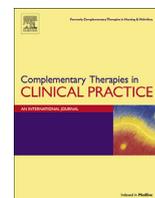




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## Diet and lifestyle intervention on chronic moderate to severe depression and anxiety and other chronic conditions



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### ABSTRACT

This group study explored how an intervention of diet, lifestyle and behavior modification, including a plant-based diet, daily exercise and mindfulness techniques, would affect 500 adult men and women participants diagnosed with chronic moderate to severe depression and anxiety and other conditions during a 12 week period. An analysis of the health outcomes detailed in self-reported diary entries was carried out at the conclusion of the 12 week period. These reports noted improvements in depression, anxiety and all other conditions addressed by the study, with the majority of participants reporting substantial benefits. A six month follow up indicated that these benefits persisted in most of the participants. These results demonstrate that an intervention of diet, exercise, lifestyle and behavior modification may provide considerable benefits for moderate to severe depression and anxiety as well as other conditions.

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### 1. Introduction

Chronic diseases and conditions account for 7 of the top 10 causes of death in the United States [1]. Approximately 117 million people, or half of the American adult population, have one chronic illness and about one quarter of this population has two or more chronic diseases or conditions [1].

The role of diet in the prevention of chronic illness is a popular area of study in the scientific literature. The vast majority of these studies, however, do not analyze the long-term health outcomes of individuals who adhere to a particular diet. Notable exceptions are the Nurses' Health Studies (NHS) and the substantial body of research on the Mediterranean Diet, which stand out as major scientific investigations showing the significant long-term benefits of a healthy diet rich in vegetables, fruits, nuts and seeds in preventing chronic inflammatory conditions [2–6]. The NHS also offers compelling evidence of the disease-fighting effects of regular exercise [2]. However, as observational studies, the NHS could not explore the potential benefits of consuming a purely plant-based diet combined with regular exercise. These investigations also do not account for stress management among study participants.

Studies have demonstrated separately the benefits of a plant-

based diet, exercise and mindfulness-based de-stress exercises on chronic conditions. Research correlates a plant-based diet with healthy low blood pressure [7–9]. Limited research has explored the impact of a plant-based diet on depression and anxiety, though preliminary evidence suggests positive effects [10–12]. A small but growing body of research shows a plant-based diet may offer significant benefits to arthritis and pain sufferers [13–15]. The effects of a plant based diet on fatigue and insomnia is extremely sparse.

Exercise has shown to be beneficial for patients suffering from depression and anxiety [16–20]. Regular aerobic and resistance exercise help to alleviate pain [21–23] and reduce high blood pressure [24–27]. Clinical studies demonstrate that fatigue [28–30] and chronic insomnia [31,32] can be considerably helped by physical activity.

Mindfulness practices have been observed to relieve depression and anxiety [33–36]. Mindfulness-based techniques significantly help subjective markers of pain among patients [37–39]. Preliminary research indicates that mindful awareness practices may improve quality of sleep [40–42] and reduce fatigue in a variety of populations [43–47]. A definitive link between mindfulness techniques and healthy low blood pressure has not been established.

This present investigation aims to build on the conclusions of this research by examining the short-term effects of a rigorous diet, lifestyle and behavior modification program including adherence to an entirely plant-based diet, regular exercise and mindfulness-based de-stress practices on patients affected by chronic

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moderate to severe depression and anxiety and a range of other chronic conditions.

## 2. Materials and methods

### 2.1. Participants

Five hundred study participants were recruited from the general public. A group of 231 men and 269 women joined the program. All participants were required to provide medical records showing a diagnosis of chronic moderate to severe depression and anxiety. Many of the participants were also diagnosed with at least one other chronic condition with hypertension, pain, insomnia and fatigue being the most common. Participants were instructed to maintain regular contact with their physicians. Only their attending physician was to determine if medications were to be altered or eliminated.

### 2.2. Study design

This was a behavior modification study on the impact of lifestyle and diet on individuals suffering from chronic moderate to severe depression and anxiety. The study consisted of instruction on the necessary components of a healthy lifestyle: proper diet, juicing, detoxification, exercise, mindfulness and de-stressing techniques, environmental hygiene, and examination of beliefs and attitudes. Information on the prescribed intervention was given in weekly sessions of 2½ hours each, over a period of 12 weeks from the first meeting to the last. Medical supervision was provided by Luanne Pennesi, RN, a nurse practitioner with 36 years of experience including clinical nurse supervisor at Long Island Jewish hospital. Five nutritionists were available during the week to assist participants in implementing the recommended protocol.

### 2.3. The protocol

#### 2.3.1. Diet

The diet prescribed was an anti-inflammatory plant-based diet with 70% raw and 30% lightly cooked foods. The daily diet was comprised of 60% non-refined complex carbohydrates, 20% protein, and 20% fats from healthy oils. Total daily caloric intake ranged from 1700 to 2700 calories. Men who led more active lifestyles were advised to consume 2200–2700 calories daily. Men who led less active lifestyles and women were advised to eat 1700–2200 calories daily.

The diet required complete elimination of certain foods, especially pro-inflammatory foods or food preparations, including refined carbohydrates and any wheat, gluten, dairy, meat, poultry, or shellfish. No caffeine, alcohol, refined sugar, or artificial sweeteners or chemicals such as additives, preservatives, coloring agents or flavorings, and no carbonated beverages, including sodas and seltzer were included. No conventional table salt, microwaved, deep fried, toasted foods, or nightshade vegetables were allowable. To minimize costs involved, participants were encouraged to buy the recommended staples of the diet in bulk. Recipes were given to the participants to encourage adherence to the protocol. The following daily dietary guidelines were suggested:

- Two 1 cup servings of plant-based protein from sources such as legumes or beans including lentils, navy beans, black beans, soybeans, kidney beans, split peas, adzuki beans, fava beans, pinto beans and mung beans. Protein intake ideally was 0.9 g/kg of body weight. Fiber intake was at least 35–50 g.

- Two 1 cup servings of plant-based gluten free grains including amaranth, buckwheat, quinoa, oats, brown rice and millet.
- One 3 oz serving of nuts or seeds including walnuts, almonds, pine nuts, hazelnuts, sesame seed, pumpkin seed, and sunflower seed.
- Beverages including herbal teas, bottled or filtered water, fresh squeezed organic fruit juice as well as almond-, rice-, and coconut-based beverages.
- Sweeteners including raw honey, brown rice syrup, raw coconut palm sugar, natural fruit sweeteners, and stevia.
- Three to 5 tablespoons of oils including flaxseed, avocado, extra virgin olive oil, coconut, macadamia and mustard seed oil. Foods were to be cooked at low heat temperatures.
- Nine servings of nutrient-dense fruits and vegetables (preferably organic). Additionally, one serving of sea vegetables.
- Fruits including fresh or frozen berries daily, purple or red grapes, apple, pear, melons, kiwi, citrus, star fruit, papaya, and pomegranate.
- Vegetables including kale, cabbage, arugula, bok choy, lettuce, asparagus, carrots, celery, watercress, beets, squash and sweet potatoes.
- Herbs and spices including cayenne, curcumin, basil, rosemary, oregano, thyme, chili peppers, anise, cinnamon, horseradish, wasabi, mustard, dill weed, fennel, and spearmint.
- Protein smoothie for breakfast including 20–25 g of vegetable protein from powder: pea, rice, or hemp, 1000–2000 mg vitamin C, almond-, rice-, and coconut-based beverage, 1 teaspoon chia powder or fennel seeds and 1 teaspoon coconut oil.

#### 2.3.2. Juicing

- Participants were instructed to drink one 16 oz. fruit and vegetable juice per day during the first week and increase to two juices daily the second week and continue to add one juice per week until 6 juices per day was achieved at week six. They were advised to maintain 6 juices daily until the completion of the study.
- Suggested juice combinations included celery, cucumbers with apple, watermelon, grapefruit, or lemon.
- Additional suggested juicing foods included bok choy, cabbage, cilantro, parsley, kale, collard greens, beets, and chard.
- Dilute green vegetables with water.
- Apple seeds removed, citrus can be juiced whole with skin and lemon.
- Morning drink of juice of one teaspoon of lemon and of apple cider vinegar, and half teaspoon of manuka honey diluted in 8 oz. of water.

#### 2.3.3. Environmental hygiene

- Declutter living space.
- Clean floors and surfaces with safe cleaners: can use hydrogen peroxide, rubbing alcohol.
- Remove indoor pollution sources, including outgassing furniture, carpet, and building materials.
- Use water filter, and veggie wash or apple vinegar to clean produce.
- Avoid secondhand smoke.
- Recommend houseplants or air filter for oxygen, purifying.

### 2.3.4. Exercise

Typical prescribed exercise was aerobic exercise such as power walking 45–60 min 5 days per week, and 3 days per week 30 min resistance exercise. Additional instruction was given for types of exercises that could be done in a seated position for those with significantly limited mobility.

### 2.3.5. Mindfulness and de-stress techniques

Recommended techniques included 20 min of daily meditation, prayer, tai chi, guided imagery, and mindfulness in nature.

### 2.3.6. Beliefs and attitudes for self-actualization

Participants were encouraged to examine core values, life purpose, potential for helping others, and to avoid conditioned responses and negative or self-limiting thinking.

### 2.3.7. Outcome measures

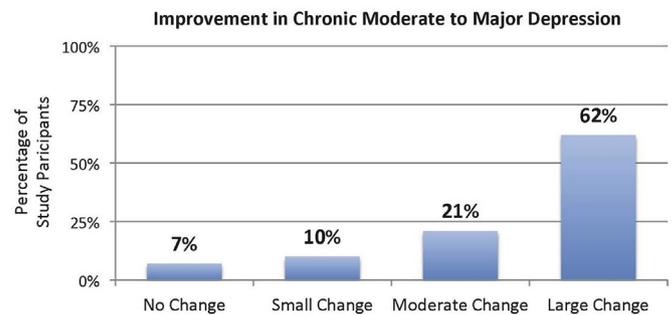
Participants were asked to keep a daily health diary to self-report changes or improvements to their physical, mental and emotional well-being during the 12 week period. They were prompted to describe the changes they experienced as either small, moderate or large based on a scale ranging from 1 to 10 defining small improvement as 1–3, moderate improvement as 4–6 and large improvement as 7–10. The content of the health diaries was carefully reviewed post-study to determine what improvements were realized and to what extent. Particular attention was paid to reporting on moderate to severe depression, anxiety, fatigue, insomnia and pain over the course of the entire study period. Participants' weight, blood pressure, and body fat percentage were also assessed at the start and conclusion of the study. A six month follow-up survey was carried out, allowing participants to provide additional feedback and mention any other changes to their health.

## 3. Results

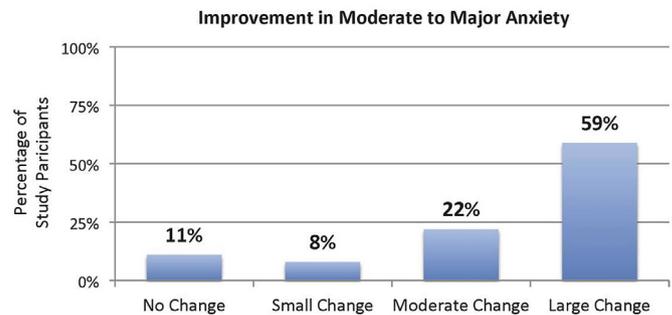
Of the 500 participants who began the study, 334 participants dropped out. Ninety percent of those who dropped out did so within the first two weeks of the study. Approximately 85% of those who dropped out did so because the diet and behavior modification program was too rigorous for them. Most of the other individuals who did not complete the study cited a lack of time and resources to prepare food in accordance with the program's dietary protocols alongside family members who ate a different diet, though no participants who dropped out indicated that the diet plan was too cost-prohibitive to maintain. Among the 166 individuals who participated for the duration, 85 were female and 81 were male. Among the individuals who participated for the duration 86 entered the study with a diagnosis of moderate to major insomnia, 96 entered the study with a diagnosis of moderate to major fatigue and 105 entered the study with a diagnosis of moderate to major pain.

A review of the health diaries indicated the following:

- Substantial improvements were realized by the majority of participants in the area of moderate to severe depression. One hundred and two participants (62%) reported large improvement or full remission of symptoms. Moderate improvement was noted by 35 participants (21%), small improvement was noted in 17 participants (10%) and 12 participants (7%) experienced no change (See [Graph 1](#)).
- Ninety-eight participants (59%) reported large improvement or full remission of anxiety symptoms. An additional 37 participants (22%) experienced moderate improvement, 13 participants (8%) observed a small change and 18 participants (11%) reported no change (See [Graph 2](#)).

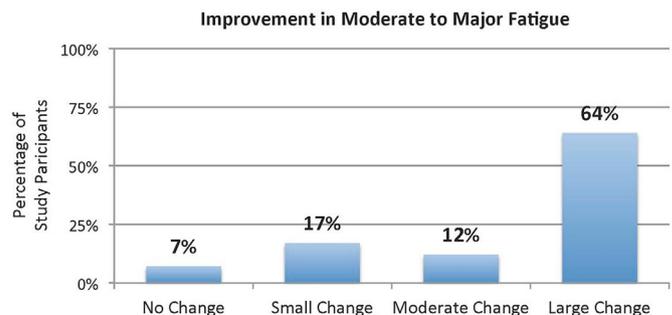


**Graph 1.** Improvement in chronic moderate to major depression.

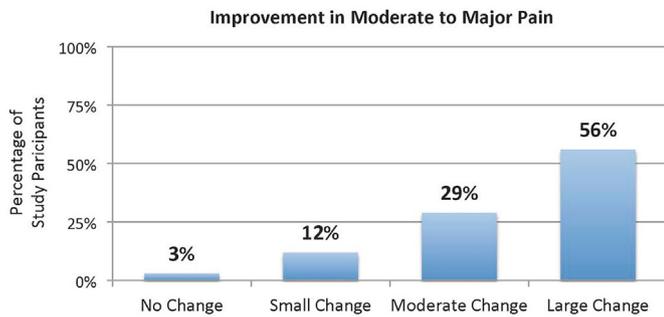


**Graph 2.** Improvement in moderate to major anxiety.

- Among the 96 participants affected by moderate to major fatigue, 61 participants (64%) reported large improvement or full remission of symptoms. A moderate improvement of fatigue symptoms occurred in 12 participants (12%), 16 participants (17%) noted small improvement and 7 (7%) experienced no improvement (See [Graph 3](#)).
- Among the 105 participants affected by moderate to major pain, 59 participants (56%) reported large improvement or full remission of symptoms. Thirty participants (29%) noted moderate improvement while 13 participants (12%) experienced small improvement and 3 participants (3%) reported no change (See [Graph 4](#)).
- Among the 86 participants affected by moderate to major insomnia, 37 participants (43%) reported significant improvement or full remission of symptoms. Moderate improvement was reported among 17 participants (20%). Twenty participants (23%) experienced small improvement and twelve (14%) saw no improvement (See [Graph 5](#)).
- Several subjects reported having many more days where they felt optimistic and looked forward to social interactions



**Graph 3.** Improvement in moderate to major fatigue.



**Graph 4.** Improvement in moderate to major pain.

where previously they had spent more time withdrawn from society and in a state of loneliness.

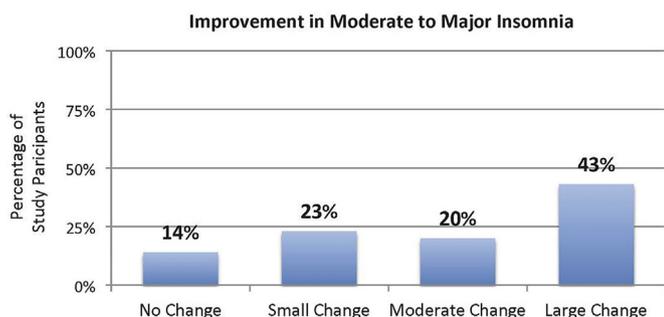
- Eighty-one percent of the participants affected by insomnia reported a reduction in the number of times they awoke during the night and a feeling of greater refreshment upon starting the day.
- The most frequently consumed types of grains were brown rice and quinoa. The most frequently consumed types of beans and legumes were lentils, black beans and soybeans. The most frequently eaten type of oil was coconut oil. The most frequently consumed fruits were apple and blueberries and the most frequently consumed vegetables included broccoli, carrots and lettuce.

Health data collected at the beginning and conclusion of the program revealed the following:

- The group's average systolic blood pressure fell 6.6 mmHg and the average diastolic blood pressure fell 3.5 mmHg.
- The average weight loss among the group was 5.7 lbs and the average decrease in body fat percentage was 1.9%.

The 6 month follow up survey showed the following:

- Seventy-eight percent of participants reported that they were able to decrease or altogether eliminate antidepressant medications under the care of their physicians.
- 17 participants (10%) who had noted no or small improvement in depression at the conclusion of the study reported significant improvements in mood and emotional well-being in the intervening time period.
- The average weight loss among the group from the beginning of the study until the time of the follow up was 15.0 lbs.



**Graph 5.** Improvement in moderate to major insomnia.

## 4. Discussion

While moderate to severe depression and anxiety affected all of the study subjects, the investigation ambitiously addressed a broad range of chronic diseases and conditions. This comprehensive intervention provided wide ranging nutritional and lifestyle support, for mind and body, to show significant therapeutic benefit for multiple specific conditions. The substantial improvements witnessed in the majority of study participants in this intervention deserve the attention of researchers examining complementary methods of combatting chronic disease.

### 4.1. Limitations

The study was of a short duration. It is our hope that larger studies of 6 and 9 months and 1 year durations be conducted.

Due to the inclusive nature of the study it was impractical to obtain and analyze biomarkers related to several medical conditions. The study did not distinguish between the health outcomes of participants who, during and after the study, were following physician-prescribed medical and pharmacological interventions. Future investigations could offer more clarity about the impact of such a lifestyle program if they focused on more homogeneous populations.

Though substantial reductions in blood pressure and weight occurred in many participants, because not all subjects were hypertensive or obese it is possible that these reductions would be even larger if this program were implemented by only these populations.

## 5. Conclusion

The impact of a comprehensive diet, lifestyle and behavior modification intervention including a healthy plant-based diet, regular exercise and mindfulness and de-stress techniques show great promise in the prevention of chronic disease and conditions. Long term studies that monitor the health outcomes of individuals following such holistic protocols are warranted.

### Author contributions

Both authors contributed extensively to the work presented in this paper. Gary Null created the intervention guidelines as well as drafted and revised the paper. Both Gary Null and Luanne Pennesi carried out the data collection and analysis and approved the final version to be published.

### Funding

This study was carried out at the expense of the authors. No outside funding was provided.

### Ethical approval

As this study involved an entirely lifestyle-based and non-pharmacological intervention, no ethical approval was obtained.

### Conflicts of interest

None.

### Acknowledgments

Special thanks to the group of volunteers who helped gather the study data from participants.

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