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## The Association Between Fruit and Vegetable Consumption and Mental Health Among Young Adults

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The Association Between Fruit and Vegetable Consumption and  
Mental Health Among Young Adults

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Human Development and Family Sciences Minor

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## **Abstract**

While the majority of the American population is aware that fruits and vegetables can improve physical health, research also suggests that mental health may benefit as well. With depression and anxiety rates increasing and fruit and vegetable consumption decreasing across the country there is potential that the two are related. It has been found that majority of American adults do not meet fruit and vegetable recommendations, while 16 million adults face depression and anxiety. Young adults reported the lowest amount of fruit and vegetable consumption, as well as some of the highest rates of depression and anxiety. The purpose of the current study was to find if there is a relationship between fruit and vegetable consumption and mental health in young adults. The study gathered data on 113 American young adults, ages 18-25, and their recorded food intake and mental health using validated questionnaires and nutrition tools. The findings show a positive relationship between fruit intake and self-esteem, a negative correlation between fruit intake and cognitive dysregulation and lastly, a positive correlation between total fruit and vegetable intake and self-esteem. These findings support existing literature in that there is a correlation between fruit and vegetable consumption and mental health in young adults.

## Introduction and Background

In the 90's, when kids were being taught about the food pyramid, fruits and vegetables were emphasized as key components of a healthy diet. Today, the majority of 90's-born children are now considered young adults, being between the ages of 18 and 25. There are several well-known benefits to adequate fruit and vegetable intake (FVI), such as their ability to help lower the risk for type 2 diabetes, heart disease, multiple cancers and obesity.<sup>1</sup> According to the Center for Disease Control (CDC), in 2015, only 1 in 10 American adults were meeting the federal recommended guidelines for fruit and vegetable consumption.<sup>1</sup> The CDC also found that adults ages 18-30 years reported the lowest amount of fruit and vegetable consumption compared to other age categories.<sup>2</sup> The Study on America's Consumption of Fruit & Vegetables found that, over the past 5 years, fruit and vegetable consumption has declined 7% per person.<sup>3</sup> This study concluded this decline is primarily due to the reduction of fruit juice consumption at breakfast as well as vegetable consumption at dinner.<sup>3</sup>

Additionally, the CDC reported that about 16 million American adults are affected by depression and anxiety every year.<sup>4</sup> Perhaps what makes this even more concerning is that depression and anxiety are more prevalent in young adults than other age groups.<sup>4</sup> Moreover, Arkansas ranks in the top 10 for several mental and physical health risks, including emotional distress, depression, obesity and drug dependency.<sup>5,6,7,8,9</sup> The purpose of the present study is to examine the impact of fruit and vegetable intake on mental health in young adults ages 18-25.

Fruits and vegetables provide our bodies with essential key nutrients and antioxidants. Certain antioxidants lower oxidative stress, which can lead to decreased risk for some cancers, atherosclerosis, chronic inflammatory disease, and depression.<sup>10</sup> Vitamin C and carotenoids, which fruit and vegetables are rich in, specifically play a vital role in lowering oxidative stress.<sup>10</sup> Fruit and vegetables also contain high amounts of water soluble vitamins and minerals that support healthy cognitive and emotional functioning.<sup>10</sup> Vitamins and minerals playing essential roles in our body to ensure healthy functioning is a foundational concept in the nutrition field. Subclinical micronutrient (vitamin and mineral) deficiencies could negatively impact psychological factors.<sup>11, 12,13,14</sup> This broad concept has been supported in several

studies investigating the effect that vitamin and mineral supplementation can have on depression symptoms.<sup>11,12,13,14</sup>

While current studies investigating the impact of FVI on mental health are diverse in their methodology, little research has focused on young adults, ages 18-25. This age group is distinctly different from adults due to age-specific physical and mental developmental stages.<sup>15,16,17</sup> These stages greatly effect nutrient needs and psychological function, therefore impacting dietary requirements, and ability to think and process emotions.<sup>15,16,17,18</sup> Additionally, individuals ages 25 and younger are still undergoing brain development. When studies recruit participants 18 years and older, the broad age range serves as a major limitation in the applicability of results because the sample is too diverse.<sup>19</sup> Additionally, without controlling for other variables, a clear relationship cannot be determined between FVI and depression and anxiety.

### ***Effects of Raw Fruit and Vegetable Intake (FVI) on Mental Health***

Studies have shown that raw and processed fruits and vegetables should not be considered equal due to the added sugars and sodium in processed foods.<sup>20</sup> Nonetheless, in one study, individuals who consumed processed fruits and vegetables reported having a more positive mental health than individuals who did not consume any fruits and vegetables.<sup>10</sup> An additional variable carried this study one step further by analyzing mental health based on a third FVI criterion, unprocessed. The final results showed no matter the source, there were mental health benefits with any form of fruit and vegetable intake compared to no intake. However, it was found that individuals who consumed raw fruits and vegetables reported fewer depressive symptoms as well as more positive mental health, life satisfaction, and thriving.<sup>10</sup> While this is a correlation study, which may be viewed as a limitation, this study did control for demographic and health variable. The main limitation of this study is that the dietary recall measure used is not validated and participants had to estimate serving sizes.<sup>10</sup> In another study, adolescents who consumed raw fruits and vegetables also showed signs of improved psychological well-being.<sup>21</sup> This study is limited by a narrow timeframe (two weeks) therefore, the long-term benefits are unknown. Further research needs to be done to learn the long-term effects of raw fruit and vegetable consumption on mental health.<sup>21</sup>

However, both studies have the same strength of having a large sample population of participants between ages 18 and 25.<sup>10,21</sup>

### ***FVI Frequency Studies***

Recently, a study found higher FVI was associated with decreased odds of feeling depressed as well as feeling distressed.<sup>22</sup> However, one of the main limitations of this study is the FVI assessment regarded frequency of FVI, not actual quantity. This is a limitation because it failed to assess the number of fruit and vegetable servings consumed, therefore results cannot be compared to recommended intake amounts. Another limitation is the broad age range of participants which includes ages 12 years and older. One published study regarding FVI frequency looked at the benefits of the Mediterranean diet, which focuses on fruit and vegetable consumption.<sup>23</sup> This study investigated the relationship between FVI and positive and negative affect. Affect was measured using the Positive and Negative Affect Schedule (PANAS), a validated tool using a 5-point rating scale to gather comparable data.<sup>23</sup> Positive affect can be described as positive expression and emotion, such as: inspired, alert, excited, enthusiastic, and determined.<sup>23</sup> Negative affect was identified by expression of: afraid, upset, nervous, scared, and distressed. The study found frequent consumption of fruits and vegetables are linked to positive affect.<sup>23</sup> The main limitation to this study is that the population was not screened for mental illness which can affect eating habits (emotional eating or eating disorders). Secondly, this study includes participants from age 30 year and older. Lastly, the sample studied was narrowed to Seventh-day Adventists, a religion following both a healthy and spiritual lifestyle, which is not representative of the entire population.<sup>23</sup>

### ***FVI Serving-Size Based Studies***

A cross-sectional study found similar results suggesting FVI and mental health share a relationship.<sup>24</sup> The study looked at self-reported depression rates as well as self-reported servings of fruit and vegetables consumed on a daily basis. An intriguing aspect of this study was the inclusion of three separate sample groups from Bangladesh (n=3,262), India (n=7,594) and Nepal (n=3,277).<sup>24</sup> Across each group, the results were similar. In India, those who consumed less than 5 servings of vegetables a day

were 51% more likely to report feelings of depression in comparison to those who consumed more than 5 servings.<sup>24</sup> In Bangladesh 5 or more servings of vegetables was associated with decreased likelihood of depressive feelings by 32%. In Bangladesh and Nepal, consuming 5 servings of fruit per day was associated with an 86% decrease in self-reported depression, compared to those who consumed less than 5 servings of fruit.<sup>24</sup> Therefore, regardless of geographical location, the study found a positive relationship between FVI and mental health with the acknowledgement that more research needs to be done. While these are important findings, they need to be replicated in a sample in the US to apply to young adults in Arkansas. A limitation of this study is that the participants were ages 18 and older, which is far too broad due to the different developmental and life stages.

Similar findings were found in a study that measured daily FVI through questionnaires.<sup>25</sup> This study found reduced odds of depressive symptoms in women who consumed at least two pieces of fruit per day.<sup>25</sup> While the study had clear findings regarding fruit intake, vegetable intake only showed an effect on mental health when consumed in high quantities. The study found vegetable intake was strongly associated with positive mental health; however, further research is needed to determine the level of consumption at which benefits are seen.<sup>25</sup> This is because the study's analysis does not show a clear effect of vegetable intake on mental health. This study's limitation is that it analyzes one the age range of 45-50 years, and only women. Another study concluded the daily consumption of 7-8 fruits or vegetables increased not only a same-day positive affect, but the following day as well.<sup>26</sup> Participants experienced the most positive affect during days they ate more servings of fruit.<sup>26</sup> This finding correlates with the previous study's conclusion that fruit intake has a more positive impact on mental health than vegetable intake.<sup>25,26</sup> This study collected data using an affect scaling procedure, similar to the study regarding the Mediterranean diet.<sup>23,26</sup> During dietary assessment, participants are asked to report total number of fruit and vegetable servings, disregarding juice and dried fruits.<sup>26</sup> This could be addressed as a limitation since many vitamins and minerals found in fresh and whole fruits are still present in these forms. While assessing them separately could be beneficial, excluding them is limiting. The food diary asked participants five specific question regarding the servings of and timing of fruit, vegetable, cookies, chips,



and pastries.<sup>26</sup> While these questions did provide specific data, they are limiting as to what further information could have been drawn from the participants' diet reports. However, a strength of this study is that the participants are between the ages of 18 and 25, which means participants are in approximately the same stage of life.<sup>26</sup>

A college student-based study consisting of 541 students, used web-based questionnaires to assess the correlation of certain dietary habits and happiness.<sup>27</sup> The study concluded the highest happiness scores were achieved by those who ate breakfast, more than 8 servings of fruits and vegetables a day and ate 3 meals with 1 to 2 snacks per day.<sup>27</sup> While their final conclusion consisted of multiple variables, their findings regarding FVI were clear. The measure of happiness was higher in students who consumed more than 8 servings of fruit and vegetables.<sup>27</sup> The main limitation with this study includes participants in a very broad age range, between ages 18 and 46. Another limitation is that participants were to provide how frequently they consumed fruits and vegetables and in what serving size.<sup>27</sup> This is a limitation because the participant is expected to know what an actual serving of fruits and vegetables is or to measure their food, which is unlikely. This same limitation is true in two studies investigating the effects of FVI on well-being.<sup>28,29</sup> Additionally, while these two studies both account for frequency and amount of servings, they also have a very broad age range of 15 years and older.<sup>28,29</sup> This is a limitation because with such a large range the data cannot be representative of a specific population, namely young adults with their unique developmental stage and particularly high rates of anxiety and depression.

### ***Present Study***

To address the aforementioned limitations, the present study will examine the impact of FVI on mental health (i.e., anxiety, depression, self-esteem, and dysregulation) in a sample of young adults (ages 18-25). This age range was selected due to the high rates of anxiety and depression (25.8%) seen in this group and the lack of focused research on this population.<sup>30</sup> As discussed earlier, a narrow age range in a study is crucial for gathering data that is comparable because participants are in similar developmental and life stages. Since emotions and diet choices tend to vary by age group, when collecting data regarding mental health and FVI, focusing on a single, similar age range is critical. The study will use a dietary

recall program (ASA24<sup>®</sup>) that helps participants record their diet accurately using images to represent serving sizes. ASA24<sup>®</sup> will also allow participants to record any foods, beverages and supplements they consume, including add-ons such as condiments, creamers and other similar items. Therefore, this program allows participants to not only record FVI, but also other food groups, the frequency which they consumed each food and how many servings they consumed per sitting. The aim of the current study is to investigate whether FVI is associated with mental health in young adults. The secondary aim is to examine whether meeting the federally suggested FVI guidelines shows a positive correlation with mental health in the same population. It is hypothesized that if participants consume fruits and vegetables daily then their mental health and mental health will positively benefit. It is also hypothesized that if participants meet the federal guidelines for daily fruit (1½ to 2 cups) and vegetable (2 to 3 cups) intake, then their mental health will be more positive than those who did not meet the daily FVI guidelines.<sup>1</sup>

## **Methods and Materials**

### ***Recruitment of Participants***

This study is a part of a larger parent-study examining the effects of multivitamin and mineral supplementation on physical and mental health. One-hundred and forty participants were recruited through a southern university campus announcements, flyers, as well as in class announcements made by research assistants and professors. Eligibility criteria include: 18-24 years old; working or going to school part or full time; no diagnosis related to impaired liver or renal function; no diagnosis of malabsorption or related gastrointestinal diagnoses; no mental health diagnosis (e.g., general anxiety disorder, depression, bipolar-related diagnoses, and eating disorders); not receiving medication for mental health diagnoses; and subjects must be willing abstain from taking supplements, herbal teas, and illicit drugs (e.g. marijuana) during the study. Due to the nature of the parent study's research aims, half the subjects needed to be of a healthy BMI and the other half of an overweight/obese BMI. A healthy BMI will be

classified as being 18.5-24.9, while an overweight/obese BMI will be classified as greater than 25. The screening occurred over the phone, to determine eligibility of an individual for the study.

### ***Study Design***

Participants were involved in this study for 32 days and required to complete two online assessments on five days (day 0, 2, 3, 15, and day 30). For the present study, only baseline data was used due to potential effects of the supplement intervention on the outcomes of interest here. One of the assessments was used to evaluate psychosocial functions. The assessments are validated tools that are accessed through Qualtrics. The second assessment, the ASA24<sup>®</sup>, collected data on food and beverage intake. This is a separate website developed by the National Cancer Institute that provided confidential login access only. The self-administered dietary intake tool, ASA24<sup>®</sup>, asked participants about their intake of all foods and beverages from the previous day. The data were analyzed using t-tests for independence, Levene's for variability and a Pearson's correlation test. A p-value of  $p < 0.05$  was used to identify significant correlations.

Participants received a reminder the night before a survey day via text or email. Subjects received \$100 cash for completing the study. Payment was distributed as each assessment is completed as follows: Day 0 = \$10, Day 2 = \$15, Day 3 = \$20, Day 15 = \$25, Day 30 = \$30. Below are the full descriptions for each of the assessment tools that will be used to assess the subjects.

***Questionnaire-I: Questionnaire-I is a compilation of several mini questionnaires to assess psychological functioning.***

1. Beck Anxiety Inventory (BAI): The BAI evaluates physiological and cognitive symptoms of anxiety.
2. Center for Epidemiologic Studies Depression Scale (CES-D): The CES-D is a brief assessment measuring attitudes and symptoms of depression.
3. Self-Esteem: A single item measures self-esteem or your feelings about yourself.
4. Abbreviated Dysregulation Inventory (ADI): The ADI evaluates ability to control thoughts, feelings, and behavior.

5. Perceived Stress Scale (PSS): The PSS assesses feelings and thoughts related to stress and coping.

### ***Questionnaire-II:***

Automated Self-Administered 24-Hour Dietary Assessment Tool (ASA24<sup>®</sup>): The ASA24<sup>®</sup> was developed by the National Cancer Institute and assesses what was eaten over the previous 24-hour period.

### ***Statistical Analysis***

Data was analyzed using the Statistical Package for the Social Sciences (SPSS), and two forms of tests were run. A Pearson's correlational test was run to investigate any association between general FVI and mental health. Secondly, t-tests comparing mental health (anxiety, depression, self-esteem and dysregulation) questionnaire results between participants that met either the recommended FVI amounts and those who did not meet any recommendations.

## **Results**

At present, 113 participants have completed the baseline questionnaires for the parent study. The average age of those participants is 21 (SD = 1.74), comprised of 22 males (19.5%) and 91 females (80.5%). Of the participants 18 (16.2%) were classified as freshman, 31 (27.9%) as sophomores, 20 (18.0%) as juniors, 27 (24.3%) as seniors and 15 (13.5) as graduate students. Most participants did not meet the recommended intake levels for fruits or vegetables (Table 1).

For the fruit intake measure, participants were more likely than chance to report high self-esteem, resulting in a positive correlation,  $r = .211$ ,  $p < 0.05$  (Table 2). Fruit intake was negatively associated with cognitive dysregulation,  $r = -.212$ ,  $p < 0.05$  (Table 2). Lastly, FVI total was more likely to be associated with high self-esteem,  $r = .203$ ,  $p < 0.05$  (Table 2).

In comparing those who met any recommendations with those who did not, self-esteem scores were higher for those who met either recommendation (scores = -1.99, respectively,  $p < 0.05$ ; Table 2). The t-test showed a difference in self-esteem in between the group of participants who met fruit intake recommendations and those who did not,  $t = -1.99$ ,  $p < 0.05$  (Table 2). Additionally, those who did and

did not meet fruit or vegetable intake showed a difference regarding self-esteem,  $t = -2.359, p < 0.05$  (Table 1).

Table 1. Descriptive Statistics for Study Variables by FVI Compared to Federal Recommendations

Total Sample n = 113	Met Fruit Recommendations n = 11	Did Not Meet Fruit Recommendations n = 102	Met Vegetable Recommendations n = 26	Did Not Meet Vegetable Recommendations n = 86	Met Fruit or Vegetable Recommendations n = 31	Did Not Meet Fruit or Vegetable Recommendations n = 81
Variable	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
BAI	7.91 (5.24)	7.65 (7.03)	6.92 (5.019)	7.72 (7.19)	6.84 (4.68)	7.80 (7.38)
Self-Esteem	4.18 (0.87)	3.66 (0.83) *	3.89 (0.71)	3.64 (0.87)	3.97 (0.71)	3.59 (0.86) *
Behavioral Dys.	8.82 (5.97)	6.24 (4.56)	6.04 (4.40)	6.62 (4.89)	6.55 (4.68)	6.46 (4.83)
Cognitive Dys.	6.91 (6.72)	9.36 (5.52)	8.46 (6.04)	9.30 (5.59)	8.03 (5.70)	9.52 (5.66)
Emotional Dys.	5.27 (5.22)	4.78 (3.77)	4.27 (3.66)	4.97 (3.99)	4.84 (4.33)	4.79 (3.77)
Total Dys.	21.00 (14.72)	20.38 (10.23)	18.77 (11.31)	20.88 (19.53)	19.42 (11.70)	20.77 (10.34)
Depression	10.27 (4.69)	8.73 (3.09)	8.27 (3.37)	9.05 (3.28)	8.65 (3.44)	8.95 (3.26)

Table 2. Correlations among Fruit Total, Vegetable Total, FVI Total, Anxiety, Depression Behavioral, Cognitive, Emotional Dysregulation

Indicator	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Fruit Total	1	--	--	--	--	--	--	--	--	--
2. Vegetable Total	.199*	1	--	--	--	--	--	--	--	--
3. FVI Total	.673**	.859**	1	--	--	--	--	--	--	--
4. Anxiety	-.028	.048	.021	1	--	--	--	--	--	--
5. Self-Esteem	.212*	.122	.203*	-.153	1	--	--	--	--	--
6. Behavioral Dys.	.051	.059	.071	.295**	-.036	1	--	--	--	--
7. Cognitive Dys.	-.212*	-.002	-.112	.193*	-.298**	.434**	1	--	--	--
8. Emotional Dys.	-.06	.026	-.012	.535**	-.129	.378**	.148	1	--	--
9. Total Dys.	-.112	.035	-.032	.430**	-.221*	.814**	.778*	.613**	1	--
10. Depression	-.094	-.042	-.081	.491**	-.194*	.559**	.243**	.503**	.562**	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).  
 \* . Correlation is significant at the 0.05 level (2-tailed).

## Discussion

The current study aimed to investigate the impact of fruit and vegetable consumption on mental health in young adults ages 18-25. Of the 140 recruited participants, baseline data from only 113 were used due to time constraints. As expected, behavioral dysregulation, anxiety, cognitive dysregulation, emotional dysregulation, total dysregulation and depression were positively correlated (Table 2).

Correlations were run between FVI on mental health was assessed as well as how results from those meeting intake requirements compared to those who did not. The only significant correlations found are

that fruit intake is positively correlated with high self-esteem and negatively associated significantly with cognitive dysregulation (Table 2). Lastly, a positive correlation between FVI total and self-esteem was found (Table 2). An interesting factor is that while fruit intake did not show significant correlation with depression, emotional and total dysregulation does. Therefore, there is potential that while FVI might not directly impact these factors, perhaps the impact of FVI on self-esteem does. Meaning, the findings suggest that because FVI is associated with self-esteem, FVI is also associated with mental health. The t-test reports support the above finding by showing a difference self-esteem in those who met fruit recommendations and did not, and those who met fruit or vegetable recommendations and those who did not (Table 2). Similarly, comparisons between groups that met or did not meet recommendations, revealed that those meeting at least one recommendation showed more positive mental health. Only 6 of the 113 participants met fruit and vegetable intake recommendations, thus limiting ability to further examine causation. Since only 6 participants met recommendations it can be hypothesized that poor FVI is common among young adults in the US.

There are multiple plausible biological mechanisms connecting FVI and mental health in young adults. Fruit and vegetables are high in several important vitamins and minerals such as vitamin C, B, E and carotenoids. Vitamin C is an antioxidant that is required to convert amino acids into dopamine, norepinephrine, serotonin and epinephrine. These neurotransmitters are known to contribute to mental and physical energy and satisfaction. Research has shown that individuals with depression had significantly lower amounts of serum vitamin C than healthy individuals.<sup>31</sup> Vitamin B is required for similar syntheses of mental health impacting neurotransmitters such as dopamine and serotonin.<sup>32</sup> Vitamin E is another antioxidant that, much like carotenoids, is known for its anti-inflammatory effects.<sup>22</sup> Past studies have found that lower inflammation might prevent depression in individuals.<sup>33</sup> Therefore, there is a possibility that due to vitamin and mineral concentration, FVI could impact brain chemistry and consequently mental health.

The results of this study are similar to what past research has found. While there are several studies regarding FVI and mental health, most studies have the same limitations. In order to gain more

accurate data, participants would need to weigh their food and a professional would be needed to assess their mental health. However, requiring this type of effort and exposure of participants would significantly lower the number of participants recruited. Additionally, when asking about mental health it is assumed that participants are comfortable and self-aware enough to answer honestly and accurately. One way the present study differs from past research is the FVI and mental health assessment tools. For example, the use of a dietary assessment tool that accounts for frequency and provides a serving size visual aid. Secondly, this study uses multiple validated questionnaires that assess for a variety of mental health indicators (dysregulation, self-esteem, etc.) rather than the commonly analyzed single factor of depression. By assessing both FVI (servings and frequency) and mental health in young adults, the present study helps further explain a relationship between the two. By finding a correlation between self-esteem, cognitive dysregulation and FVI there is potential that there is a causal relationship between FVI and mental health in young adult.

A strength of the present study is the inclusion of participants only ages 18-24, in school or working at least part-time, with no mental health diagnosis or medication. These screening questions help assure that confounding variables such as diagnosed depression, anxiety, etc. are limited. The use of the ASA24<sup>®</sup> dietary assessment tool is another strength of the present study. This tool provides specific detail while also including visual aids regarding serving size. Therefore, ASA24<sup>®</sup> provided information on both FVI frequency and serving size. For the present study, only baseline data was analyzed to eliminate any confounding variables regarding the parent study's use of multivitamin and mineral supplementation. Additionally, the mini questionnaires assessing psychological functioning are validated surveys which strengthens the correlations found. Limitations include the dependence on self-report due to the inability to assure accuracy and the limiting nature of correlation studies. Another limitation to the present study is the small sample size (n=113) which may limit generalizability to a larger population. Additionally, within the study's subgroups (those who met fruit and/or vegetable consumption recommendations) there was an uneven distribution. There were significantly fewer participants who met fruit and/or vegetable consumption recommendations than those who did not. Not having an even number of participants in

each subgroup creates a limitation due to the difficulty in gathering comparable data from each group. Additionally, the narrow range of intake recommendations (fruit 1½ to 2 cups, vegetable 2 to 3 cups) is a limitation when assessing correlations because the range is not significantly greater than 0. Other limitations include that alcohol consumption, physical activity and non-mental health prescription medication use were not controlled for. Each of these factors are limitations because there is a possibility that they could impact young adult mental health. There is also possibility that participants could be reaching their vitamin and mineral needs through other foods in their diets. Contrarily, there is potential that certain foods (such as sugar-sweetened vegetables or junk foods) could negatively impact participants' mental health. Lastly, the data is from only one day which is hardly representative of typical dietary intake. This is a limitation because there is little knowledge on whether the effects of nutrients on mental health are short-term or require long-term exposure.

Our findings have implications that fruit and vegetable consumption could positively correlate with particular aspects of mental health in young adults. However, due to our subgroup sample size, we are not able to clearly define the significance of the data. Further research needs to be conducted using a similar study design, however with matched pair samples. Matched pair samples would allow for comparable data between subgroups allowing further conclusions to be drawn. Additionally, it would be beneficial for future researchers to take into account physical activity since past research suggests that being physically active can impact both eating habits and mental health.<sup>33,34</sup>

In conclusion, while correlations were found between FVI and aspects of mental health, the specific cause cannot be determined. With data supporting that FVI impacts mental health factors such as self-esteem and cognitive dysregulation, this is a topic and population that warrants further research.



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## Appendix 1

### Script for Initial contact and Study Screening

Hello, my name is \_\_\_\_ and I am a research assistant with the Multivitamin-Mineral Supplementation study at the University of Arkansas. Is now a good time to talk and give you some information about the study? (If yes, say thank you and continue on. If no, then ask if there is a better time to call back).

Thank you very much for your interest in our study. First, I would like to tell you a little about the study and if you are interested then ask you a few questions to determine if you are eligible to participate.

This research study is looking at the effects of multivitamin-mineral supplementation on mental health and overall well-being. Participants in this study will be asked to take a daily multivitamin supplement or placebo for 30 days and complete online questionnaires asking about mental and physical health, diet, and weight-related health. Your participation would last approximately 32 days and you would be compensated \$100 for participating.

Are you still interested? (If they are not interested in participating: Thank you for your time and interest in the study.)

If yes: Great! We are happy to hear you are interested in participating. We have a few screening questions that we would like to ask to determine your eligibility in the study. These questions ask your basic information and if you have any health-related diagnoses that could possibly impair the effectiveness of the multivitamin supplementation. Do I have your permission to ask these questions?

Note to research assistants: Please go through the entire screening questionnaire even if they are disqualified half way through.

#### Screening Questionnaire

1. What is your name?

2. What is your phone number and email address?
3. What is your preferred method of contact?
4. What is your height?
5. What is your current weight?
6. BMI?
7. Are you between 18 and 24 years old?
8. Are you pregnant or planning to become pregnant? (If male, skip this question)
9. Are you going to school or working at least part-time?
10. Have you ever been diagnosed with malabsorption, or any related gastrointestinal diagnoses for example, Chron's disease or inflammatory bowel syndrome?
11. Have you ever received a diagnosis related to impaired liver or renal function?
12. Do you have iron deficiency anemia?
13. Have you ever been diagnosed with a mental health disorder, for example, general anxiety, depression, bipolar disorder or an eating disorder?
14. Are you currently taking any prescription medications for a mental health diagnosis?
15. Are you willing to abstain from taking any other supplements during the study and abstain from taking any drugs, including marijuana?
16. Are you extremely uncomfortable or unable to swallow pills?

NOTE: People responding YES to questions 7, 9, 10, 11, 12, 13, and 15 or a NO to question 14 are not eligible for the study.

For those not eligible to participate (answering yes to any of the above disqualifies the person from participating): I am sorry to inform you that unfortunately you are not eligible to participate in the Multivitamin-Mineral Supplementation study. Thank you very much for you interest in participating.

For those eligible to participate: You are eligible to participate in our study! Next, we would like for you to come to our study laboratory so that we can obtain your informed consent, explain the study instructions, and get some further background information from you. Our study laboratory is located on the 2nd floor of the Home Economic building in office 205D on the University of Arkansas campus.

When would be a good time for you to come in? (Schedule a date and time).

We appreciate your interest in the multivitamin-mineral supplementation study and we look forward to meeting you on (date) and (time). If you have any questions or trouble locating our lab, please do not hesitate to contact me at \_\_\_\_\_.



# Multivitamin-Mineral Supplementation & Mood Study

## Participant Instruction Booklet

For questions about any part of the study, please contact your study coordinator.

**Study Coordinator: Sharon Chang**

**Laboratory: HOEC 205D**

Research Coordinator: \_\_\_\_\_

Coordinator Phone Number: \_\_\_\_\_

**Emergencies—Dr. Becnel**

(480) 276-2955

**Email**

Yc031@uark.edu

*Please stop taking all medications and dietary/herbal supplements (including all vitamins and teas) beginning one week before the study period.*

***Stop on:*** \_\_\_\_\_

## Purpose of the Study

The primary purpose of this study is to examine the effects of a multivitamin-mineral supplement (MVM) on psychological functioning, health, and weight-related satisfaction among young adult college students.

## Study Procedures and Time Commitment

This is a research study looking at the effects of Multivitamin-Mineral Supplementation on mood and overall well-being. The total timeline for the project is two years, during which we

will conduct a randomized controlled trial at the University of Arkansas, Fayetteville. However, you are required to participate in the study only for 31-days.

**You may qualify for the study if you are/have:**

- 18 – 24 years old;
- Going to school or working at least part-time;
- No diagnosis of malabsorption or related gastrointestinal diagnoses (e.g., Crohn’s disease, inflammatory bowel disease);
- No diagnosis related to impaired liver or renal function;
- No mental health diagnosis (e.g., general anxiety disorder, depression, bipolar-related diagnoses);
- Not taking prescription medications for mental health diagnoses;
- And willing to not take any other supplements during the study.

After the screening interview over the phone, if you qualify, you will be asked to come to the study laboratory to have your height and weight taken, fill out a one-time demographic questionnaire, and be given the study instructions and activities. At this time, we will randomly assign you to either the MVM supplement or placebo group. The following week, you will return to the study laboratory to receive a week’s supply of the supplement or placebo pills and will be instructed to take two pills at approximately the same time every morning. You will return to the study laboratory once a week for another week’s supply of the supplement or placebo pills and to return any pills that you did not take during the previous week.

You will also be asked to complete the following two questionnaires on each of the five assessment days: Consent Day, Day 3, Day 4, Day 15, and Day 31. They are,

1. **Questionnaire- I:** A self-administered online questionnaire to assess your psychosocial functioning, health indicators, and weight related satisfaction. It is a set of questionnaires that will be presented in a random order each time through Qualtrics software.
2. **Questionnaire- II:** A self-administered online questionnaire, ASA24<sup>®</sup>, to assess your dietary intake in the previous 24 hours. ASA24<sup>®</sup> is completed separately using a website and confidential login from the National Cancer Institute.

You will be instructed to complete the questionnaires within three hours after taking the supplement or placebo on Day--3, Day 15, and Day 31. However, on Day 4 you will be required to complete the questionnaires **before** taking the supplement. Links to the questionnaires will be provided to you and you will be reminded to complete the questionnaires via text, email, or phone calls.

**Coming to HOEC**

The Home Economics (HOEC) building is located on the University of Arkansas, Fayetteville campus. The study office is located on the 3<sup>rd</sup> floor of HOEC in 205D.

## Supplement

The Multivitamin-Mineral Supplement that we are using in this study was formulated to contain selective nutrients such as B vitamins, vitamin C, calcium, magnesium, and zinc and no additional compounds such as herbals. The composition of MVM supplement is given in the table below. We will randomly assign you either to an MVM supplement group or a placebo group. You will be asked to take two pills at a time each day. For research purposes, we will make both the supplement and placebo pills look exactly the same and you will not know whether you are taking MVM pills or placebo pills.

Supplement packets can be picked up from the study laboratory every Tuesday. Please bring back the empty supplement packs from the week prior when you pick up the new pack for the next week.

Vitamin/Mineral	Amount in Supplement	RDA	%RDA
B1 = Thiamin	15 mg	1.1 – 1.2 mg	1364
B2 = Riboflavin	15 mg	1.1 – 1.3 mg	1364
B3 = Nicotinamide	50 mg	14 – 16 mg	357
B5 = Pantothenic Acid	23 mg	5 mg	460
B6	10 mg	1.3 mg	769
B12	10 µg	2.4 µg	416
C	500 mg	75 – 90 µg	667
H = Biotin	150 µg	30 µg	500
Folic Acid	400 µg	400 µg	100
Calcium	100 mg	1,000 mg	10
Magnesium	100 mg	310 – 400 mg	32
Zinc	10 mg	8 – 11 mg	125

## Questionnaires

You will be asked to complete questionnaire-I and questionnaire-II on each of the five assessment days. In addition, you will be asked to complete one time questionnaires on demographics and alcohol consumption at the start of the study.

### Demographics:

A demographic questionnaire will ask about age, gender/sex, year and full or part time in college, socioeconomic status and work status, geographic location (urban vs. rural), food insecurity, Greek life engagement, general eating behaviors, and sleep behaviors.

### **Alcohol Use:**

Participants will complete 6 questions from National Institute on Alcohol Abuse and Alcoholism (NIAAA) on frequency of drinking and binge drinking behaviors.

### **Questionnaire-I:**

Questionnaire-I is a compilation of several mini questionnaires to assess psychological functioning, weight related functioning and health measures.

#### **1). Psychological Functioning Measures:**

*BAI (Beck Anxiety Inventory):* The BAI evaluates physiological and cognitive symptoms of anxiety.

*Center for Epidemiologic Studies Depression Scale (CES-D):* The CES-D is a brief assessment measuring attitudes and symptoms of depression.

*Self-Esteem:* A single item measures self-esteem or your feelings about yourself.

*ADI (Abbreviated Dysregulation Inventory):* The ADI evaluates ability to control thoughts, feelings, and behavior.

*PSS (Perceived Stress Scale):* The PSS assesses feelings and thoughts related to stress and coping.

#### **2). Weight-Related Functioning Measures:**

*IWQOL-Lite (Impact of Weight on Quality of Life-Lite):* The IWQOL-Lite assesses the impact of obesity on quality of life in areas of physical functioning, self-esteem, public distress, and work.

*BSQ (Body Shape Questionnaire):* The BSQ measures individuals' self-perception of their body shape and body satisfaction/dissatisfaction.

#### **3). Health Measures:**

*HRQOL (CDC Health Related Quality of Life-14 Measure):* The HRQOL is a measure developed by the Centers for Disease Control to assess health related to physical, emotional, and social functioning.

IPAQ (*International Physical Activity Questionnaire*): The IPAQ measures health-related physical activity.

**Questionnaire-II:**

ASA24® (*Automated Self-Administered 24-Hour Dietary Assessment Tool*): The ASA24® was developed by the National Cancer Institute and assesses what was eaten over the previous 24-hour period.

**Detailed Schedule of Study Activities**

Day	Date	Instructions	Complete
Consent		Agree to participate in study; measurements taken; complete questionnaires	Questionnaire I Questionnaire II
Day 0		Pick up supplements from study lab	
Day 1		Begin taking the supplement in the morning	
Day 3		Complete the online questionnaires within 3 hours of taking the supplement	Questionnaire I Questionnaire II
Day 4		Complete the online questionnaires <i>before</i> taking the supplement	Questionnaire I Questionnaire II
Day 7		Return to the study lab for another week's supply of the supplement & return any unused supplements	
Day 14		Return to the study lab for another week's supply of the supplement & return any unused supplements	
Day 15		Complete the online questionnaires within 3 hours of taking the supplement	Questionnaire I Questionnaire II

<b>Day 21</b>		<b>Return to the study lab for another week's supply of the supplement &amp; return any unused supplements</b>	
<b>Day 30</b>		<b>Complete the online questionnaires within 3 hours of taking the supplement</b>	<b>Questionnaire I Questionnaire II</b>
<b>Day 31</b>		<b>Return to the study lab to finish out the study &amp; return any unused supplements</b>	
<ul style="list-style-type: none"> <li>✓ Take 2 pills at a time every day throughout the study period</li> <li>✓ Avoid herbal supplements, herbal teas and other vitamin-mineral supplements during the study period</li> </ul>			

### **Things to Avoid During the Study**

You will be asked not to take any other vitamin, mineral and herbal supplements and teas as well as herbal teas during the study. You should let us know if a medication is started for a mental or physical health-related diagnosis any time during the study.

### **Compensation**

Thank you for your interest in participating in the Multivitamin-Mineral Supplementation & Mood Study. You will receive a total of \$100 in cash as a stipend to compensate you for your time, effort, and inconvenience related to completing the study. This stipend will be distributed incrementally as assessments are completed. Cash is received for each day the online questionnaires are completed. Amounts increase for each questionnaire day (Day 1 = \$10, Day 3 = \$15, Day 4 = \$20, Day 15 = \$25, Day 31 = \$30). Stipends can be picked up from the study laboratory on Day 7, Day 21, and Day 31.

### **Questions and Contact Information**

If you have any questions at any time, you can contact the study coordinator, Ryan Grant at 479-575-7538. The researchers conducting this study are Jen Becnel, PhD and Sabrina Trudo, PhD, RD. If you have any questions for them, you can contact Dr. Becnel at 479-575-2358 and Dr. Trudo at 479-575-4863. If you have any questions or concerns about your rights as a research participant, then you are encouraged to contact Ro Windwalker at 479-575-2208.

### **Services Available for Discomfort Experienced during the Questionnaire**

The online questionnaires that you are asked to take ask questions regarding depression, anxiety, and how you feel about yourself. If you experience any discomfort while answering

these questions, please do not hesitate to contact Counseling and Psychological Services (CAPS) here on campus at 479.575.5276.