

You Are What You Eat?  
The Effect of Diet on Mental Health Symptoms and Blood Pressure  
on African-American High School Students

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## **Abstract**

The purpose of this study is to investigate the effect of diet on mental health symptoms and blood pressure in African American high school students. Previous research has found that the proper intake of fruits and vegetables can generally lead to better mental health and blood pressure. We hypothesized that students who eat more fruit and vegetables will have better mental health symptoms and lower blood pressure. We also predicted that people who cook their own food may have different mental health symptoms and blood pressure. Thirty-seven high school students' mental health symptoms were recorded with a DASS 21 survey and their daily meal intake was also recorded with a food diary. We found that fruit and vegetable servings did not affect mental health and blood pressure because we couldn't measure an accurate relationship because of the very low consumption of fruits and vegetables by our participants. Our data suggests that being independent in food preparation might be beneficial. Our study should not be interpreted as fruits and vegetables do not matter, only that we did not see a relationship in this sample.

## Introduction

Diet and its effect on the mental and physical health of high school students is very important because diet is essential to a student's well-being. Statistics show that worldwide obesity in children has tripled since 1975 and 9.4 percent of children have depression and anxiety; could these be connected (1, 2)? Diet could be a factor in having good mental and physical health, especially with high school students. Research suggests diets might influence anxiety, depression, BMI, blood pressure, and physical activity (3, 4, 5, 6, 7). The purpose of this study was to see how good or poor diets can correlate with the mental and physical well-being of students. This study had students at TNA complete a diet log, as well as a mental health survey, and measure their blood pressure.

Mental health is an essential component of human health if a person is leading an unhealthy lifestyle then that can be associated with poor mental health (6). The impact of nutrients on mental health and well-being is positive and an increasing amount of studies reveal that micro and macro nutrients incorporated into a diet are very beneficial to a healthy lifestyle. In a 2021 review article, researchers found positive effects for the nutrients magnesium, folic acid, omega-3, alpha-tocopherol, docosahexaenoic acid, and ethyl eicosapentaenoic acid. They argue that these can help aid certain sleep disorders, stress, burnout, and psychiatric disorders such as depression, anxiety, and cognitive impairments (6) This is important because these nutrients can be found in healthy diets that contain a diet of fruits, vegetables, and healthy proteins. Therefore we expect teens who have healthy diets to have fewer mental health symptoms.

Teenagers' relationship with their diet quality and mental health is essential because they can experience life stress in high school and when entering college (3). This is very important because a student's mental health and well-being should be prioritized due to the stress that school has on them. So for this study, the students were given a questionnaire with a series of questions about their eating habits, diet, and more before and after transitioning to college. It was found that first and second-year students' diet quality was significantly lower than third-year students and those same students had higher depression and anxiety rates (3). This is because transitioning to university can take a toll on your mental health and eating habits since it's such a huge switch from home and somewhere they have been for a while to an unknown place. Diet can influence how a person feels, or vice versa, and being independent can be a protective factor. This is important to the current study because while independence was found to be a protective factor for college students, it is unclear if that is the same for high school students. High school students who cook for themselves might rely on cheap, poor food, and this might be problematic.

If students are consistently not receiving the right amounts of and qualities of food, this might lead to food insecurity, which can also impact mental health (5). Improving high school students' diet intake through increased access to healthy food could improve the mental health and well-being of students, who are engulfed in a high-stress environment and could be transitioning from one to another stressful environment which would be college. Wattick et al. surveyed college students in the Appalachian region, asked about food insecurity, and intake of fruits and vegetables, and screened for depression and anxiety (5). For male students, food insecurity and low vegetable and fruit intake indicated depression. For females, only food

insecurity was related to depression. For both sexes, higher sugar intake and insecurity indicated higher anxiety. Because there are differences in sex and the relationship between food and mental health, we will need to consider both sexes separately as well as the entire group of students.

The role of fruits and vegetables in the mental health of children is crucial because they must receive the proper nutrition to function properly. Guzek et al. conducted a systematic review that found that students who don't intake a good amount of fruits and vegetables in their diet are more likely to feel symptoms of depression and anxiety (4). The authors reviewed a total of 12 studies and found that most found a positive relationship between fruits and vegetables and mental health. There were several shortcomings with the studies they reviewed such as first many studies also included exercise so it was hard to tell if the effect of fruits and vegetables was the reason. Second, some studies incorporate things such as juice which could mess up results due to the sugar content. Lastly, the studies had multiple different ways of measuring mental health so it was hard to determine if they all found the same thing (4). This is important to our study because it tells us fruits and vegetables are important but it is important to look at the other factors such as juice and exercise.

Other research has observed changes in BMI and blood pressure after a school-based intervention (7). Over 600 students were involved in this Intervention group and the survey questionnaire that was sent out has found that this is important because obesity rates and blood pressure rates with children are increasing worldwide. And that is important to dive deeper into because if it continues to rise too quickly that will be a problem because when those children reach adulthood they can develop many underlying health issues they can eventually have trouble with. The children who were involved ate more fruits and vegetables, consumed fewer fats, meats, and sugars, and saw that even without physical activity there was a change in BMI. This is important in our study because the students in our school could benefit from a school-based intervention so we could see if an intervention check would improve their BMI and blood pressure with a change in diet. Including more fruits and vegetables and cutting out certain meats, fats, and sugars.

Overall the research says that a healthy diet that includes fruits and vegetables promotes positive changes in blood pressure, BMI, and mental health symptoms such as depression and anxiety (3, 4, 5, 6, 7). This study contributes to our understanding of this topic by exploring the effect of healthy diets on teenagers in a college-preparatory high school. In addition, mental health problems are more common in the African American community so looking at this population would be beneficial (8). We will track the blood pressure, mental health symptoms, and diet of about 20 neighborhood academy students over a period of a few weeks and look for relationships between what they eat and how healthy they are.

We hypothesize that students who eat more fruit, and vegetables and have a healthy diet overall will (a) have better mental health symptoms and (b) lower blood pressure. We predict that people who cook their own food may have different mental health symptoms and blood pressure. This is nondirectional because a prior source said college students who cook for themselves are healthier but we think, based on anecdotal experience, high school students who feed themselves probably rely on junk foods.

## Materials and Methods

A total of thirty-seven high school students from The Neighborhood Academy participated in the study. All participants from the study were African American, composed of males (54%) and females (46%) from grades 10 and 12 and between the ages of 15-18. All students in the grade had the same schedules and experienced similar academic environments.

The participants will be given a survey known as the DASS21, to get their baseline scores on their stress, anxiety, and depression symptoms (9). The survey consisted of 21 statements in total with 7 statements about either stress, anxiety, or depression symptoms. For example, anxiety had statements such as "I was worried about situations where I might panic and make a fool of myself." For depression, there were statements such as "I couldn't seem to experience any positive feeling at all". Lastly, for stress, there were states such as "I found it hard to wind down." Based on the participant's responses to those statements, they would answer 0 meaning that the statement did not apply to them at all, and 3 meaning that it applied to them very much or most of the time. The participants were scored by their ratings being added up on the scale for each statement on anxiety, stress, or depression. Those totals for each disorder would then determine the severity of their symptoms for each disorder. For example, a score of 0-4 in the depression category would mean the person's symptoms are "normal" and a score of 14+ would mean that their symptoms are "extremely severe" (10).

For the food diary, the students were given a page at the beginning of the day and were required to document all that they had to eat and drink throughout the day. The food diary has five sections to document food, each section has a category of what foods you ingest throughout the day. The categories are breakfast, lunch, snacks, dinner, and drinks, alongside those categories I have a section of how much the participant has of whatever they eat in the day. There is also a guide at the bottom that helps the participant accurately document how much they had, or there is also the option of checking the package/ bottle to get the exact amount. There is also a rate your day section under the amount guide which reads "This is a normal day for me" "This was a cheat day" and "I had a healthy day". So after the day is finished and the slip is filled out, participants will circle what kind of day it was for them.

The next day after participants completed the food diary, we asked them to complete the DASS21 and took their blood pressure. Participants had to sit, remain relaxed, remove sweaters, and not talk while pressure was taken. Before finishing, we reviewed the diary to check that they filled it out correctly and asked who prepared their food: them or their parents. Each diary was analyzed for fruit and vegetable servings (11). A half-cup of vegetables (or 3oz) was one serving, except for voluminous items like salad, where a serving was one cup. For fruit, a serving was judged to be one cup. Many participants drank homemade servings, and because they compressed during blending, we said a serving of a smoothie was ½ cup. Juice counted as a fruit serving (1 cup is one serving).

Relationships between fruit, vegetables, mental health, and blood pressure were tested with Pearson r-tests. Comparing diets, mental health, and blood pressure for those who cook for themselves versus family (or eating out) will be done with a t-test. The abbreviation M is the

mean, and SD is the standard deviation. All tests were calculated using vassarstats.net with a 0.05 significant threshold.

## Results

We expected our results to be exactly what my hypothesis was, that a student who consumes more fruits and vegetables will have significantly better mental health symptoms and lower blood pressure than another student. We also expected that students who cook for themselves would have different mental health symptoms and higher blood pressure than students whose families cook for them. Our data came from students aged 15-18 and grades 10th and 12th. They completed a food diary and the DASS21 to measure mental health symptoms.

Before looking at our hypotheses, we wanted to determine if TNA students' mental health is similar to regular healthy people. The DASS21 provides scoring interpretation rules from normal to extremely severe (10). In general, TNA students do not display high levels of depression, with most students in the "Normal" category. For anxiety, most were "normal", but 36% of TNA students had moderate anxiety or higher. For stress, the numbers were also mostly "normal" with 24% of people displaying moderate stress or higher (Table 1).

	Depression	Anxiety	Stress
Normal	65%	51%	62%
Mild	15%	8%	10%
Moderate	17%	16%	16%
Severe	6%	10%	8%
Extremely Severe	0%	10%	0%

**Table 1. Frequency of different mental health symptoms ratings from the DASS21 among TNA students.**

I hypothesized that students who don't consume fewer fruits and vegetables will display higher levels of mental health symptoms than those who do consume more. Fruit and vegetable servings were determined by converting the amounts they ate in the food diary to servings based on standard nutrition references (10). We have found that our results were very different from what we expected; there is no correlation between fruit or vegetable servings and mental health symptoms (Table 2). This is likely because there was no significant amount of fruit and vegetable intake, making the correlations difficult to find.

	Systolic BP	Diastolic BP	Depression	Anxiety	Stress
Fruit Servings	r= 0.21 p= 0.11	r= -0.21 p= 0.11	r= 0.08 p= 0.31	r= -0.001 p= 0.49	r=0.02 p=0.44
Veggie Servings	r= 0.20 p= 0.10	r= 0.14 p=0.20	r= -0.13 p= 0.22	r= 0.02 p= 0.44	r= 0.03 p=0.43

**Table 2. Relationships between fruit and vegetable servings and blood pressure and mental health symptoms.** The r-value is a correlation coefficient.

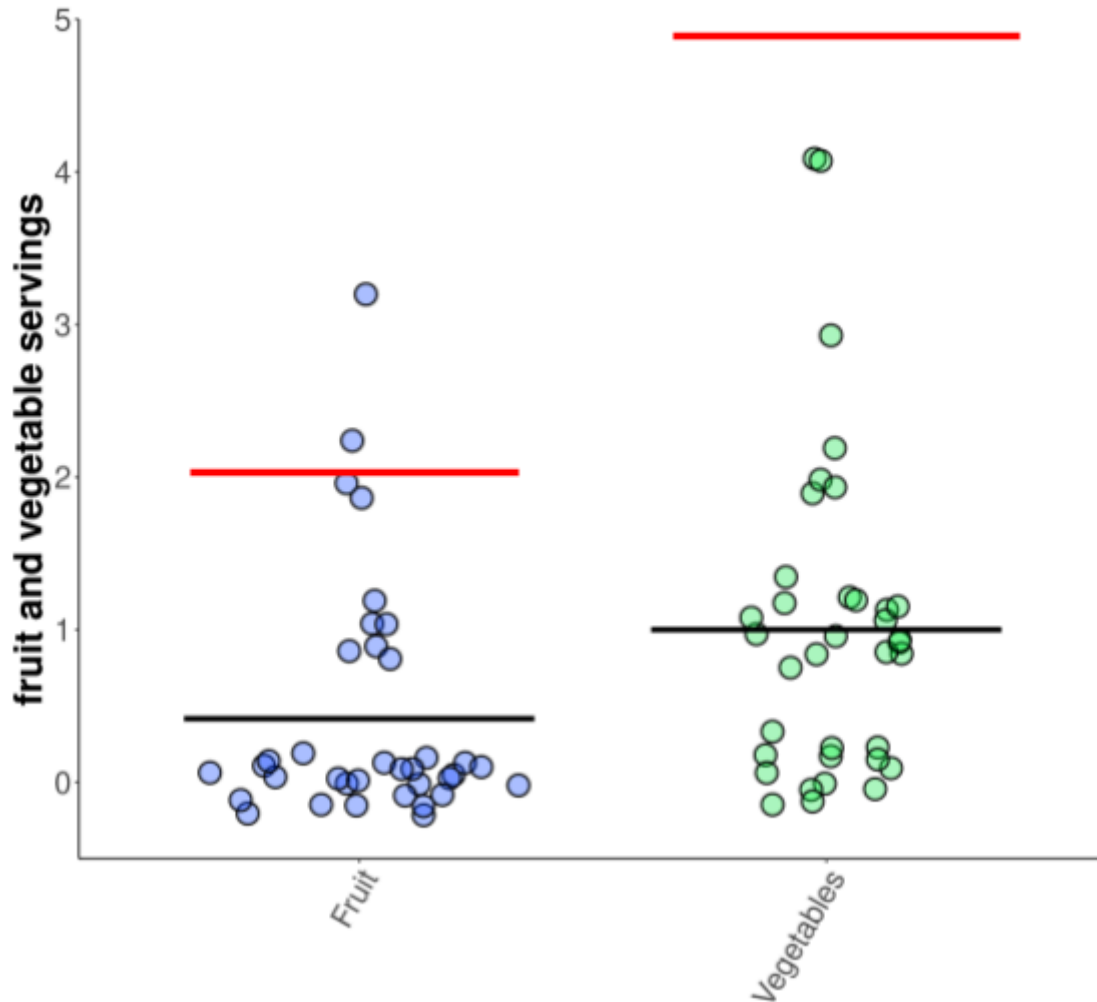
I also hypothesized that students who do make their own food may have different mental health symptoms and blood pressure than a student who has family dinners or eats out. That is because students who may make their own food could refer to unhealthier quick things to get them through the day or some could stray away from family dinners because they want to eat healthier so they are going on their path of a better diet. Participants were asked to write down who cooked their dinner for a specific meal in the food diary. They were also asked who does it in general, with most (86%) people saying this is how they normally prepare food.

	Parents Cooked Meals	Takeout of Restaurants	Cooked for Themselves	p-value
Systolic BP	130.4 (14.2)	126.2 (15.6)	111.6 (16.3)	p = 0.07
Diastolic BP	76.4 (12.5)	75.3 (15.3)	68.6 (7.66)	p= 0.52
Depression	4 (4.84)	4.25 (3.67)	1.2 (0.83)	p= 0.32
Anxiety	4.13 (4.94)	5.25 (4.13)	2.6 (2.96)	p= 0.48
Stress	5.86 (4.53)	6.81 (4.54)	2.8 (1.64)	p= 0.20

**Table 3. People who prepare meals and blood pressure and mental health symptoms.** The first number is the average, and the number in parentheses is the standard deviation. P-values are from a one-way ANOVA.

We are using 5 and 2 in serving size for fruits and vegetables because the USDA recommends that students should consume that amount of fruits and vegetables per day (11). A one-sample t-test found a significant difference in vegetable servings compared to recommended servings ( $p < 0.001$ ). TNA students averaged 1 serving a day, while the recommendation is 5. There was also a significant difference in fruit servings ( $p < 0.001$ ). TNA

students averaged 0.4 servings a day, while the recommendation is 2. The one-sample t-test shows that the neighborhood academy students don't even consume half the recommended serving size that is recommended size that should be eaten daily.



**Figure 1. TNA students' fruit and vegetable intake is lower than recommended.** A dot plot showing students' daily serving of fruits and vegetables with the black line representing the mean. The red line is the recommended serving size according to the USDA. The data came from the food diary where people were asked to record their daily food intake. The number of servings was calculated by the researcher. One sample t-test,  $p < 0.05$

## Discussion

In this study, we investigated if the consumption of fruits and vegetables would improve African American students' mental health and blood pressure. Our first hypothesis was that students who consume more fruits and vegetables and have a healthy diet overall will have better mental health symptoms and blood pressure than those who don't. This was not



supported because there were no significant relationships found between fruit or vegetable servings and depression, anxiety, stress, or blood pressure (Table 2). Our second hypothesis was that people who cook their own food may have different mental health symptoms and blood pressure. This was partially supported because while there weren't any significant differences there was a clear trend between people who cooked for themselves and better health (Table 3). Lastly, we also found students that who participated did not consume the recommended amount of fruits and vegetables (Figure 1).

Our results are inconsistent with other studies on diet and mental health (3). They found that first and second-year students had significantly lower diet quality and higher depression and anxiety rates than third-year students. They also found that being independent can be a protective factor when it comes to students cooking meals for themselves. Our study did not find this, people with poor diets did not have higher mental health symptoms. Our study also found that students who cooked for themselves had lower blood pressure. One of the reasons why our studies were different was because we had different populations, they had college students and ours had high school students. That could be a problem because college students have more reign over their food intake vs high school students who eat the same lunch provided by the school every day. Therefore, the diet and mental health connection is more noticeable in populations where people have choices. In our sample, because everyone had such poor diets it's hard for us to confidently weigh in.

Our results are also inconsistent with a meta-analysis on the relationship between fruits and vegetables with mental health. They conducted a systematic review that found that students who don't intake a good amount of fruits and vegetables in their diet are more likely to feel symptoms of depression and anxiety. Our study did not find there was a significant relationship with fruits and vegetables and mental health. In addition to TNA students not eating fruits and vegetables, they are mentally well. Almost all participants had normal or mild mental health symptoms. Our results being inconsistent doesn't mean the meta-analysis is wrong but we tested a relatively healthy population.

Prior research on food insecurity found that food-insecure students had higher anxiety for both sexes and higher depression rates for females. In our study the majority of our population voted for free or reduced lunch, however, we did not ask what students are food insecure so we don't know if the individuals with moderate or severe anxiety and depression are food insecure. This would be an interesting thing to look at in the future if we were able to ask individuals. It might be possible that those moderate and severe cases of mental health symptoms are students who are food insecure. The Neighborhood Academy should investigate this connection.

Our study had multiple limitations. Our first limitation was that the participants involved in the study did not consume enough fruits and vegetables for us to determine anything. Another limitation was that we only had one day of collecting food diary data, we believed that was an accurate measure of how they eat, but it seems more time could have been beneficial as well. For future research and improvements, there could be more data collected from more than just one day so what's truly used is accurate. This could improve the overall results of the entirety of the project by introducing more variation in scores. It would be important to include looking at

other ways to measure healthy and unhealthy diets such as fats, salt, and sugars to measure if there were more variations in health.

According to research by others, consuming fruits and vegetables and having a healthy diet can have a positive effect on blood pressure and mental health. However, in our study, we did not find that because we couldn't measure an accurate relationship with the limited consumption of fruits and vegetables of our participants. We recommend that students still should eat more fruits and vegetables recommended by the USDA. Also in addition our data suggest that being independent with food preparation may be an important factor in health, so parents and students should take that into consideration. The Neighborhood Academy should also consider ways to include a wider variety of fruits and vegetables that are more desirable to the students.

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