
# Investigating the Relationship Between a Plant-Based Diet and Reported Levels of Stress and Anxiety

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# Submission of Thesis and Dissertation

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**Abstract**

The present study investigated the relationship between a plant-based diet on reported levels of stress and anxiety, as well as examining the gender differences amongst these variables. Existing research has indicated that there is a relationship between a plant-based diet and lower levels of stress and anxiety. However, these findings are novel, and consider other variables such as lifestyle change. The aim of the current research study was to expand on the baseline of knowledge, but solely focus on the effects of anxiety and stress alone, in relation to plant-based intake. The sample consisted of 149 adult participants, which completed a DASS-21 questionnaire to measure their levels of anxiety and stress, in relation to their dietary preferences. The current research found a statistically significant effect of individuals who consumed more plant-based foods, reported lower levels of stress and anxiety. These results were found using a one-way between groups ANOVA (non-parametric version Kruskal-Wallis test). Furthermore, the study sought to examine gender as a factor of reported anxiety amidst these variables and found females to report higher levels of anxiety than males. The current findings provide further insight into the novel topic of plant-based foods reducing levels of anxiety and stress (and the positive relationship with mental health), as well as conveying gender differences amongst these variables. Implications for this study and suggestions for future research on plant-based eating in relation to anxiety and stress are discussed.

## Introduction

The relationship between a human beings' mood and food intake has been considered interdependent for over 30 years now (Lam, 2010). Research to date primarily focuses on the role of serotonin, although there are many neurotransmitters involved in mood control, such as dopamine, serotonin, noradrenaline, and substance P (Stahl, 2009). Defect of the serotonergic system has been associated with many psychiatric disorders, such as depression, anxiety, obesity and even schizophrenia (Wallin, 1994). Accumulative evidence indicates that the amino-acid tryptophan has a role to play in production of serotonin (Keszthelyi, 2009). An antioxidant and tryptophan rich diet can be associated with a positive effect on mood and cognition (Strasser, 2016). Therefore, highlighting the importance of a healthy diet and the brain-gut connection in controlling mood overall, with approximately 95% of serotonin found in the GI tract (consists of the mouth, oesophagus, stomach, large and small intestine, and the anus) (Kim, 2000). Diet plays a vital role in the composition of the gut microbiota (Alou, 2016). A plant-based diet is inherently rich in antioxidants and tryptophan, which in turn promotes positive mood through the action of neurotransmitters (Johnston, 2017). Merging evidence suggests that imbalance in the composition of gut microbes may be connected to variations in the standard functioning of the nervous system (Forsythe, 2010). Research further indicates that gut microbes significantly effect cognitive functioning and behaviour patterns, impacting social interaction and management of stress (Dinan, 2015). Indicating that gut-microbes have a substantial influence on central neurochemistry and behaviour, particularly regarding stress related disorders (Dinan, 2019). The aim of this literature review is to investigate the relationship between a plant-based diet and reported levels of stress and anxiety, while examining literature that includes gender differences between variables.

**The Effects of a Plant-Based Diet on Physical Health**

Research to date indicates that a plant-based diet is associated with a myriad of health benefits, from a healthy BMI and weight to reported lower levels of blood pressure and cholesterol, reducing the risk of heart disease (Winston, 2009). As well as having low disease-promoting substances such as saturated fat and cholesterol, a plant based diet is full of protective health promoting substances such as being rich in fiber, vitamins, minerals, and antioxidants (Dunn-Emke, 2001). One study investigated the effects of a low-fat, plant-based diet in multiple sclerosis (Yadav, 2016). The study found significant improvements in fatigue, lipid profile, and BMI, which may contribute to long-term vascular health benefits. The findings from such studies indicate a correlation between a plant-based lifestyle and overall improved quality of life, reduction of stress, and anxiety. A further study conducted over a span of eight years, investigated the relationship between a plant-based diet quality and health related quality of life in women. The results suggested that improvements in both mental and physical health related quality of life, were associated with adhering to a plant-based diet (Baden, 2020).

**The Effects of a Plant-Based Diet on Cognitive Health**

A study by Ramey, Shields and colleagues examined the association between a plant-based dietary pattern and cognitive functioning. The study took macronutrient intake, long-term memory, and executive function into consideration. Results found that adherence to the plant-based diet contributed to improved performance on all cognitive tasks, indicating that a plant-based diet contributes to better cognition, especially regarding executive control (Ramey, 2020). A further study conducted by Rajaram, Jones and colleagues investigated plant-foods and a plant-based diet in relation to age-related cognitive decline. The study found that based on the association of a plant-based diet and improved long-term health outcomes, and the commonality between neurodegenerative disorders and cardiovascular

disease, it is plausible to infer that plant-based living can benefit cognitive decline (Rajaram, 2019).

**The Effects of a Plant-Based Diet on Mental Health**

One protective factor of mental health is understood to be a nutrient rich diet (Dawson, 2016). There continues to be evidence supporting the claim that gut microbes play a vital role in neurochemistry and behaviour, particularly with stress related disorders such as depression and anxiety (Dinan, 2019). An investigative study aimed to discover whether a plant-based nutritional program in a corporate environment would improve levels of anxiety, depression, and productivity. The study was run across ten corporate settings of an esteemed American insurance company, participants were either given weekly instruction of a vegan health plan, or no instruction at all. The results of the study found that the dietary plant-based intervention improved reported levels of anxiety, depression, and productivity within the professional environment (Agarwal, 2015). As well as within a corporate setting, change in reported quality of life, anxiety, stress, and immune markers were examined within a raw vegan institute. This refers to a retreat location in which participants stayed for the duration of the study. The attendees stayed 1-3 weeks within the institute and completed questionnaires covering quality of life, dietary quality of life, perceived stress, anxiety, and depression upon arrival and departure. The investigation found that overall reported quality of life improved by 11.5%, levels of anxiety decreased by 18.6%, and perceived levels of stress decreased by 16.4% (Link, 2008).

One recent study examined the consumption of legumes and nuts amongst Iranian adults, in relation to depression, anxiety and other psychological distress (Anjom-Shoae, 2020). Participants consisted of 3172 adults, ranging from 18 to 55 years of age. The results of the study found that men who placed in the top quartile of legume and nut consumption, reduced their likelihood of anxiety by 66%. However, such significant results were not

emulated with regards to female participants. This research is consistent with findings that suggest females experience higher levels of anxiety than males (Stumpf, 2014; Longstaff, 2020). Therefore, a plant-based intervention to reduce anxiety may have lesser effect on female participants than males.

A further study Catt, Beenstock and colleagues conducted investigated the effects of a plant-based intervention amongst individuals with moderate to severe depression. The results of the study found 62% of participants reported improved depressive symptoms, alongside 59% reporting improvements in anxiety symptoms. Such findings are important, as the interest in holistically focused mental healing is increasing (Thieme, 2015). This research aids individuals who wish to improve their mental health status through a diet-centred holistic approach (Catt, 2020).

**Reported Stress: Vegan vs Omnivore**

The diet of an omnivore is rich in arachidonic acid (AA) compared to that of a vegan or vegetarian, research indicates that a high intake of AA promotes changes in the brain that could potentially disturb mood (Beezhold, 2012). A study completed by 792 individuals between the ages of 25-60 posed health, wellness, and food choice related questions. Embedded within the study was the Depression, Anxiety, Stress Scale-21 (DASS-21), which participants were asked to engage with. The results of the study portrayed lower reported rates of stress and anxiety amongst vegans than their omnivore counterpart (Beezhold, 2014). Overall, plant-based diets have been associated with factors which improves rates of mortality and encouraged by many for its health and environmental benefits (Baden, 2019).

One novel study examined the effect of yeast-based spreads (marmite and vegemite) on anxiety and stress (Mikkelsen, 2018). Such yeast-based spreads consist of brewer's yeast extract, which is known as one of the richest sources of B vitamins (Mayfield, 1956). The study conducted a series of questions, given to 520 participants, relating to the consumption

of yeast-based spreads. Upon examining participant history of psychiatric disorders and yeast-based spread intake, significant improvements were found in levels of anxiety and stress, however, similar findings of significance were not found regarding depression. The study concluded that vitamin B is a vital dietary supplement which eases the experience of stress and anxiety.

**Overview of the Findings**

A thorough review of the literature revealed that a plant-based diet appears to improve levels of stress and anxiety, including depression and overall life satisfaction, within the intervenes studies. According to the literature evidence, there appears to be many benefits in adopting a plant-based diet. Based on the current evidence, one could infer that the relationship between a plant-based diet and reported levels of depression and anxiety is one of positive, impactful, and healthy nature. In the current literature review, an apparent limitation detected is the lacking volume and frequency of plant-based diet related studies. It appears that global interest in veganism is increasing, measured by the number of recently published vegan cookbooks and exclusive vegan products on the market today (Kerschke-Risch, 2015).

Upon the review of the research discussed, it is apparent that a vegan lifestyle has many positive attributes overall, and especially in relation to levels of stress and anxiety. Regarding the current Covid-19 collective societal anxiety, it is valuable to be aware of the ‘self-help’ mechanisms that exist and are effective. Both diet and exercise have major positive impacts on mental health and further research on the topic indicates the beneficial nature of plant-based living for improved health, increased levels of life satisfaction and deduction in reported levels of stress and anxiety (Baden, 2019). A recent study which examined the mental health repercussions of Covid-19 and physical social distancing found quite likely that there will be significant increases in anxiety, depression, and loneliness

amongst the general population (Galea, 2020). Such findings emphasise the current demand for self-help techniques and mechanisms which promote positive mental health, especially amongst individuals who have existing mental health issues. A plant-based diet has the potential to act as the catalyst for positive mental health, given the indication that plant-based promotes positive mental health, from examining the existing research (Beezhold, 2014; Beezhold, 2010; Dinan, 2019).

**The Current Study**

The aim of the current study therefore is to examine the relationship between whether a more plant-based diet will contribute to lower levels of reported stress and anxiety than an omnivorous counterpart, while also investigating the gender differences amongst these factors. This study is important as it will help to identify whether plant-based living alone is a plausible treatment for anxiety and stress, which would provide an array of beneficial outcomes, that will be discussed within the current study. Research to date primarily uses a combination effect of exercise, mindfulness, and plant-based living in treating anxiety and other stress-related disorders, therefore inhibiting the ability to judge the effect that plant-based consumption has on anxiety and stress alone (Null, 2017; Clark, 2016).

Furthermore, taking the origin of the current Covid-19 pandemic into consideration (contracted from consuming a bat (Fan, 2019)), and the current climate crisis, the need for plant-based living is increasing (Sabate, 2014). A recent study found the highest motive for adopting a plant-based diet to be health (Miki, 2020). Particularly in the current environment, health is at the forefront of societies' mind, with a rise in health worries and subsequently anxiety symptoms (Bergman, 2020). With regards to the current climate crisis, there is a noticeable demand for alternative, more sustainable ways of living (Pimentel, 2003). Taking these factors into consideration, the argument and warranted exploration of a societal change to more plant-based consumption is valuable.

Specifically, the research questions are ‘will levels of stress and anxiety differ from plant-based eaters (vegans/vegetarians) vs. omnivorous individuals?’ and ‘is there a gender difference in reported levels of stress and anxiety when consuming a more plant-based diet.’ The hypothesis, based on prior literature; that there is a relationship between the predictor variable (PV) plant-based diet, and the criterion variable (CV) reported levels of stress and anxiety. Hypothesis two is that there will be a gender difference between reported levels of stress and anxiety, regarding plant-based consumption.

## Method

### Participants

The sample for the current study consisted of 149 (Females: *n* = 118; Males: *n* = 29; Other: *n* = 2) adults. Participants ranged from 18 to 67 years of age, with an average age of 29 (*SD* = 12.58). Participants were recruited through a non-probability, convenience sampling strategy approach, through the researcher's social media accounts (Instagram, Twitter, and Facebook). Also, a minor element of snowball sampling was used through the researcher sending the study on to various family members and close friends, who further forwarded the study on to their family members and close friends. Adhering to ethical considerations, all participants were asked to confirm that they were over 18 years of age, before taking part. Furthermore, their informed consent was mandatory prior to completing the questionnaire. All participants were recruited online and individual willingness to take part was heavily relied on.

### Materials

The study was created on the survey tool Google Forms, which was hosted on a link through the researcher's social media pages (Facebook, Instagram & Twitter). Within the study itself, there were demographic questions related to gender and age, three diet-related questions in relation to consumption of meat and plant-based foods, as well as one question on their attitude towards plant-based eating, and the Depression Anxiety and Stress Scale (DASS-21).

**Demographics.** Participants were asked to indicate their gender (male, female, other) and to provide their age. No other demographic questions were asked as they did not prove meaningful to the collection of data. The demographic questions aimed to obtain an overview of the profile of participants taking part in the study. However, given the nature of DASS-21

questions it was important that the studied remained anonymous, for the respect and ease of participants taking part.

**Diet-related questions.** Participants were asked “Do you eat meat?”, and responded ‘yes’, ‘no’ or ‘sometimes’. Secondly participants were asked ‘How many plant-based food items would you eat in a given week (i.e. fruits, vegetables, legumes, seeds, nuts, nutbutters, herbs, plant-based milk, plant-based protein, whole grains)? and asked to rank their intake from ‘5-10’, ’10-20’, ‘20-30’, and ‘30+’. Research suggests that consuming 30 plant-based foods weekly, or greater, has proven beneficial in optimising gut health and gut bacteria (Lee, 2020). This gut health contributes to the creation of the neurotransmitter serotonin, resulting in the ‘feel good’ factor of plant-based eating (Kim, 2000). To conclude the questionnaire, participants were asked the multiple-choice question ‘Do you find that increasing your intake of plant-based foods (i.e. fruits, vegetables, legumes seeds, nuts, nutbutters, herbs, plant-based milk, plant-based protein, whole grains) improves your mood?’, ‘yes definitely’, ‘more often than not’, ‘somewhat’, and ‘not at all’ were the response options.

**Depression Anxiety Stress Scale** (DASS-21): developed by Lovibond & Lovibond (1995), is a 21-item scale designed to measure an individuals’ level of distress, which exclusively measures levels depression, anxiety, and stress. Each item is measured using 4 response options which range from 0 = *Did not apply to me at all* to 3 = *Applied to me very much, or most of the time*. Individual scores for each scale (Depression, Anxiety and Stress) are calculated by adding the ratings per scale together, to get the final score. Once calculated, scores can be assessed for severity rating, which ranges for Depression from 0 - 4 = *Normal* to 14 + = *Extremely Severe*, Anxiety 0 – 3 = *Normal* to 10 + = *Extremely Severe,* and Stress 0 – 7 = *Normal* to 17 + = *Extremely Severe* (see Appendix II). The Cronbach’s alpha was ($\alpha$ = .94), which demonstrates a high level of reliability within the scale.

**Design**

The study implemented a cross-sectional experimental design, as all data was collecting at a specific point in time and followed quantitative approach. The predictor variable (PV) was a plant-based diet, and the criterion variable (CV) was levels of anxiety and stress.

**Procedure**

All data used in this study was collected through an online questionnaire. The researcher's social media accounts (Instagram, Facebook, and Twitter) were used to share the questionnaire, and a link was provided to take part. As well as the researcher forwarding on the questionnaire to family members and friends, who followed suit. The questionnaire was anonymous in nature and relied on individual willingness to self-report. Once individuals agreed to take part, they were provided with an information sheet disclosing the nature and contents of the study. This covered what the study would involve, eligibility to take part, potential risks of taking part, and provided helplines and contact details, should any participant feel triggered by any of the material (see Appendix III for further details). Participants were informed of their ability to withdraw from the study at any part, prior to submission. Further information was given on the anonymous nature of the study and the handling of their data, in accordance with the NCI data retention policy. Consent was obtained through a consent form which was provided prior to the questionnaire, participants were asked to give their consent by clicking 'yes' option. Participants were then asked to confirm that they were of legal age to take part (over 18), by clicking the 'yes' option (see Appendix IV). Once confirmed, participants could proceed to the questionnaire. The questionnaire consisted of two demographic questions in relation to age and gender, three diet-related questions, followed by the Depression Anxiety and Stress scale. Once participants completed all aspects of the questionnaire, a debriefing sheet was provided. This

thanked them for taking part, re-iterated the aims of the research study, the anonymous nature of the study, and further provided contact details of the researcher's supervisor and support services. Participants were encouraged to contact the necessary support services should they feel distressed by anything raised within the questionnaire (see Appendix V).

**Ethical considerations**

All data involved in this study was collected in accordance with the ethical guidelines of NCI. An information sheet was provided disclosing all necessary details regarding the study. Any potential risks that participants may encounter were outlined clearly, prior to taking part, as well as the ability to withdraw at any stage, prior to submission. Informed consent was mandatory, and all participants were over the age of 18. Support services and contact information was provided on both the information sheet and debriefing form. Contact details for helplines such as pieta house were provided, had participants felt distressed after completing the questionnaire (see Appendix III, IV & V for further details).

# Results

## Descriptive Statistics

Descriptive statistics were performed for all continuous variables (age, anxiety, and stress). The sample which the data was taken from consisted of 149 adult participants. The breakdown of the sample was 79.2% female ($n$ = 118) and 19.5% male ($n$ = 29). Means (M), Standard Error Means (SEM), Medians (MD), Standard Deviations (SD), and Range are presented in Table 1. The Cronbach's alpha for the subscales (stress & anxiety) was ($\alpha = .82$), which indicates a good reliability. Participants had a mean age of 29.28 years (SD = 12.58), with a range of 49. Upon testing for normality, a highly significant result of ($p < .000$) of the Kolmogorov-Smirnov test was found for all continuous variables. This suggested that the data was non-normally distributed. Upon examining the histograms for age, anxiety, and stress it is apparent that the data are positively skewed. A log data transformation was conducted to amend the positive skewness of the data; however, it did not result in the removal of such skewness. Based on the investigation of the distribution of variables, non-normality is inferred.

**Table 1**

*Descriptive Statistics for all continuous variables, N=149*

| Variable | Mean (95% Confidence Intervals) | Std. Error Mean | Median | SD | Range |
|---|---|---|---|---|---|
| Age | 29.28 (27.24 - 31.33) | 1.03 | 23 | 12.58 | 49 |
| Anxiety | 5.04 (4.33 – 5.75) | .36 | 4 | 4.37 | 16 |
| Stress | 8.05 (7.21 – 8.88) | .42 | 7 | 5.16 | 21 |

**Inferential Statistics**

A Spearman rank correlation coefficient was conducted to examine the relationship between the stress and anxiety. Preliminary analysis was conducted to ensure no violations of the assumptions of non-normality, linearity, and homoscedasticity. There was a significant, strong correlation between stress and anxiety ($r = .76$, $n = 149$, $p < .01$). Results indicated that as stress increases, levels of anxiety increase similarly (see Table 2).

A Spearman rank correlation coefficient was conducted to examine the relationship between the age and anxiety. Preliminary analysis was conducted to ensure no violations of the assumptions of non-normality, linearity, and homoscedasticity. There was a significant moderate, negative correlation between age and anxiety ($r = -.32$, $n = 149$, $p < .01$). Results indicate that there is one gets older, levels of anxiety decreases (see Table 2).

A Spearman rank correlation coefficient was conducted to examine the relationship between the age and stress. Preliminary analysis was conducted to ensure no violations of the assumptions of non-normality, linearity, and homoscedasticity. There was a weak, positive correlation between stress and age ($r = .21$, $n = 149$, $p < .01$). Results indicated that individuals get older, levels of stress increase slightly (see Table 2).

**Table 2**

*Spearman rank correlation coefficient between continuous variables*

| Variable | 1. | 2. | 3. |
|---|---|---|---|
| 1. Age | 1 | | |
| 2. Anxiety | -.32** | 1 | |
| 3. Stress | -.21* | .76** | 1 |

*Note*: N = 149; Statistical significance: *p <.05; **p < .01

**Hypothesis 1**

'Is there a relationship between the predictor variable (PV) plant-based diet, and the criterion variable (CV) reported levels of stress and anxiety.' The null hypothesis was accepted ($p$ = .88). A one-way between groups ANOVA test was performed to examine the relationship between the predictor variable (a plant-based diet) and the criterion variable (anxiety). The non-parametric version (Independent-Samples Kruskal-Wallis Test) was executed as the data are positively skewed, and not normally distributed. There was a significant effect of a plant-based diet on anxiety (H(2) = .26, $p$ = .88), with a mean rank of 64.22 for meat eaters, 60.24 for non-meat eaters and 61.69 for those who sometimes eat meat.

Furthermore, a Kruskal-Wallis test was performed to examine the relationship between the predictor variable (a plant-based diet), and the criterion variable (stress). There a significant effect of a plant-based diet on stress than anxiety, (H(2) = 1.40, $p$ = .48), with a mean rank of 69.37 for meat eaters, 77.59 for non-meat eaters and 78.15 for individuals who sometimes eat meat.

**Hypothesis 2**

'Will there be a gender difference between reported levels of stress and anxiety, in relation to plant-based consumption'. The null hypothesis was accepted ($p$ = .77). A one-way between groups ANOVA test was performed to examine the gender difference between reported levels of stress and anxiety, when consuming higher levels of plant-based foods. Results found a significantly higher level of reported stress and anxiety amongst females, (H(1) = .083, $p$ = .77), with a mean rank of 62.64 for males and 64.13 for females.

In summary, there is a significant difference between a plant-based diet and reported levels of anxiety. However, there is a lesser significance between a plant-based diet and

reported levels of stress. Regarding gender differences, females reported higher levels of anxiety than males, respectively.

## Discussion

The aim of the current study was to investigate the relationship between a plant-based diet and reported levels of stress and anxiety. Furthermore, it aimed to examine the gender differences between each variable. Previous findings have shown that an increased intake in plant-based foods (i.e. fruits, vegetables, legumes, seeds, nuts, nutbutters, herbs, plant-based milk, plant-based protein, whole grains), have been associated with lower levels of reported stress and anxiety (Beezhold, 2015). Research to date has indicated a plant-based diet is a catalyst for a myriad of health improvements, specifically in relation to mental health (Baden, 2019). Such findings have emerged in response to the new wave of interest in sustainable plant-based living (Pimentel, 2003). Futher interest has awoken in the recent awareness of the relationship between mood and food (Flaskerud, 2015). Therefore, the most prevalent and recent research in this field examines the effects of a plant-based diet on mental health (Perm, 2013; Berding, 2021; Parletta, 2013).

Upon examining previous literature, the topic of interest was formed, which involved one predictor variable (a plant-based diet) and two criterion variables (anxiety and stress). Prior to executing more complex analyses, a Spearman rank correlation coefficient was performed to first explore the relationship between the continuous variables. The first relationship which was examined was between stress and anxiety. The results found a significiantly strong correlation between these varaibles, suggesting that an increase in stress resulted in an increase in anxiety. Secondly, a spearman rank correlation coefficient was conducted to examine the relationship between age and anxiety. The correlation found a significant relationship between age and anxiety, suggesting that as an individuals' age increases, the level of anxiety they experience decreases. Such findings are in accordance with previous research to suggest that the severity of anxiety, and anxiety disorders decreases over time (Ramsawh, 2008; Krasucki, 1998; Crocetti, 2009). The final element of the

preliminary analysis executed a correlation which examined the relationship between age and stress. The results found a weak positive correlation between levels of stress and age, suggesting that as an individual ages, there is a mild increase in the level of stress they experience. The results stated correlate with previous research, suggesting that stress is mildly prevalent amidst aging (Martin, 2001; Ng, 1994; Aldwin, 1996). However, as these preliminary findings are correlational, a causal relationship can not be inferred. Once the relationship between each continuous variable was established, the hypotheses were then tested.

Hypothesis one (H1), was based on the examination of prior literature, suggesting that there was a relationship between eating plants and benefits of mental well-being (Hall, 2019). The first hypothesis (H1) queried whether there would be a relationship between reported levels of stress and anxiety and a plant-based diet. This hypothesis was explored through the use of a one-way between groups ANOVA (Independent-Samples Kruskal-Wallis Test). Results showed a significant relationship between a plant-based diet and levels of anxiety, with non-meat eaters reporting less anxiety than their meat-eating counterpart. In relation to individuals who consumed meat sometimes, their results reflected accordingly. 'Sometimes' meat-eaters reported less anxiety than those who omni-consumed meat, and more than those who did not eat meat at all. These results are in line with prior research, and interventions which suggest increased plant-eating may help to reduce anxiety symptoms (Null, 2017; El Shebini, 2021; Shanbhag, 2019; Kris-Etherton, 2020). Furthermore, the relationship between stress and diet was examined using the same statistical analysis. A significant effect was found between variables, however the effect was lesser than that of anxiety. Research to date fails to examine plant-based consumption on the effects of stress alone.

For hypothesis two (H2), similarly, a one-way between groups ANOVA (Independent-Samples Kruskal-Wallis Test) was employed. This investiagted the difference amongst different genders in relation to reported stress and anxiety. The overall result was statistically significant, with females reporting higher levels of stress and anxiety, than males. The results were consisitent with research which examines levels of reported stress and anxiety regarding gender (Stewart, 1997; Bahrami, 2011; Palanza, 2001). However, there is an apparent lack of research relating to the gender differences in anxiety and stress, in relation to previous studies, diet interventions, and a plant-based diet.

The current study is amidst the earliest findings to examine the effects of a plant-based diet on anxiety and stress alone, and furthermore, their respective gender differences. From a literature perspective, such findings demonstrate the contemporary nature of the current study. To date plant-based living is a relatively new phenomenon (Williams, 2017). As such, current research is limited and obtains a vast capacity for growth, and further investigation. Futhermore, there is an obvious requirement for sole focus on the effects of a plant-based diet on mental health, specifically anxiety. To date, studies and interventions primarly focus on the results of a plant-based diet, on anxiety levels in conjunction with exercise, or lifestyle change. Such interventions confound variables and dilute the potential effect a plant-based diet alone might have on anxiety on a biological and psychological level. Although, emerging findings are beginning to separate a plant-based diet from an entire lifestyle change that may consist of alternative anxiety reducing variables (i.e. the effects of a plant-based diet on mental health in conjunction exercise, mindfulness, journalling etc.). The most recent evidence that is beginning to surface, is surrounding gut health (a cornerstone of plant-based eating), and its effect on mental health; primarily the neurotransmitter serotonin, and lack of such, resulting in depression and anxiety (Bear, 2020). Findings of the current study are consistent with the transpiring literature, portraying the positive effects plant-based

consumption has on anxiety (Beezhold, 2010; Anjom-Shoae, 2020). Positive affects mentioned may be potentially attibuted to the production of serotonin in the gut, as previously mentioned (Banskota, 2019). However, further research on this topic continues to emerge.

Overall, the findings of the current study importatly contribute to existing literature. Such findings convey that both stress and anxiety are impacted positively by a plant-based diet. Furthermore, the current findings add a novel contribution to the exisiting literature, demonstrating that there is a further difference between the experience of 'plant-based effects' amongst genders, with females reporting higher levels of anxiety. However, considering the novelty of the subject entirely, further mental health benefits may exist in future research.

**Implications**

The findings obtained in the current study have both important practical and theoretical implications. The current study exhibits the importance of investigating and further examining the effects of a plant-based diet on anxiety, and mental health overall. Further research is required to examine how a plant-based diet is associated with, and may effect, behavioural and overall well-being outcomes. Research to date suggests that the relationship between these variables exists, with plant-based consumption easing symptoms of anxiety (Beezhold, 2015). However, a considerable amount of research examines the effects between these variables, in conjunction with lifestyle change which may reduce anxiety, as previously mentioned. To successfully look into advanced research directions, it is vital to embrace the potential significance plant-based living may have, not only on mental health but on overall health in general.

Findings gathered from the current study have practical implications for mental well-being. Exploring this from a societal perspective, further knowledge on anxiety and the

effects of what we consume has on anxiety is required. This may help reduce the frequency and likelihood of anxiety developing into a life-long illness. Therefore, resulting in less expenditure on anxiety and mental health by the state (Hu, 2006). Not to mention the potential positive affects this may have on mortality overall. Furthermore, potentially reducing rates of obesity, and associated diseases such as diabetes through plant-based eating (McMacken, 2017; Satija, 2016; De Natale, 2009). From a personal perspective, individuals may experience decline in anxiety related hospital admissions, absenteeism at work and increase in overall mental and physical well-being, which may contribute to an increase in life satisfaction (Morton, 2018; Tuso, 2015; Grosse, 2020; Sawicka, 2021).

The current study is important as generalised anxiety disorder is one of the most prevalent mental health disorders existing in the general population (Jorm, 2017). With over 15% of adults experiencing symptoms of anxiety on a regular basis (Terlizzi, 2020). The need for change is paramount. However, it is vital that this change is long-lasting and durable. Research to date suggests that anxiety medication is a short-term solution, with society veering towards the want for a more holistic approach (Knekt, 2008; Bateson, 2011). The implementation of a plant-based diet in further therapies may prove successful in elongating the lasting effect.

**Limitations and future research**

One of the strengths of the current study is its expansion of the exisiting research in a novel manner, resulting in being among the first to solely focus on effects of stress and anxiety and gender differences amongst them, in relation to a plant-based diet. As far as the researcher is aware, there is no other existing literature to solely focus on the impact of these variables. The current findings may be at the helm of the explosion in research on this topic, judging by the prevalence of new research emerging, as well as generational interest and saturation of plant-based eaters amongst young people today (Gvion, 2020). Another strength

is the age sample within the study, with individuals ranging from 18 to 67 years of age, thus controlling for generational biases that may have exisited amongst millennials and GenZ participants. Furthermore, an additional strength lies in the nonparametric tests conducted for the positive skewness in data, in an attempt to control for any biases within the results. Finally, the validity of the DASS-21 serves as a strength of the current research study, as it is both highly valid and reliable (Lovibond, 1995).

However, the current study is not without limitations, which there are some. Given that the current study is a cross-sectional design, causality can not be inferred. As there was stastically significant evidence, this is one of the most aparant limitations of the study. However, current findings correlate with a significant amount of the exisiting evidence to suggest that a plant-based diet reduces levels of anxiety and stress. Furthermore, current findings regarding the gender difference in reported levels of stress and anxiety in relation to a plant-based diet are also in line with existing research. Another potential limitation of the study is its generalisability, as the demographics obtained are limited to age and gender. The researcher did not deem this to be a major issue within the study, given the nature of DASS-21, it was deemed appropriate to keep demographic questions to a minimum, in order to put participants at ease.

Future research may wish to use a larger sample size, across a bigger population, and obatin further demographics which would contribute to the generalisability of this study. As this topic is relatively novel, there is copious potential for future research. To begin, future research may wish to solely look at the effects of a plant-based diet on levels of anxiety and stress alone, along with other mental disorders, such a depression. It is important for future findings to omit confounding variables that may reduce anxiety, in order to obtain ecologically valid results. Futhermore, future research may wish to look at generational

differences and biases within the topic. This would distinguish a plant-based way of living from its 'fad' counterparts, such as ketogenic diets, paleo diets etc.

Futhermore, it is apparent that education around diet and well-being (i.e. mood and food), must be more widespread. It could be inferred that lower-socioeconomic statuses do not have the 'privilege' to change their diets accordingly to help their mental health, due to financial implications (Bhurosy, 2014).

**Conclusion**

Overall, there is emerging consistent evidence to support the hypothesis that increased intake of plant-based foods eleviates symptoms of anxiety, and to some degree stress, resulting in lower levels of reported anxiety and stress. Futhermore, there are larger amounts of evidence to suggest that there are higher levels of reported anxiety in the female population, as opposed to male. However, the findings which look at the gender effects in relation to a plant-based diet are scare. The present study found a statistically significant result between increased intake of plant-based foods and lower levels of reported anxiety and stress. Regarding gender differences, females reported higher levels of anxiety respectively. The current study contributes to previous literature by solely examining the effects of anxiety and stress on a plant-based diet. To the researcher's knowledge, the current study is the first to examine the relationship between the predictor variable and criterion variables alone. Findings of the study emphasise the importance of further information and investigation into the relationship of diet, specifically plant-based, and mental health, specifically anxiety. However, further research is required to explore how these variables are associated with behavioural, social, and psychological outcomes in the general population.

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# Appendices

## Appendix I

Evidence of data and SPSS output (full version available upon request).

| | Name | Type | Width | Decimals | Label | Values | Missing | Columns | Align | Measure | Role |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ID | Numeric | 8 | 0 | | None | None | 8 | Right | Scale | Input |
| 2 | Gender | Numeric | 6 | 0 | | {0, Male}... | None | 6 | Right | Nominal | Input |
| 3 | Age | Numeric | 6 | 0 | | {0, 18-27}... | None | 12 | Right | Scale | Input |
| 4 | Diet1 | Numeric | 14 | 0 | Diet Recoded | {0, Yes}... | None | 14 | Right | Nominal | Input |
| 5 | Howmanyplantbased... | String | 10 | 0 | How many plant-based food items would you eat i... | {0, 5-10}... | None | 10 | Left | Nominal | Input |
| 6 | Ifounditthardtowinddown | Numeric | 2 | 0 | I found it hard to wind down | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 7 | Iwasawareofdryness... | Numeric | 2 | 0 | I was aware of dryness of my mouth | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 8 | Icouldntseemtoexper... | Numeric | 2 | 0 | I couldn't seem to experience any positive feeling ... | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 9 | Iexperiencedbreathin... | Numeric | 2 | 0 | I experienced breathing difficulty (e.g. excessively... | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 10 | Ifounditdifficulttowork... | Numeric | 2 | 0 | I found it difficult to work up the initiative to do things | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 11 | Itendedtooverreactto... | Numeric | 2 | 0 | I tended to over-react to situations | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 12 | Iexperiencedtremblin... | Numeric | 2 | 0 | I experienced trembling (e.g. in the hands) | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 13 | IfeltthatIwasusingalot... | Numeric | 2 | 0 | I felt that I was using a lot of nervous energy | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 14 | Iwasworriedaboutsitu... | Numeric | 2 | 0 | I was worried about situations in which I might pa... | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 15 | Ifeltthatlhadnothingto... | Numeric | 2 | 0 | I felt that I had nothing to look forward to | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 16 | Ifoundmyselfgettinga... | Numeric | 2 | 0 | I found myself getting agitated | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 17 | Ifounditdifficulttorelax | Numeric | 2 | 0 | I found it difficult to relax | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 18 | Ifeltdownheartedandb... | Numeric | 2 | 0 | I felt down-hearted and blue | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 19 | Iwasintolerantofanyth... | Numeric | 2 | 0 | I was intolerant of anything that kept me from getti... | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 20 | Ifeltlwasclosetopanic | Numeric | 2 | 0 | I felt I was close to panic | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 21 | Iwasunabletobecome... | Numeric | 2 | 0 | I was unable to become enthusiastic about anything | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 22 | Ifeltlwasntworthmuch... | Numeric | 2 | 0 | I felt I wasn't worth much as a person | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 23 | Ifeltthatlwasrathertou... | Numeric | 2 | 0 | I felt that I was rather touchy | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 24 | Iwasawareoftheactio... | Numeric | 2 | 0 | I was aware of the action of my heart in the absen... | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 25 | Ifeltscaredwithoutany... | Numeric | 2 | 0 | I felt scared without any good reason | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 26 | Ifeltthatlifewasmeani... | Numeric | 2 | 0 | I felt that life was meaningless | {0, Did not a... | None | 12 | Right | Nominal | Input |
| 27 | Doyoufindthatincreas... | String | 19 | 0 | Do you find that increasing your intake of plant-ba... | {0, Yes defi... | None | 19 | Left | Nominal | Input |
| 28 | Age1 | Numeric | 8 | 0 | Age Recoded | {0, 18-27}... | None | 10 | Right | Nominal | Input |
| 29 | TotalScoreDepression | Numeric | 8 | 0 | | None | None | 22 | Right | Nominal | Input |

**Nonparametric Correlations**

**Correlations**

| | | | Age | Anxiety_Log | Stress_Log |
|---|---|---|---|---|---|
| Spearman's rho | Age | Correlation Coefficient | 1.000 | -.320** | -.210* |
| | | Sig. (2-tailed) | . | .000 | .012 |
| | | N | 148 | 124 | 143 |
| | Anxiety_Log | Correlation Coefficient | -.320** | 1.000 | .757** |
| | | Sig. (2-tailed) | .000 | . | .000 |
| | | N | 124 | 125 | 123 |
| | Stress_Log | Correlation Coefficient | -.210* | .757** | 1.000 |
| | | Sig. (2-tailed) | .012 | .000 | . |
| | | N | 143 | 123 | 144 |

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

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

```
NONPAR CORR
  /VARIABLES=Anxiety_Log Stress_Log
  /PRINT=SPEARMAN TWOTAIL NOSIG FULL
  /MISSING=PAIRWISE.
```

## Appendix II

### Depression Anxiety Stress Scale

Lovibond & Lovibond (1995)

***Participant Instructions***

Please read each statement and select a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

***Rating scale***

0 | Did not apply to me at all – NEVER

1 | Applied to me to some degree, or some of the time – SOMETIMES

2 | Applied to me to a considerable degree, or a good part of time – OFTEN

3 | Applied to me very much, or most of the time – ALMOST ALWAYS

***Items***

1. I found it hard to wind down
2. I was aware of dryness in my mouth
3. I couldn't seem to experience any positive feelings at all
4. I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)
5. I found it difficult to work up the initiative to do things
6. I tended to over-react to situations
7. I experienced trembling (e.g. in the hands)
8. I felt that I was using a lot of nervous energy
9. I was worried about situations in which I might panic and make a fool of myself

10. I felt that I had nothing to look forward to
11. I found myself getting agitated
12. I found it difficult to relax
13. I felt down-hearted and blue
14. I was intolerant of anything that kept me from getting on with what I was doing
15. I felt I was close to panic
16. I was unable to become enthusiastic about anything
17. I felt I wasn't worth much as a person
18. I felt that I was rather touchy
19. I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)
20. I felt scared without any good reason
21. I felt that life was meaningless

***Calculating Individual Scores***

**Appendix III**

**Participant Information Sheet**

You are being invited to take part in a research study. Before deciding whether to take part, please take the time to read this document, which explains why the research is being done and what it would involve for you. If you have any questions about the information provided, please do not hesitate to contact me using the details at the end of this sheet.

WHAT IS THIS STUDY ABOUT? - I am a final year student in the BA in Psychology programme at National College of Ireland. As part of our degree we must carry out an independent research project.

For my project, I aim to investigate the relationship between a plant-based diet and reported levels of stress and anxiety.

Research to date suggests that a vegan diet benefits an individual in a myriad of ways. The information gathered will contribute to research that helps us to understand plant-based diets in relation to levels of reported stress and anxiety, and aid the necessity for sustainable, health focused living.

WHAT WILL TAKING PART IN THE STUDY INVOLVE? - If you decide to take part in this research, you will be asked to initially complete a 2-minute online questionnaire stating whether you are plant-based or omnivore.

Irrespective of your answer, you will then be asked to take 10-minutes to complete a Depression Anxiety Stress Scale (DASS-21) and provide the researcher with the answers.

**Participation Criteria:**

WHO CAN TAKE PART? - You can take part in this study if you are aged over 18 and are plant-based or omnivore.

DO I HAVE TO TAKE PART? - Participation in this research is voluntary; you do not have to take part, and a decision not to take part will have no consequences for you. If you do decide to take part, once you have submitted your questionnaire, it will not be possible to withdraw your data from the study, because the questionnaire is anonymous and individual responses cannot be identified. However, all your data from the questionnaire will be kept securely and will unidentifiable.

**Risks**

WHAT ARE THE POTENTIAL RISKS OF TAKING PART? - Participation in this research requires filling out a Depression Anxiety Stress Scale, this is a standardized scale which has been used in multiple studies and will present no substantial risk with any of the questions asked. However, as the scale is measuring the rate of Depression Anxiety or Stress in a given week, it is required to reflect upon the week gone past. In the instance of a challenging week

and reflecting upon the challenge, it is possible to feel potentially upset by the Depression Anxiety and Stress Questionnaire.

**Helplines**

Should you feel upset or distressed by the Depression Anxiety and Stress Questionnaire:

Pieta house helpline: 1800 247 247

Or text HELP to 51444

WILL TAKING PART BE CONFIDENTIAL AND WHAT WILL HAPPEN TO MY DATA? - All data will be treated in the strictest confidence. Each participant will be anonymous. Responses to the questionnaire will be stored securely in a password protected/encrypted file on the researcher's computer. Only the researcher and their supervisor will have access to the data. Data will be retained for 5 years in accordance with the NCI data retention policy.

WHAT WILL HAPPEN WITH THE RESULTS OF THIS STUDY? - The results of this study will be presented in my final dissertation, which will be submitted to National College of Ireland.

**Contact information**

Should you have any reason to contact, please see contact details below:

Lead researcher: Roisin Murphy

Email: x18446274@student.ncirl.ie

Supervisor: Linda Horn

Email: linda.horn@ncirl.ie

**Appendix IV**

**Consent Form**

By clicking 'I give informed consent' you are consenting that you have read the Participation Information Sheet and understand what it entails, the anonymous nature, and that you wish to take part in the study.

⬭ I give informed consent

By clicking ‘Yes’ you are consenting that you are over the age of 18.

⬭ Yes

**Appendix V**

**Debriefing Form**

I'd like to thank you for participating in this research study, the aim of the study was to investigate the relationship between a plant-based diet and reported levels of stress and anxiety. I would like to reiterate that all data generated is fully anonymous and will be treated with the highest level of discrepancy.

Should you have any further questions or concerns please feel free to contact me (x18446274@student.ncirl.ie or my supervisor Linda Horn linda.horn@ncirl.ie) for more information.

Should you feel the need, pieta house helpline: 1800 247 247

Or text HELP to 51444.

Thank you for your time.