental health as somewhat poor/poor reported fewer days of consuming five or more servings of F&V ($\beta = -1.47$, $p < .001$) compared with those reporting excellent mental health over the prior two-week period. With the addition of the sociodemographic factors in Model 2, the relationship between somewhat poor/poor self-rated mental

Table 3. Effect of self-rated mental health on the number of days reported consuming five or more servings of fruits and vegetables in the past week during COVID-19 (n = 754).

	Model 1				Model 2				Model 3			
	β	SE	p	95% CI	β	SE	p	95% CI	β	SE	p	95% CI
Self-rated mental health¹												
Somewhat good	-.39	.31	.213	[-1.00, .22]	-.18	.31	.561	[-.78, .42]	-.05	.31	.871	[-.65, .55]
Average	-.38	.29	.194	[-0.95, .19]	-.09	.29	.747	[-.67, .48]	.17	.30	.565	[-.42, .76]
Somewhat poor/poor	-1.47	.30	< .001	[-2.06, -.89]	-.90	.31	.003	[-1.51, -.30]	-.49	.33	.133	[-1.13, .15]
Age (in years)												
Male ²					.02	.01	< .001	[.01, .04]	.03	.01	< .001	[.02, .04]
Female ³					-.16	.22	.473	[-.58, .27]	-.17	.21	.432	[-.59, .25]
Education³												
Some college/technical degree					-.23	.25	.367	[-.72, .27]	-.27	.25	.275	[-.76, .22]
College degree or more					-.44	.27	.102	[-.98, .09]	-.56	.27	.038	[-1.09, -.03]
Income⁴												
Under \$25,000					-.51	.26	.051	[-1.02, .002]	-.48	.26	.068	[-.99, .04]
Over \$25,000					-.08	.29	.790	[-.64, .49]	-.18	.29	.523	[-.74, .38]
Race/Ethnicity⁵												
Black					.39	.28	.163	[-.16, .93]	.45	.27	.102	[-.09, .99]
Other race/ethnicity					.01	.35	.975	[-.67, .69]	-.02	.34	.958	[-.69, .65]
Food insecure⁶					-.64	.23	.004	[-1.08, -.20]	-.54	.22	.016	[-.98, -.10]
Self-rated physical health⁷												
Good									-.46	.35	.189	[-1.14, .23]
Fair									-.97	.39	.014	[-1.74, -.20]
Poor									-1.41	.47	.003	[-2.33, -.48]

¹ref = Excellent ²ref = Female ³ref = High school or less ⁴ref = \$25,000 to under \$50,000 ⁵ref = White ⁶ref = Food secure ⁷ref = Excellent.

Note: SE = Standard Error; CI = Confidence Interval. Bolded p values are significant at the p < .05 level.

health was weakened but still significant ($\beta = -.90$, $p = .003$). Additionally, the number of days respondents reported consuming five or more servings of F&V increased with age ($\beta = .02$, $p < .001$) and was significantly lower for respondents who reported food insecurity ($\beta = -.64$, $p = .004$) compared with those who were food secure.

With the addition of self-rated health in Model 3, there was no longer an association between self-rated mental health and the number of days respondents reported consuming five or more servings of F&V. The number of days respondents reported consuming five or more servings of F&V remained positively associated with age ($\beta = .03$, $p < .001$) and negatively associated with food insecurity ($\beta = -.54$, $p = .016$). Respondents with a college degree or higher reported consuming five or more servings of F&V on fewer days ($\beta = -.56$, $p = .038$) compared with those with a high school diploma or less. Self-rated health was negatively associated with consumption of F&V, with respondents reporting fair ($\beta = -.97$, $p = .014$) or poor ($\beta = -1.41$, $p = .003$) physical health reporting fewer days of consuming five or more servings of F&V compared with those self-reporting excellent physical health over the prior two-week period.

Discussion

Our results demonstrated that Arkansans who self-reported lower levels of self-rated mental health during the prior two-week period during the height of the COVID-19 pandemic engaged in PA and consumed five or more servings of F&V on fewer days than those who rated their mental health as excellent. The relationship between mental health and PA and diet remained statistically significant with the addition of sociodemographic factors as indicators of access to resources. With the addition of self-rated health, the relationship between self-rated mental health and PA remained significant for respondents who self-reported their mental health as somewhat poor/poor. Furthermore, with the addition of self-rated health, there was no longer an association between self-rated mental health and the number of days reported consuming five or more servings of F&V. These results are consistent with pre-pandemic research which has shown engagement in adequate PA and eating a healthy diet are associated with improved mental health (Zaman et al., 2019; Null and Pennesi, 2017; Głowska et al., 2020; Marx et al., 2017; World Health Organization, 2020). Research during the COVID-19 pandemic has also demonstrated mental health difficulties are associated with reduced PA and diet quality (Faulkner et al., 2021; Ingram et al., 2020).

One potential explanation for the lack of association after the addition of the self-rated health measure is the complicated interplay between mental and physical health and its assessment in surveys. For the respondents in this study, the pandemic and its associated stressors had been ongoing for several months; however, the self-rated mental health question is time-limited to the prior

two-week period. Self-rated health does not have a time limit associated with the question; therefore, it may be that the self-rated health measure is capturing a more global rating of both perceived mental and physical health, rather than just the subjective physical health of the participant. Self-rated health measures have been shown to incorporate not only the respondent's perceived physical health factors, but also psychological processes including expectations of the future, mood, motivations, and mental health (Garbarski, 2016). Prior work using cognitive interviews has shown that when respondents self-rate their health, they include references to not only health behaviors and physical functioning, but comparisons to relevant 'others', including themselves at other points in time (Garbarski et al., 2017). In the case of the COVID-19 pandemic, self-rated health asked without a time limit may encompass temporal comparisons to mental and physical health before the pandemic that is restricted in the assessment of self-rated mental health which asked specifically about the prior two-week time period. More work is needed to understand how respondents assess self-rated health and how it affects measures of self-rated mental health.

Men in our sample reported engaging in at least 30 min of PA more often than women. Men have reported better mental health during COVID-19 in prior surveys, which may positively affect PA (Pieh et al., 2020; Lin et al., 2020; Proto and Quintana-Domeque, 2021). Further, women have taken on much of the burden resulting from epidemiological mitigation efforts including reducing paid work hours and assuming more of the childcare and housework responsibilities, which has been shown to affect both mental health and PA levels (Yildirim and Eslen-Ziya, 2021; Czymara et al., 2021; Farré et al., 2020; Benke et al., 2020). Future research should seek to understand the gender dynamics concerning PA during the COVID-19 pandemic and the potential for negative health outcomes for women because of these gender differences in responsibilities and expectations during the pandemic.

Food insecurity was very high in our sample, with approximately 2 in 5 reporting food insecurity, despite a higher percentage of individuals with college degrees (36%) compared with the general Arkansas adult population (23%) (Vasquez and Dolan, 2019; United States Census Bureau, 2019). The prevalence of food insecurity in the US since the pandemic began has been estimated to have more than doubled (Schanzenbach and Pitts, 2020; Fitzpatrick et al., 2020). In our sample, food insecurity was negatively associated with the number of days respondents reported consuming five or more servings of F&V. Food insecurity is associated with a wide range of negative health outcomes including asthma, type 2 diabetes, poor self-rated physical and mental health, and overweight/obesity, in part due to the lack of availability of nutrient dense foods (Gundersen and Ziliak, 2015; Stupplebeen, 2019). More work is needed to understand the long-term

effects on mental and physical health because of increased food insecurity observed during the pandemic.

The results showed college-educated participants reported fewer days of adequate F&V consumption compared with those with a high school or less education. This finding is counter to previous research, which has shown college-educated individuals tend to eat five or more servings of F&V on more days than those with lower educational attainment (Thompson et al., 1999; Blanck et al., 2008; Lee-Kwan et al., 2017; Assari and Lankarani, 2018). Research from Europe conducted early in the pandemic showed decreases in the frequency of food shopping trips and the consumption of fresh foods, including F&V (Janssen et al., 2021). The findings presented here may be evidence of a similar phenomenon in the US, with a disproportionate effect found among college-educated populations who normally report more F&V consumption. College-educated Americans have been more likely to work remotely (Bick et al., 2020) and have been more likely to avoid unnecessary trips outside the home (Hamidi and Zandiatashbar, 2021); as such, this may have resulted in fewer trips to the grocery store to purchase fresh produce. Given the increase in online food shopping during the pandemic, one potential option for addressing the lower F&V consumption is to encourage online vendors to promote fresh produce options to patrons while shopping.

Limitations

The results of the study should be considered with limitations in mind. The sample was limited to people who were patients at one of six clinic sites across the state of Arkansas and, therefore, may not be generalizable to the general Arkansas or US adult populations. Additionally, PA and diet vary geographically, and Arkansas has low levels of PA and F&V consumption compared to other US states (Lee-Kwan et al., 2017; Lange et al., 2019), which may limit generalizability. All of the measures used in this study were self-reported and are reliant on respondent understanding of the questions and their recollections (e.g., serving size and number of F&V servings), which may result in response biases. The survey had time restraints, and in the interest of collecting data on multiple topics, many measures were limited to single item measures. For example, the survey did not include additional questions regarding the intensity of exercise or a full screener for mental health conditions (e.g., CES-D). The data is cross-sectional; therefore, no temporal or causal claims can be made regarding the observed relationships. Finally, although information on negative behaviors (e.g., sedentary time; consumption of unhealthy foods) would have added to these findings, the survey did not include this information.

Applications for practice

Despite these limitations, the study makes a significant contribution to the literature. The results establish a relationship

between self-rated mental health and PA among Arkansans during the COVID-19 pandemic. Several of the reported findings provide a basis for further action. The relationship between mental health and PA and diet reaffirms a need for healthcare providers to educate patients on the importance of maintaining both a healthy PA level and a nutrient-rich diet in the face of challenging circumstances, such as a global pandemic. The results also indicate the need for support for opportunities to engage in PA for women who may take on a large portion of the home and family responsibilities during a public health emergency. Finally, it is valuable to consider how respondents assess their self-rated health. Self-rated health is more than a subjective measure of physical health and may point to the complicated interplay between physical and mental health, with implications for health behaviors.

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Availability of data and materials

The deidentified data underlying the results presented in this study may be made available upon request from the corresponding author, Dr. Pearl A. McElfish, at pamcelfish@uams.edu. The data are not publicly available in accordance with funding requirements and participant privacy.

Authors' contributions

JAA and BR conceived and designed the analysis. JAA performed the analysis, and all authors contributed to the interpretation of the analysis. JAA, BR, and EG wrote the original draft of the paper. DEW, NH, HCF, CRL, and PAM revised for important intellectual content. All authors provided final approval of the version to be published and agree to be accountable for the work.

Consent for publication

Not applicable

Declaration of conflicting interests

The authors declared no conflicts of interest.


Ethical approval

The study was approved by the University of Arkansas for Medical Sciences Institutional Review Board (IRB#261226). Research Electronic Data Capture (REDCap) was used to administer the consent and survey.

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