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## The Impact of Lifestyle Medicine on Nonalcoholic Fatty Liver Disease

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The Impact of Lifestyle Medicine on Nonalcoholic Fatty Liver Disease

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for Pursuance of Degree

Doctor of Nursing Practice

Southern Adventist University

School of Nursing

### Dedication

*This paper is dedicated to my family. My husband Louis, who has given me unwavering support along this journey. Your support has allowed me to pursue my dream. You have offered sage advice, been my cheerleader, and the voice of reason. For this, I am eternally grateful. My children, Samuel and Garrett, you are my reason for doing everything. My love for you knows no limits. You are my greatest joys and accomplishments in life. It is my desire that you have learned, from watching me along this journey, that you can accomplish anything, no matter your age. My parents, who are always reminding me of how proud they are, freely offering their love and support. My Heavenly Father, whose love is constant and evermore. Through faith, He has led me along this path.*

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## Abstract

Nonalcoholic fatty liver disease (NAFLD) is the most common liver disease worldwide. The main risk factor for the development of NAFLD is metabolic syndrome. Women are at greatest risk, typically in their 5<sup>th</sup> to 6<sup>th</sup> decade of life. The more aggressive form of NAFLD is nonalcoholic steatohepatitis (NASH) which is characterized by inflammation associated with NAFLD. NASH has the greatest tendency to progress into cirrhosis. However, lifestyle intervention has been shown to effectively treat, and even reverse NAFLD. The purpose of this quantitative, quasi-experimental study was to lend additional research and demonstrate improvement in NAFLD through lifestyle intervention with 1) a Mediterranean diet, high in fiber and low in saturated fat, 2) moderate exercise with walking 90 minutes per week, and 3) social support group meetings once monthly over a six-month period. Outcomes were measured by 1) 5% total body weight (TBW) loss, 2) improved hepatic steatosis as measured by ultrasound, and 3) improved serum fibrosis staging. There were 20 participants, with a mean age of 53.55 years. Participants were 85% female, 15% male, 85% Caucasian, 10% African American, and 5% Hispanic. They received education on a Mediterranean diet, agreed to walk 90 minutes each week, and attended six support group meetings over a six-month period. At the end of six months, 90% of participants achieved 5% TBW loss. Diet adherence was shown to be statistically significant to the prediction of percentage of TBW loss. However, walking and group meeting attendance were not statistically significant to the prediction of percentage of TBW loss. With regard to ultrasound outcomes, diet and walking adherence were not found to be statistically significant; still, diet adherence was noted to make a person 1.75 times more likely to have a positive ultrasound outcome, with improved fibrosis. Improved post-intervention serum fibrosis scores were found to be statistically significant. After careful

consideration, the greatest limitation of this study was size. This study was too small to accurately measure the power of all of the independent variables and their impact on NAFLD. Future studies should include a larger, more diverse population, and be conducted over a longer period of time. Future studies would also benefit from a multi-disciplinary team approach. Despite the limitations, the knowledge gained from this research will help shape and advance current clinical guidelines. Nurse Practitioners (NPs) serve as leaders in lifestyle medicine. NPs are vital to advancing research and studying the impact lifestyle medicine has on chronic disease, such as NAFLD.

*Keywords:* NAFLD, NASH, fibrosis, cirrhosis, exercise, diet, social support in treatment of chronic disease, weight loss, metabolic syndrome, T2DM, dietary modification, Mediterranean diet, hyperlipidemia and liver disease, lifestyle modification, lifestyle medicine, diagnosis, and treatment of NAFLD

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## The Impact of Lifestyle Medicine on Nonalcoholic Fatty Liver Disease

### CHAPTER 1

#### Background

##### **Prevalence and Significance of Nonalcoholic Fatty Liver Disease**

NAFLD is the most common liver disease worldwide (Bellentani, 2017). It is characterized by steatosis which is the hepatic accumulation of triglycerides. A major risk factor for the development of NAFLD is metabolic syndrome which is characterized by diabetes mellitus type II (T2DM), obesity, and hyperlipidemia. All these disease states endorse the development of NAFLD through insulin resistance which fosters hepatic accumulation of fatty acids. NAFLD is regarded as the hepatic component of metabolic syndrome (Andronesu, Purcarea, & Babes, 2018). It is estimated that 66% of those over the age of 50 with a diagnosis of diabetes or obesity have NASH with advanced fibrosis (Rinella, 2015).

Women are at greater risk for development of NAFLD, accounting for 65%-83% of cases, typically peaking in the fifth and sixth decade of life (Andronesu et al., 2018). NAFLD affects approximately 30% of people in the United States, with another 5% of the population going on to develop the more aggressive form of NAFLD, NASH. Additionally, half of all deaths in those with NASH are secondary to cardiovascular disease and malignancy (Rinella, 2015). NASH has the propensity to progress into cirrhosis, being the 11<sup>th</sup> leading cause of death in the United States in 2017 (Kochanek et al., 2019). NASH cirrhosis is predicted to be the leading indication for liver transplantation in the United States by the year 2020 (Corey & Chalasani, 2014).

Other risk factors for the development of NAFLD and fatty liver disease are alcohol dependence, viral hepatitis, rapid weight loss resulting from gastric bypass surgery, certain



medications, and long-term total parenteral nutrition infusion. The most common medications associated with NAFLD are amiodarone, glucocorticosteroids, tetracyclines, zidovudine, and tamoxifen (Andronescu et al., 2018).

As the occurrence of obesity and T2DM has continued to grow, so too has NAFLD (Ma et al., 2018). Globalization of a Western diet, improved access to food, and sedentary lifestyles are believed to be responsible for the upward trend in the global prevalence of NAFLD.

Lifestyle modification that promotes weight loss through improved dietary habits and exercise has been recommended for treatment of NAFLD. Studies showing improved eating habits and dietary counseling throughout one year with a weight loss of 7% or more may improve the histopathologic features of NASH (Ahmed, Wong, & Harrison, 2015). Ahmed et al. (2015) go on to assert that patients who also incorporated exercise during this one-year period demonstrated more long-term weight loss.

### **The Impact of Lifestyle Medicine on NAFLD**

Lifestyle intervention is the foundation of treatment for NAFLD. Pharmacologic therapies are limited and have failed to provide long-term improvement (Worcester, 2014). However, diet, exercise, and social support leading to weight loss have proven very effective in the treatment of NAFLD.

The Mediterranean diet has been associated with weight loss, improved cardiovascular health, and reduced hepatic fat accumulation (Ma et al., 2018). The Mediterranean diet is primarily plant-based. It is made up of fruits, vegetables, nuts, legumes, whole grains, and fish, with moderate consumption of poultry, eggs, cheese, and yogurt. Red meat is avoided and saturated fats and butter are replaced with extra virgin olive oil and canola oil. In addition to the dietary guidelines outlined in the Mediterranean diet, the recommended caloric intake for weight

loss in women is 1000-1200 calories per day and 1200-1600 calories per day for men (Ahmed et al., 2015).

Complications arising from metabolic syndrome, T2DM, and obesity in patients with NAFLD are further exaggerated by a sedentary lifestyle and lack of aerobic exercise. Regular exercise promotes protein synthesis and expands muscle mass, while a sedentary lifestyle results in muscle breakdown (Ahmed et al., 2015). Aerobic activity, such as swimming or running, for 120 minutes each week promotes insulin sensitivity through building lean muscle mass, which promotes more efficient glucose uptake. This leads to reduction in accumulation of hepatic fat, offering protection against NAFLD (Keating, Hackett, George, & Johnson, 2012).

Lifestyle change and behavioral modification are difficult for most individuals. Middleton, Anton, and Perri (2013) found that people who participated in social support provided in a group setting had an increased perceived ability to adhere to lifestyle modifications and were better equipped to manage barriers to long-term change. Middleton et al. (2013) note that when providers are conducting group-based interventions, it is important to allow group members to share health knowledge when appropriate and help guide self-discovery to potential solutions during problem solving. This promotes self-efficacy among group members.

### **Purpose of Research**

Lifestyle modification is the foundation for treating NAFLD. Unfortunately, research is limited on this topic. The purpose of this study was to demonstrate improvement in NAFLD through lifestyle intervention with 1) a Mediterranean diet, high in fiber and low in saturated fat, 2) moderate exercise by walking 90 minutes per week, and 3) social support group meetings once monthly over a six-month period. It is hoped that this study will also lead to improved

long-term health outcomes in patients with NAFLD, as well as augmenting additional research in the treatment of NAFLD.

### **Clinical Question**

In patients with NAFLD, does 1) a Mediterranean diet, high in fiber and low in saturated fat, 2) moderate exercise with walking 90 minutes per week, and 3) social support group meetings once monthly over a six-month period show disease improvement? Outcomes were measured by 1) 5% TBW loss, 2) improved hepatic steatosis as measured by ultrasound (obtained at baseline and repeated at six months), and 3) improved fibrosis staging through measurement of Echosens FibroMeter (obtained at baseline and repeated at six months).

### **Concepts and Definition of Terms**

The following provides an explanation of related definitions with regard to this study.

**Nonalcoholic Fatty Liver Disease (NAFLD).** Encompasses the entire spectrum of fatty liver disease in individuals without significant alcohol consumption, ranging from fatty liver to steatohepatitis and cirrhosis.

**Nonalcoholic Fatty Liver (NAFL).** Presence of hepatic steatosis with no evidence of hepatocellular injury in the form of ballooning of the hepatocytes or no evidence of fibrosis. The risk of progression to cirrhosis and liver failure is minimal.

**NAFLD Activity Score (NAS).** Represents the sum of scores for steatosis, lobular inflammation, and ballooning, ranging from 0-8.

**Nonalcoholic Steatohepatitis (NASH).** Presence of hepatic steatosis and inflammation with hepatocyte injury (ballooning) with or without fibrosis. This can progress to cirrhosis, liver failure, and rarely liver cancer.

**NASH Cirrhosis.** Presence of cirrhosis with current or previous histological evidence of steatosis or steatohepatitis.

**Fibrosis.** Formation of abnormally large amount of scar tissue in the liver in an attempt to repair or replace damaged cells. Severe scarring from fibrosis can progress to cirrhosis. Stages of fibrosis: F0 (without fibrosis), F1 (portal fibrosis without septa), F2 (portal fibrosis with rare septa), F3 (bridging septa between the central veins and the portal veins), and F4 (cirrhosis).

**Lifestyle Medicine.** One aspect of medicine centered on research, prevention, and treatment of disorders resulting from lifestyle factors. It focuses on the predominate use of a whole food, plant-based diet, regular physical activity, sleep, stress management, and positive social networks to treat, reverse, and prevent chronic disease.

### **Theoretical Framework**

The clinical use of nursing models and theories help facilitate expansion of nursing knowledge. It is an essential phase for achieving the goals that influence the practical application of clinical and educational research. For the purposes of this study, the Neuman Systems Model and CREATION Health Model was utilized.

The Neuman Systems Model was created in the 1970s by nursing theorist Betty Neuman. It is a broad system, wholistic theory that suggests the nature of living organisms are open systems that interact with each other and their environment. Neuman (1996) wrote that patients are not defined by their illness or injury; rather, we need to view them as an entire person. The Neuman Systems Model is constructed around the relationship and reaction a patient has with stress, and the dynamic nature of reconstitution factors that help the individual fight against and recover from stress. There are three lines of defense central to Neuman's theory: 1) lines of

resistance that represent internal factors that allow the patient to fight against stress; 2) the normal line of defense, which represents a patient's equilibrium; and 3) the flexible line of defense, which represents dynamic factors that can quickly change in a short amount of time.

The nurse endorses stability through utilization of three levels of prevention: 1) primary prevention, which defends the normal line of defense and strengthens the flexible line of defense; 2) secondary prevention, which is used to strengthen the internal lines of resistance, thereby reducing the reaction and increasing resistance factors; and 3) tertiary prevention, which stabilizes, and guards the patient's return to wellness following treatment. Within the Neuman Systems Model the client may be an individual, family, group, community, or social entity (Neuman, 1996).

The CREATION Health model uses Biblical principles supported by evidenced-based science for wholistic living, focusing on mind, body, and spirit. Each letter in CREATION represents a different component for good health: Choice, Rest, Environment, Activity, Trust, Interpersonal Relationships, Outlook, and Nutrition (Hickey, 2014).

When applying Neuman's theory to this study, the person with NAFLD was at the center with the emphasis placed on their liver. The normal line of defense was represented by the caring, connecting, empowering received from family, peers, and the nurse practitioner (NP). Diet, exercise, and weight loss served as the flexible line of defense against liver disease.

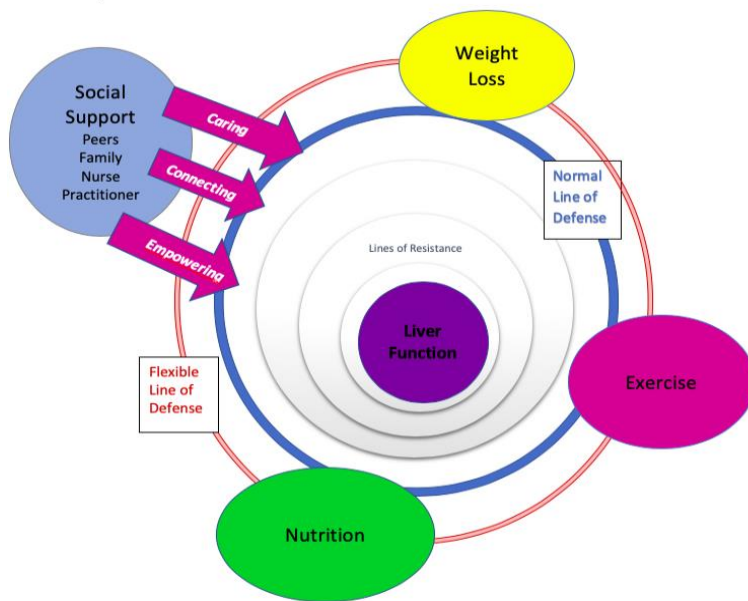
This study was further supported by the CREATION health model with four obvious aspects: 1) Choice, because patients chose to participate in this study and to implement lifestyle change; 2) Activity, through walking to help improve NAFLD; 3) Interpersonal relationships, through participation in monthly support group meetings; and 4) Nutrition, demonstrated by following a low-fat, high-fiber diet. The less obvious principles included Rest, Environment,

Trust in God, and Outlook. Rest, because it is essential to good health through lowering blood pressure, relaxation, and stress reduction. Environment, both external and internal environmental influences impact overall health and well-being. Trust in God and recognizing the link between spirituality and healing endorses our physical and spiritual health. Finally, our outlook toward life and how we view circumstances creates our reality. Our mind influences our physical body and attitude toward health. All of these components together are essential in the prevention, treatment, and reversal of disease in patients with NAFLD.

**Conceptual Model**

**Figure 1**

*Conceptual Model*



This conceptual model integrates components of the Neuman Systems Model and the CREATION Health Model.

As depicted in Figure 1, at the center of this conceptual model is the person with NAFLD, with emphasis being placed on healthy liver function and disease reversal. The normal lines of defense are represented through caring, connecting, and empowering, received from family, peers, and the NP. This line of defense provides balance to competing stressors that

impede successful management and reversal of liver disease. The flexible lines of defense, being the most dynamic because of how quickly they can change, are represented through weight loss, exercise, and nutrition. These lifestyle modifications require Choice as a first step, because before an individual can achieve nutrition, exercise, and weight loss, they must first choose to make changes in these areas.

As the role of the NP continues to grow and evolve, so too will the impact NPs have on the face of health care in the United States and globally. Considering that most of the chronic disease NPs treat today is a result of poor lifestyle choices, there is a responsibility to include lifestyle modification as a way to prevent and treat chronic disease, such as NAFLD. Diet and physical activity ought to be regarded as medicine, and equally important to patient outcomes. NPs are going to have to become adept at applying the principles of lifestyle medicine and become leaders in their community, promoting good health, and advocating for those in underserved communities. They also need to actively participate in research that will further expand their role as health care leaders, particularly in lifestyle medicine.

NAFLD is the most common liver disease globally and is regarded as the hepatic component of metabolic syndrome (Andronescu et al., 2018). Attributing factors include sedentary lifestyles, globalization of a Western diet, and improved access to food (Ahmed et al., 2015). Patients with NAFLD that go on to develop NASH are at the greatest risk, given NASH has the propensity to progress into cirrhosis. If nothing is done to intervene in the state of our health care, NASH cirrhosis is predicted to be the leading indication for liver transplantation in the United States (Corey & Chalasani, 2014). This study demonstrates and replicates findings from previous studies that show lifestyle modification can result in disease regression and

resolution. Additionally, it highlights the role of the NP, in research and treatment of chronic disease through lifestyle medicine.



## **CHAPTER 2**

### **LITERATURE REVIEW**

NAFLD accounts for the majority of chronic liver disease in the U. S. and has the propensity to progress into cirrhosis (Singh et al., 2015). Lifestyle modification is the only long-term treatment for management of this disease. Weight loss, improved diet, and exercise can reduce aminotransferases and improve hepatic steatosis, as demonstrated by ultrasound and magnetic resonance imaging (Chalasani et al., 2018). Patients who are overweight are much more likely to have increased insulin resistance, diabetes, and hypertriglyceridemia, placing them at greater risk for the development of NAFLD. While lifestyle modification with diet and exercise have been recognized as effective therapeutic strategies for diabetes and cardiovascular disease, research is limited providing similar recommendations for NAFLD. Current clinical guidelines recommend weight loss of at least 3% - 5% of total body weight (TBW) to improve steatosis, however greater weight loss of 10% TBW may be needed to improve necroinflammation. It is recommended this weight loss should be achieved through a hypocaloric diet alone or concurrently with exercise. Regular exercise is also recommended in adults with NAFLD, as exercise independent of dietary modification may reduce hepatic steatosis. However, its ability to improve other features of liver histology remain undetermined (Chalasani et al., 2018).

An extensive literature review was conducted using the Cumulative Index to Nursing and Allied Health Literature (CINAHL) and the American Gastroenterological Association (AGA). Keywords used included: NAFLD, NASH, fibrosis, cirrhosis, exercise, diet, social support in treatment of chronic disease, weight loss, metabolic syndrome, T2DM, dietary modification, Mediterranean diet, hyperlipidemia and liver disease, lifestyle modification, lifestyle medicine,

diagnosis, and treatment of NAFLD. Studies were excluded based on a diagnosis of cirrhosis, alcohol and/or drug induced etiology, viral hepatitis, and human immunodeficiency virus.

Fourteen studies were chosen for this review, published between 2004-2018. Following summary of the literature findings, organized by three identified themes: 1) progression of fibrosis; 2) lifestyle modification (diet, exercise, social support) for the treatment of fibrosis and NAFLD.

### **Progression of Fibrosis**

Fibrosis can progress into cirrhosis. However, little is known about the difference in fibrosis progression rates between NAFLD and NASH. Singh et al. (2015) conducted a systematic review and meta-analysis of all available research that assessed paired liver biopsies in patients with NAFLD and NASH to estimate the rate of fibrosis progression. A total of 11 cohort studies were used for analysis. The researchers identified 411 patients with biopsies confirming NAFLD, 150 patients with NAFLD and 261 with NASH. Of the 11 studies included in this meta-analysis, eight were obtained from Western populations and three from Asian populations. The average age of participants ranged from 44 to 55 years with 53% being men. The mean BMI ranged from 27.4 to 37.7 kg/m<sup>2</sup>, and 49.9% of participants were diabetic. The distribution of fibrosis at baseline was stage 0 (35.8%), stage 1 (32.5%), stage 2 (16.7%), stage 3 (9.3%), and stage 4 (5.7%). Follow-up evaluation was over 2145.5 person-years. During this time, 33.6% ( $n = 138$ ) had progression by one fibrosis stage when compared to baseline, 43.1% ( $n = 177$ ) remained stable, and 22.3% ( $n = 96$ ) had improvement with a decrease by at least one fibrosis stage when compared to baseline. The annual fibrosis progression rate for the NAFLD patients who had fibrosis stage 0 at baseline was 0.07 stages (95% CI, 0.02-0.11 stages) and patients with NASH progressed 0.14 stages (95% CI, 0.07-0.21 stages). These findings showed

that NAFLD had a fibrosis progression rate of one fibrosis stage over 14.3 years (95% CI, 9.1-50.0 y), compared to NASH that progressed one fibrosis stage over 7.1 years (95% CI, 4.8-14.3 y) (Singh et al., 2015).

This meta-analysis demonstrated that fibrosis can progress in patients with NAFLD and NASH. The progression rate of one fibrosis stage for NASH was twice as rapid as noted in NAFLD. Singh et al. (2015) suggested that NAFLD embodies a complex relationship between genetic, environmental, and intrinsic factors; therefore, the natural progression of NAFLD is likely modifiable through lifestyle modification and is not a universally progressive condition.

### **Lifestyle Modification**

Vilar-Gomez et al. (2015) conducted one of the first large prospective studies exploring the impact of lifestyle modification on the histologic features of NASH. They followed 293 clinic patients in Havana, Cuba with histologically proven NASH. Mean age of participants was 48.5 years, 59% were women, and average BMI was 31.3. Approximately one-third of participants had T2DM and more than half had hypertension. Of the participants with metabolic syndrome, 63% had at least three components of the syndrome. Patients were encouraged to reduce their weight and placed on a low-fat hypocaloric diet that was 750 kcal/d less than their daily energy requirement. Dietary guidelines were proportionally distributed: carbohydrates 64%, fat 22% with < 10% of saturated fatty acids as part of their total daily caloric intake, and protein 14%. Patients were also encouraged to walk 200 minutes each week. Additionally, all participants received individual counseling sessions every eight weeks to promote compliance. Medications with potential benefit for NASH, such as glitazones and vitamin E, were prohibited during this study. Patients with hyperlipidemia who had not been on previous treatment, whose lipid profiles did not improve after three months of lifestyle intervention, were started on lipid-

lowering agents per guidelines. Baseline and follow-up measurements included age, sex, weight, BMI, waist circumference, laboratory tests (alanine aminotransferase, aspartate aminotransferase, uric acid, cholesterol, triglycerides, fasting glucose, and the Homeostatic Model Assessment of Insulin Resistance Index), and liver biopsies at initiation and at conclusion of study.

After 52 weeks of lifestyle change, paired liver biopsies were available from 261 out of 293 participants. Results showed 72 (25%) attained resolution of steatohepatitis, 138 (47%) had reductions in NAFLD activity scores (NAS), and 56 (19%) demonstrated improvement of fibrosis. By the end of the study, 88 (30%) participants lost  $\geq 5\%$  TBW. Vilar-Gomez et al. (2015) demonstrated improvement in all NASH-related histological parameters independent of the amount of weight loss (odds ratios = 1.1 - 2.0;  $p < .01$ ). However, they did note those with  $\geq 5\%$  loss in TBW were more likely to achieve NASH resolution (51 of 88 [58%]) and a two-point reduction in NAS (72 of 88 [82%]), when compared to those with  $< 5\%$  loss of TBW ( $p < .001$ ). All those with  $\geq 10\%$  loss of TBW had reductions in NAS, 90% achieved resolution of NASH, and 45% demonstrated improved fibrosis. Additionally, participants with risk factors who lost 7% - 10% in TBW also demonstrated reduced NAS. This study also noted a significant reduction in NAS in female participants who lost  $\geq 10\%$  TBW who had a baseline BMI  $\geq 35$ , fasting glucose  $> 5.5$  mmol/L, and many ballooned cells noted with liver biopsy (Vilar-Gomez et al., 2015).

To date, this is one of the largest prospective studies showing empirical evidence supporting weight loss for treatment of NAFLD. Vilar-Gomez et al. (2015) concluded that modest TBW loss of 7% - 10% significantly improved NAFLD activity score. Those with more significant weight loss  $\geq 10\%$  TBW accomplished the highest rates of NASH resolution.

Therefore, in patients with NAFLD who are overweight or obese, lifestyle modification that promotes weight loss is essential to ensuring best clinical outcomes.

Promrat et al. (2010) conducted a randomized control trial (RCT) studying 31 obese patients with NASH. Half were randomly assigned to an intensive lifestyle intervention group and the other half were placed in the control group, receiving basic structured dietary education alone. The intensive lifestyle group had to participate in a hypocaloric diet, behavior modification, and 200 minutes a week of moderate physical activity for 48 weeks. The intervention group had 9.3% weight loss versus 0.2% in the control group. Participants with  $\geq 7\%$  TBW showed greatest improvement in steatosis, lobular inflammation, ballooning, and NAS. Promrat et al. (2010) concluded that lifestyle intervention with diet, behavior modification, and exercise leads to improvement in the histologic features of NASH.

Many studies have recommended dietary modification for treatment of NAFLD, but research is limited in determining if improving diet quality can prevent the development of NAFLD. Ma et al. (2018) conducted a prospective study examining the association between change in diet quality and change in liver fat accumulation and to explore if diet quality modifies genetic risk for NAFLD. This study looked at 1521 participants gathered from the second and third-generation cohorts from the Framingham Heart study. Two diet scores, Mediterranean-style diet score (MDS) and Alternative Healthy Eating Index (AHEI) score, were evaluated to assess for changes in liver fat and new-onset of fatty liver. The Harvard food frequency questionnaire was used to calculate MDS and AHEI scores at both baseline and follow-up. Levels of liver fat were assessed using CT imaging from baseline and at follow-up to calculate liver phantom ratio (LPR). LPR values are inversely related to liver fat. Genetic risk score

(GRS) was calculated by adding together the number of NAFLD-associated risk alleles and the corresponding regression coefficient.

Ma et al. (2018) observed that each standard deviation (SD) serial increase in MDS score from baseline to follow-up showed significant reduction in liver fat accumulation as measured by LPR with a decrease by 0.57 (95% CI 0.27-0.86;  $p < .001$ ). Likewise, for each SD increase in AHEI score the corresponding decline in LPR was 0.56 (95% CI 0.29-0.84;  $p < .001$ ). Both increased MDS and AHEI scores showed a reduction in the development of incidental fatty liver. There was a 26% decline with one SD increase in MDS (95% CI 10% - 39%;  $p = .002$ ) and a 21% decline with one SD increase in AHEI (95% CI 5% - 35%;  $p = .02$ ). Also noted was a significant interaction between GRS and MDS. Among those patients with declining MDS scores from baseline to follow-up, there was a significant association between NAFLD-associated GRS and increased liver fat accumulation ( $p < .001$ ). Likewise, similar results were noted to be significant between GRS and declining MDS ( $p < .001$ ) and AHEI scores ( $p < .001$ ), but not in those participants whose diet improved or remained stable ( $p$  for gene-diet interaction  $< .001$ ).

Ma et al. (2018) concluded that improved eating habits were associated with reduced risk for developing NAFLD. Additionally, it was thought that adopting a healthier diet may abate an individual's genetic predisposition to NAFLD. These associations were largely driven by increased consumption of fruits, vegetables, nuts, legumes, whole grains, EPA and DHA omega-3 fatty acids, and decreased consumption of red meat and trans-fat.

Exercise is known to promote weight loss and has been theorized to improve features of NASH. Houghton et al. (2017) conducted a randomized controlled trial to evaluate the effect of exercise on NASH, independent of dietary change. Twenty-four patients with NASH, as

diagnosed with liver biopsy, who reported a sedentary lifestyle with less than 60 minutes of vigorous activity weekly, were studied to evaluate the benefits of exercise on NASH, irrespective of dietary intervention. Subjects were randomly assigned to the group that exercised ( $n = 12$ ) and the group that continued standard treatment ( $n = 12$ ). The exercise group participated in cycling and strength training supervised by an exercise physiologist for three nonconsecutive days each week for a 12-week period, while maintaining their current weight. Baseline measurements and at 12 weeks included hepatic triglyceride content (HTGC), body mass index, serum inflammatory markers, hepatic fibrosis, and glucose tolerance. The goal of this study was to measure only the effect of exercise on NASH if no dietary changes were made through measurement of HTGC and biomarkers of fibrosis. Measurements obtained at the end of 12 weeks, when compared to baseline measurements, showed significant improvement of HTGC (reduction of  $16\% \pm 24\%$  vs. an increase of  $9\% \pm 15\%$  for controls;  $p < .05$ ), visceral fat (reduction of  $22 \pm 33 \text{ cm}^2$  vs. an increase of  $14 \pm 48 \text{ cm}^2$  for controls;  $p < .05$ ), serum triglycerides (reduction of  $0.5 \pm 1.0 \text{ mmol/L}$  vs. an increase of  $0.3 \pm 0.4 \text{ mmol/L}$  for controls;  $p < .05$ ), and  $\gamma$ -glutamyltransferase (reduction of  $10 \pm 28 \text{ U/L}^{-1}$  vs. a reduction of  $17 \pm 38 \text{ U/L}^{-1}$  for controls;  $p < .05$ ).

Houghton et al. (2017) observed that after 12 weeks of vigorous exercise three days each week, there was a 16% reduction in liver fat, a 12% reduction in visceral fat, a 23% reduction in circulating triglyceride levels, and a 4% increase in lean body mass. Conversely, 12 weeks post-intervention showed no significant effect on glucose control, inflammatory markers, liver enzyme levels, or NAS. This study shows the clinical value of exercise as part of the treatment for NASH, as evidenced with improvement in HTGC and visceral fat. However, exercise without weight loss affects some, but not all, factors with NASH. Therefore, treatment of

NAFLD and NASH needs to include exercise with weight management strategies to optimize long-term health outcomes.

Lifestyle change can be difficult for some to achieve and maintain. Social support has been shown to significantly improve adherence to lifestyle change, while the absence of social support has been associated with less favorable outcomes (Middleton et al., 2013). Research has also suggested that patients who did not have practical social support were twice as likely to fail to maintain lifestyle change, compared to those who did (DiMatteo, 2004). Additionally, patients who were recruited along with family and friends for weight management regained 0.1 kg at their six-month follow up, while patients recruited alone regained 1.6 kg (Middleton et al., 2013). Group support has also shown improved outcomes when compared to individual treatment. Group cohesion augments the effectiveness of treatment and promotes compliance with diet and physical activity through enhancing participants' perceived ability to comply with behavior change and navigate barriers to long-term change (Middleton et al., 2013).

### **Summary**

NAFLD, the hepatic expression of metabolic syndrome, has risen to be the leading cause of liver disease worldwide and is associated with increased risk for diabetes and heart disease (Vilar-Gomez, 2015). Several studies have evaluated the impact of diet on NAFLD, and a fair amount of these incorporate exercise and weight loss for treatment and disease reversal. However, few assess or even address the impact of social connection and support, failing to recognize the importance of connecting mind, body, and spirit in order to optimize long-term clinical outcomes. As research has demonstrated, treatment for NAFLD requires lifestyle modification that incorporates weight loss with improved diet quality, exercise, and social support to ensure best patient outcomes. The purpose of this project was to demonstrate



improvement in NAFLD utilizing lifestyle intervention that incorporates a holistic approach, through improved dietary habits, regular exercise, and social support amongst peers.

## **Chapter 3**

### **Methodology**

As stated previously, new approaches in lifestyle modification are needed to improve outcomes in patients with NAFLD. The purpose of this study was to demonstrate improvement in NAFLD through lifestyle intervention with 1) a Mediterranean diet, high in fiber and low in saturated fat, 2) moderate exercise by walking 90 minutes per week, and 3) social support group meetings once monthly over a six-month period. It is hoped that this study will also lead to improved long-term health outcomes in patients with NAFLD, as well as augmenting additional research in the treatment of NAFLD.

#### **Design**

This quantitative study utilized a quasi-experimental research design to establish a cause-effect relationship between lifestyle modification, as demonstrated through improved diet, regular exercise, and social support, and how those variables impact NAFLD. Control groups and randomization were not utilized for this study.

#### **Study Participants**

Twenty study participants were recruited from a gastroenterology practice in Southeast Tennessee. Inclusion criteria was a diagnosis of NAFLD/NASH with fibrosis ranging from stage F0 to F3 as determined from hepatic ultrasound and Echosens FibroMeter. This study did not discriminate based on age, sex, or ethnicity. Participant exclusions included those with cirrhosis, prior history of alcohol/drug dependence, refusal to abstain from alcohol consumption throughout the course of this study, viral hepatitis, pre-existing medical conditions preventing participation in walking, and autoimmune liver disease.

## **Ethical Considerations**

Institutional review board (IRB) approval was obtained prior to implementation. Risk to human subjects was limited based on the Six Aims for Healthcare Improvement (IOM, 2001), which states that research and healthcare improvement should be safe, effective, patient-centered, timely, efficient, and equitable.

Safety for participants was demonstrated by avoiding injuries from care intended to help. There were no invasive procedures associated with this study, other than venipuncture for monitoring serological response to interventions. Services provided over the course of this study were based on scientific knowledge and current clinical guidelines, as outlined throughout this paper. Participants were determined based on a diagnosis of NAFLD and participation was only offered to those who would benefit from participating in this study. Care was patient-centered, respectful, and responsive to individual preferences and needs. Participant values guided all clinical decisions, and services provided were timely. There were no interventions that could result in harm related to delays in care. Care was efficient, avoiding waste of equipment, supplies, and energy. All health outcomes were evaluated based on current American Association for the Study of Liver Diseases (AASLD) clinical guidelines. Finally, care was equitable to all participants and did not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, or socioeconomic status.

## **Intervention**

Participants were provided with recommendations for lifestyle modification and followed for six months. The dietary interventions consisted of a Mediterranean diet which was primarily a plant-based diet including vegetables, fruits, nuts, legumes, whole grains, and nuts. Butter and animal fat were replaced with healthier fats, such as olive oil and canola oil. Participants were

encouraged to limit sodium and use more herbs and spices to flavor their food. Red meat was replaced with fish and poultry and limited to twice a week. Participants were also asked to drink a minimum of 64 ounces of water each day. Additionally, participants agreed to walk a minimum of 90 minutes a week and attend a total of six support group meetings.

### **Description of Measures**

A multiple linear regression model was utilized to predict percent of TBW loss based on three independent variables: adherence to a Mediterranean diet, walking 90 minutes each week, and participating in six social support group meetings over a six-month period. Multiple linear regression predicts a continuous dependent variable based on multiple independent variables. It also allows for determination of the overall fit, explaining variance of the model and the relative contribution of each of the predictors to the total variance explained (Laerd Statistics, 2019).

A logistic regression model was used to predict improved ultrasound outcome based on two independent variables, adherence to following a Mediterranean diet and adherence to walking, over a six-month period of time. Logistic regression predicts the probability that a dichotomous dependent variable can be explained by one or more independent variables that are either continuous or categorical (Laerd Statistics, 2019).

Initial measurements included height, weight, BMI, blood pressure, liver function tests, fasting lipid panel, hepatic ultrasound, and Echosens FibroMeter. These same measurements were repeated at the conclusion of this study and a Wilcoxon signed-rank test was utilized to ascertain if there was a median difference between paired, pre-intervention and post-intervention observations. Outcomes were measured by five percent TBW loss, improved hepatic steatosis as measured by hepatic ultrasound (obtained at baseline and repeated at six months), and improved

fibrosis staging through measurement of Echosens FibroMeter (obtained at baseline and repeated at six months). The findings were considered statistically significant if  $p < .05$ .

### **Data Analysis Procedures**

Utilizing IBM SPSS ® 26 software, the data collected in this quasi-experimental quantitative study was evaluated using multiple linear regression to predict the percent in TBW loss and for patients with NAFLD based on three independent variables; adherence to a Mediterranean diet, walking 90 minutes each week, and participating in six social support group meetings over a six-month period. Participant compliance for adherence to diet, exercise, and group meetings was measured using a Likert scale (0 = never, 1 = less than half of the time, 2 = at least half of the time, and 3 = always). Outcomes were measured using nominal variables, 1) 5% TBW loss (0 = no, 1 = yes), 2) improved hepatic steatosis as measured by ultrasound (0 = no, 1 = yes), 3) improved fibrosis staging through measurement of Echosens FibroMeter (0 = no, 1 = yes).

This study met the eight assumptions required for multiple linear regression. These assumptions must be met in order to determine accuracy of predictions, which tests how well the regression model fits the data, thereby determining the variation in the dependent variable explained by the independent variables, and testing the hypotheses on the regression equation (Laerd Statistics, 2019).

Assumption one, there was a continuous dependent variable, NAFLD. Assumption two, there were three independent variables: Mediterranean diet, walking 90 minutes each week, and participating in six social support group meetings. Assumption three, independence of observations, was checked using the Durbin-Watson statistic. Assumption four, a scatterplot of the standardized residuals against the unstandardized predicted values, demonstrated a linear

relationship between the dependent variable and each of the three independent variables.

Additionally, a partial regression plot shows that a linear relationship existed between NAFLD and each of the independent variables. Assumption five, homoscedasticity of residuals and equal error variances, was checked by plotting the studentized residuals against the unstandardized predicted values. Assumption six, was met because the data did not show multicollinearity through inspection of correlation coefficients and Tolerance/VIF values. Assumption seven, no significant outliers with high leverage or influential points, was determined utilizing Cook's Distance. Lastly, assumption eight, normal distribution, was checked using a histogram with superimposed normal curve and a P-P Plot.

A logistic regression model was used to predict improved ultrasound outcome based on two independent variables, adherence to following a Mediterranean diet and adherence to walking, over a six-month period of time. Additionally, a Wilcoxon signed-rank test was utilized to ascertain if there was a median difference between paired, pre-intervention, and post-intervention observations of weight, BMI, blood pressure, fasting lipid panel, hepatic ultrasound, and fibrosis score.

## Chapter 4

### Analysis of Results

This study used multiple linear regression to predict the percent in TBW loss for patients with NAFLD based on three independent variables: adherence to a Mediterranean diet, walking 90 minutes each week, and participating in six social support group meetings over a six-month period. A logistic regression model was used to predict improved ultrasound outcome based on two independent variables, adherence to following a Mediterranean diet and adherence to walking. Additionally, measurements for weight, blood pressure, fasting lipid panel, hepatic ultrasound, and fibrosis score were measured pre- and post-intervention, and a Wilcoxon signed-rank test was utilized to ascertain if there was a median difference between paired observations. Outcomes were measured by 5% TBW loss, improved hepatic steatosis as measured by hepatic ultrasound, and improved fibrosis staging, as measured by Echosens FibroMeter.

### Participation and Demographic Characteristics

Participants were recruited from a gastroenterology practice in Southeast Tennessee, with a diagnosis of NAFLD/NASH, fibrosis ranging from stage F0 to F3. They were followed for six months and asked to adhere to a Mediterranean diet, walk a minimum of 90 minutes a week, and attend a total of six support group meetings.

Ages of participants ranged from 18 to 78 with a mean of 53.55 years. Gender was comprised of 85% female ( $n = 17$ ) and 15% male ( $n = 3$ ). Eighty-five percent of participants were Caucasian ( $n = 17$ ), 10% African American ( $n = 2$ ), and 5% Hispanic ( $n = 1$ ). Ninety percent ( $n = 18$ ) achieved 5% TBW loss and 10% ( $n = 2$ ) did not. The demographics and contributing variables of group participants have been depicted in Appendix A.

Compliance with diet, walking, and group meeting attendance was measured using a Likert scale questionnaire, depicted in Appendix D. Fifty-five percent ( $n = 11$ ) reported always following the diet, 40% ( $n = 8$ ) at least half of the time, and 5% ( $n = 1$ ) less than half the time. Sixty percent ( $n = 12$ ) reported walking 90 minutes each week, 35% ( $n = 7$ ) walked at least 45 minutes each week, and 5% ( $n = 1$ ) reported not walking. Eighty percent ( $n = 16$ ) of participants attended all six group meetings, 15% ( $n = 3$ ) attended at least three meetings, and 5% ( $n = 1$ ) never attended a meeting. Ninety five percent ( $n = 19$ ) achieved normal LFTs and 5% ( $n = 1$ ) did not, see Appendix A.

### **Analysis**

A multiple regression was run to predict percentage of TBW loss from adherence to a Mediterranean diet, minutes walked each week, and group meeting attendance. The multiple regression model statistically significantly predicted percentage of TBW loss,  $F(3, 16) = 6.355$ ,  $p = .005$ ,  $R^2 = .54$ . Diet adherence was statistically significant to the prediction of percentage of TBW loss,  $p = .006$ . However, minutes walked each week,  $p = .313$ , and group meeting attendance,  $p = .210$ , were not statistically significant to the prediction of percentage of TBW loss, see Appendix B.

A logistic regression analysis was performed to investigate the effects of diet adherence and walking adherence on ultrasound outcome. Both predictor variables, diet adherence and walking adherence, were tested a priori to verify that there was no violation of the assumption of the linearity of the logit. The logistic regression model was not statistically significant. Neither variable was found to contribute to the model. However, participants with greater diet adherence were 1.75 times more likely to have a positive ultrasound outcome, with improved fibrosis, see Appendix C.



A Wilcoxon signed-rank test was conducted to determine what effect adhering to a Mediterranean diet, walking 90 minutes each week, and attending six support group meetings would have on hepatic ultrasound imaging, fibrosis score, weight, SBP, DBP, and triglycerides. Pre-test and post-test variables were measured in each category. A histogram was used to assess for normal distribution. As demonstrated in Table 1, there were no statistically significant results and no median difference in the pre-intervention and post-intervention ultrasound imaging ( $Z = -0.69, p = 0.49$ ). However, fibrosis, weight, BMI, SBP, DBP, and triglycerides showed a statistically significant median decrease in pre-intervention and post-intervention testing.

**Table 1**

*Results of the Wilcoxon Signed-Rank Test Determining the Effect of a Mediterranean Diet, Walking 90 Minutes Each Week, and Support Group Meetings on the Variables Listed*

Variable	Pre-test		Post-test		Wilcoxon-Signed Rank Test	
	M	SD	M	SD	<i>z</i>	<i>p</i>
Ultrasound	.40	.50	.05	.22	-.69	.49
Fibrosis	2.15	.75	.65	.93	-3.91	.000
Weight	234.05	35.24	212.55	31.46	-3.92	.000
BMI	37.22	5.16	33.78	4.65	-3.92	.000
SBP	136.20	18.30	127.00	15.09	-3.40	.001
DBP	84.00	9.36	77.60	7.10	-2.93	.003
Triglycerides	169.60	79.20	107.45	39.46	-3.92	.000

### Summary of Findings

A thorough analysis of this study's findings revealed that 90% of participants achieved 5% TBW loss, with a statistically significant TBW loss, and reduced BMI. Diet adherence was shown to be statistically significant to the prediction of percentage of TBW loss. However,

minutes walked each week, and group meeting attendance were not statistically significant to the prediction of percentage of TBW loss. With regard to ultrasound outcomes, diet adherence and walking adherence were not found to be statistically significant; still, diet adherence was noted to make a person 1.75 times more likely to have a positive ultrasound outcome, with improved fibrosis. Improved post-intervention fibrosis scores, measured by Echosens FibroMeter, were found to be statistically significant.

### **Dissemination of Findings**

The data generated from this study will expound on the effect weight loss and exercise has on NAFLD. This relatively small study, following 20 participants over a six-month period, demonstrates the impact lifestyle behavior change has on slowing the disease progression of NAFLD and serves to promote additional research on a larger patient population for an extended period of time to demonstrate the long-term health outcomes of lifestyle intervention on NAFLD.

It is the intent of the investigator to disseminate the findings of this study to Southern Adventist School of nursing faculty and students. Publication in peer reviewed nursing journals is planned. This study can serve as a model for future studies to expand the knowledge and understanding of the impact lifestyle medicine has on the treatment of NAFLD and advance current clinical guidelines.

## **Chapter 5**

### **Discussion**

NAFLD is the most common liver disease worldwide (Bellentani, 2017). It is regarded as the liver component of metabolic syndrome. It is characterized by steatosis which is the hepatic accumulation of triglycerides. Women are at greatest risk, typically peaking in the fifth or sixth decade of life (Andronescu et al., 2018). NAFLD affects approximately 30% of the United States population, with 5% progressing to the more aggressive form of the disease, NASH. NASH can eventually progress into cirrhosis, which was the 11<sup>th</sup> leading cause of death in 2017 in the United States (Kochanek et al., 2019). Cirrhosis resulting from NASH is predicted to be the leading indication for liver transplantation in the United States (Corey & Chalasani, 2014). Pharmacologic therapies have failed to provide long-term improvement (Worcester, 2014).

While diet and exercise have been recognized as treatment strategies for diabetes and cardiovascular disease, research is limited regarding such recommendations for treatment of NAFLD. Though several studies evaluate the impact of diet on NAFLD and a fair amount of these incorporate exercise and weight loss, few assess or even address the impact of social connection and support, failing to recognize the importance of connecting mind, body, and spirit in order to optimize long-term clinical outcomes.

The purpose of this study was to demonstrate improvement in NAFLD through lifestyle intervention, leading to improved long-term health outcomes in patients with NAFLD, as well as augmenting research on the treatment of NAFLD. This led to the clinical question: In patients with NAFLD, does 1) adherence to a Mediterranean diet, 2) moderate exercise with walking 90 minutes per week, and 3) social support group meetings once monthly over a six-month period

show disease improvement? Outcomes were measured by 1) 5% TBW loss, 2) improved hepatic steatosis as measured by ultrasound, and 3) improved fibrosis staging.

This study consisted of 20 participants ranging from 18 to 78 years of age, with a mean of 53.55 years. Study participants were 85% female, 15% male, 85% Caucasian, 10% African American, and 5% Hispanic. This is consistent with observations by Andronescu et al. (2018) that NAFLD peaks between the ages of 50 to 60 years and that women are at greater risk for developing NAFLD. Out of the 20 participants, 55% reported always following dietary guidelines and 40% reported following at least half of the time; 60% walked 90 minutes each week and 35% reported walking at least 45 minutes each week; 80% attended all six group meetings, and 15% attended at least half of the meetings.

Ninety percent of participants achieved 5% TBW loss and 95% were noted to have normal LFTs at the end of the six-months. Comparing pre- and post-intervention measurements, there was a statistically significant improvement in fibrosis score, weight, BMI, BP, and triglycerides. However, ultrasound results did not show any statistically significant improvement. Diet adherence was the best prognosticator for percentage of TBW loss, while walking and support group meeting attendance were not found to be significant predictors for percentage of TBW loss. Likewise, neither diet adherence nor walking were statistically significant predictors of positive ultrasound findings. However, this study did show that participants who followed a Mediterranean diet were 1.75 times more likely to have positive ultrasound outcomes.

Outcomes measured by 5% TBW loss and improved fibrosis staging measured through Echosens FibroMeter were met, supporting the findings by Vilar-Gomez et al. (2015) who noted TBW loss of 7% - 10% significantly improved NAFLD activity score. However, this study

failed to meet improved hepatic steatosis as measured by ultrasound. Adhering to a Mediterranean diet was the best indicator for outcomes, while walking and support group meetings did not yield statistically significant findings. It is also important to acknowledge that, while this study did not yield statistically significant findings in all three of the independent variables for predicting outcomes, clinical significance warrants consideration. Out of 20 participants, 18 lost 5% of their TBW, 19 had normal LFTs at the end of six months, and serum fibrosis staging measured by Echosens FibroMeter did show statistically significant improvement. Factors that need to be considered are the small size of this study and participant recall when answering the End of Study Participant Questionnaire. This was a small, underpowered pilot study that lays the groundwork for a larger scale study to further explore the impact of lifestyle medicine in the treatment of NAFLD.

### **Limitations and Future Research**

Several limitations were identified in this study. Study participants were disproportionately Caucasian females. Participant recall is more likely to be skewed over time, making it difficult to accurately account for adherence to interventions. Length of the study may not have been long enough to obtain post-intervention hepatic ultrasound imaging to yield meaningful results. Finally, this study was too small to accurately measure the power of the independent variables to predict the outcome of the dependent variables.

Future studies should include a larger population, 100 or more participants, to include more diverse ethnic groups and gender distribution. Additionally, study participants need to be followed over a longer period of time, one year or more, to better measure long-term outcomes and further explore the impact lifestyle medicine has in the treatment of NAFLD. Future research on this topic should employ a multi-disciplinary team approach that includes a medical

provider who is well versed in lifestyle medicine, a dietician, an exercise therapist, and a lifestyle coach. In doing so, diet and exercise can be more individualized, and study participants would benefit from lifestyle coaching, both individually and in a group setting.

### **Implication for Advanced Practice Nursing**

NAFLD and NASH affects approximately 30% of Americans. It is estimated that almost 100 million people living in the United States are living with NAFLD (“Liver Disease Statistics-American Liver Foundation,” 2018). There are no current clinical guidelines that recommend screening for NAFLD. Typically, patients are asymptomatic and NAFLD and NASH are incidental findings when imaging is done for other reasons or when a patient’s liver chemistries are elevated and imaging of the liver is ordered. As the number of patients diagnosed with NAFLD continues to rise, NPs can expect to treat numerous patients with this disease. It is vital for NPs to understand the prognosis of NAFLD and NASH, and how to optimize treatment for their patients. This disease can be effectively treated, and for most, eliminated with lifestyle modification. However, if changes are not made, patients with NAFLD and NASH are at a much greater risk for development of cirrhosis.

This study validates the principles of lifestyle medicine for the treatment of NAFLD and endorses future research on a larger scale over a longer period of time, so that the long-term benefits and patient outcomes may be measured and better understood. NPs are in a unique position to stand out as leaders in research, studying the impact lifestyle medicine has on chronic disease, particularly NAFLD. The knowledge gained from this research will help shape and advance current clinical guidelines.

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## Appendix A

### Demographics

**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
age of participant	20	18	78	53.55	16.230
Valid N (listwise)	20				

**female or male**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	female	17	85.0	85.0	85.0
	male	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

**Participant Race**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Caucasian	17	85.0	85.0	85.0
	African American	2	10.0	10.0	95.0
	Hispanic	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

**5% TBW Loss**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes 5% TBW loss	18	90.0	90.0	90.0
	No %5 TBW loss	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

**Post LFTs improved**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	normal	19	95.0	95.0	95.0
	abnormal	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

**Diet adherence**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than half the time	1	5.0	5.0	5.0
	at least half the time	8	40.0	40.0	45.0
	always	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

**Minutes walked each week**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never	1	5.0	5.0	5.0
	at least 45 min each week	7	35.0	35.0	40.0
	90 min each week	12	60.0	60.0	100.0
	Total	20	100.0	100.0	

**Group meeting attendance**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never	1	5.0	5.0	5.0
	at least 3 meetings	3	15.0	15.0	20.0
	all 6 meetings	16	80.0	80.0	100.0
	Total	20	100.0	100.0	

## Appendix B

### Multiple Regression

**Model Summary<sup>b</sup>**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.737 <sup>a</sup>	.544	.458	3.68358	1.771

a. Predictors: (Constant), Group meeting attendance, Minutes walked each week, Diet adherence

b. Dependent Variable: % TBW loss

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	258.700	3	86.233	6.355	.005 <sup>b</sup>
	Residual	217.100	16	13.569		
	Total	475.800	19			

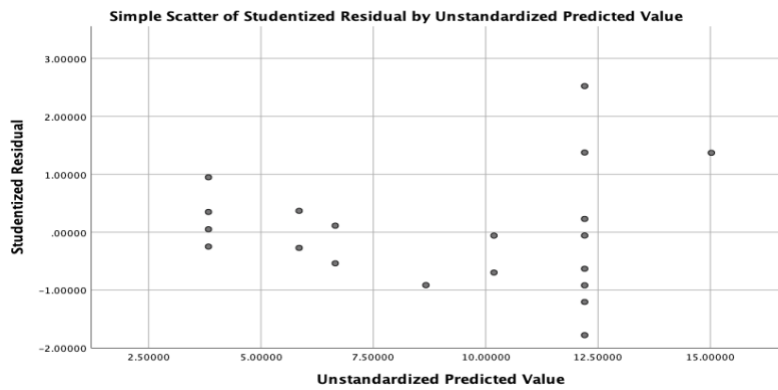
a. Dependent Variable: % TBW loss

b. Predictors: (Constant), Group meeting attendance, Minutes walked each week, Diet adherence

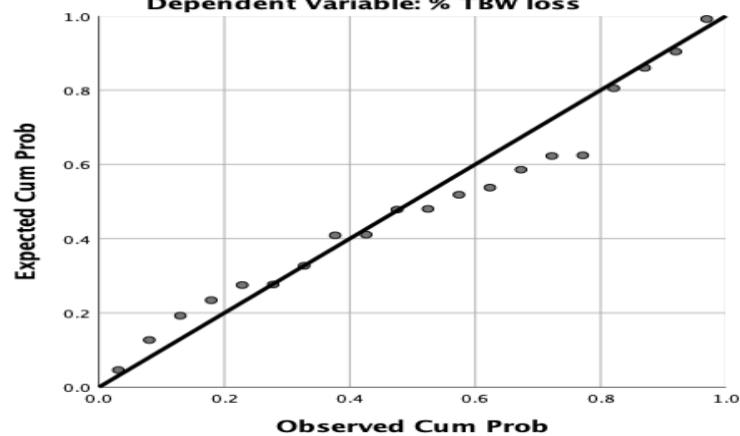
**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF	
1	(Constant)	1.105	4.474		.247	.808	-8.379	10.589						
	Diet adherence	6.352	1.988	.648	3.196	.006	2.139	10.566	.678	.624	.540	.694	1.441	
	Minutes walked each week	2.017	1.935	.203	1.043	.313	-2.084	6.119	.498	.252	.176	.755	1.324	
	Group meeting attendance	-2.822	2.163	-.231	-1.305	.210	-7.407	1.764	-.015	-.310	-.220	.906	1.103	

a. Dependent Variable: % TBW loss



**Normal P-P Plot of Regression Standardized Residual**  
Dependent Variable: % TBW loss



## Appendix C

### Logistic Regression

**Variables in the Equation**

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 <sup>a</sup>	Diet adherence - 2 groups	.563	1.074	.275	1	.600	1.756	.214	14.405
	Walking adherence 2 groups	-.107	1.087	.010	1	.921	.898	.107	7.564
	Constant	-1.114	1.786	.389	1	.533	.328		

a. Variable(s) entered on step 1: Diet adherence - 2 groups, Walking adherence 2 groups.

**Appendix D****End of Study Participant Questionnaire**

**Name:** \_\_\_\_\_

**Please circle the most appropriate response:**

**A. How often did you follow the Mediterranean diet:**

**0=Never**

**1=Less than half of the time**

**2=At least half of the time**

**3=Always**

**B. How many minutes did you walk each week (use your judgement to make an estimate):**

**0=Never**

**1=Less than 45 minutes each week**

**2=At least 45 minutes each week**

**3=90 minutes each week**

**C. How often did you attend monthly support group meetings (6 total):**

**0=Never**

**1=Less than 3 meetings**

**2=At least 3 meetings**

**3=Attended all 6 meetings**

*\*\*\*This questionnaire is intended to help evaluate the effectiveness of the interventions used for this study.*

## **Appendix E**

### **End of Program Student Learning Outcomes and the Graduate Essentials**

There are eight DNP essentials required for advanced nursing practice and completion of a scholarly project. These include: I. Scientific Underpinnings for Practice; II. Organizational and Systems Leadership for Quality Improvement and Systems Thinking; III. Clinical Scholarship and Analytical Methods for Evidenced-Based Practice; IV. Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care; V. Health Care Policy for Advocacy in Health Care; VI. Interprofessional Collaboration for Improving Patient and Population Health Outcomes; VII. Clinical Prevention and Population Health for Improving the Nation's health; and VIII. Advanced Nursing Practice.

In addition to the eight DNP essentials, Southern Adventist University (SAU) has eight student learning outcomes (SLO) that each scholarly project must satisfy for completion. These SLOs are as follows: I. Cultural Competence; II. Evidence-Based Practice; III. Health Promotion; IV. Patient-Centered Care; V. Quality and Safety; VI. Informatics and Innovation; VII. Teamwork and Collaboration; and VIII. Professionalism.

The DNP essentials and SAU SLOs are very similar. Each requires the nurse practitioner (NP) to conduct a scholarly project that exemplifies what they have learned in advanced nursing practice, while utilizing nursing science integrated with knowledge from ethics, biophysical, psychosocial, analytical, and organizational sciences. Both also require the NP to collaborate with other members of the health care team to meet the needs of their patients while advancing nursing practice and practice guidelines. Additionally, both require a professional and ethical approach to care while being culturally sensitive to all those served by the NP.

### **The Eight Essentials of Doctoral Education for Advanced Nursing Practice**

The following outlines how this scholarly project fit the Essentials of Doctoral Education for Advanced Nursing Practice.

I. Scientific Underpinnings for Practice. Through positive lifestyle changes, this study promoted the well-being and optimal function of those with NAFLD. Through the actions of the NP, participants learned about NAFLD and current treatment guidelines. Participants gained improved health status as they improved their diet and physical activity. They also received support from the NP, as well as others with NAFLD as they learned new lifestyle skills for management of this disease. Additionally, this scholarly project provided further evidence for the importance of Lifestyle Medicine in the management of chronic disease and promotes the development of new practice approaches based on current guidelines as recommended by the AGA and the AASLD.

II. Organizational and Systems Leadership for Quality Improvement and Systems Thinking. This was exemplified through delivery of care to patients that promoted overall health improvement. It incorporated principles of lifestyle medicine with nursing knowledge and current practice guidelines.

III. Clinical Scholarship and Analytical Methods for Evidenced-Based Practice. An extensive literature review was conducted using CINAHL and the AGA. There were 14 studies reviewed, between the dates of 2004-2018. Analytical methods were utilized to critically evaluate current literature to determine and implement the best evidence for practice. Utilization of these guidelines integrated with lifestyle medicine was used to formulate and advance practice guidelines.

IV. Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care. Appropriate health care technology was utilized throughout this project, examples include: utilization of the electronic medical record, conducting research for this project, and diagnostics required for evaluating outcomes of lifestyle interventions.

V. Health Care Policy for Advocacy in Health Care. NAFLD has the propensity for progression into cirrhosis. Current clinical guidelines do not recommend routine screening for NAFLD in at risk populations. This study is intended to add to current research showing the impact lifestyle medicine has on improving NAFLD and preventing cirrhosis. As we expand our understanding of the treatment and management of NAFLD, research such as this can serve as a catalyst for policy change.

VI. Interprofessional Collaboration for Improving Patient Population Health Outcomes. This study seeks to implement lifestyle medicine into practice guidelines for the treatment of NAFLD and calls for routine screening for at risk populations. This can be accomplished through interprofessional collaboration utilizing peer review, collaborative efforts to design practice guidelines, health policy, and standards of care.

VII. Clinical Prevention and Population Health for Improving the Nation's Health. NAFLD can be reversed, as long as it has not advanced to cirrhosis. This study utilized lifestyle medicine to affect positive outcomes in patients with NAFLD. These principles can be used to improve the health of the community, particularly those patients who are uninsured or underinsured through community-based education opportunities.

VIII. Advanced Nursing Practice. This study promotes the advancement of nursing practice by demonstrating care based on nursing science, integrated with sciences from other disciplines. This study demonstrated advanced levels of clinical judgement, systems thinking,



and accountability in design, delivering, and evaluating evidenced-based care to improve patient outcomes. Additionally, information learned from this study can be used by other NPs to improve nursing practice.

### **Southern Adventist Student Learning Outcomes**

The following outlines how this study meets the eight SAU SLOs for advanced nursing practice.

I. Cultural Competence. This scholarly project was open to participants from varying ethnic backgrounds and did not discriminate based on color, ethnicity, gender, or socioeconomic status. Additionally, this research was respectful of cultural customs when working within a diverse patient population.

II. Evidence Based Practice. Current research and literature has been critically evaluated to determine and implement the best evidence for practice. Utilization of current clinical guidelines integrated with lifestyle medicine has been used to formulate the guidelines and treatment interventions outlined in this study.

III. Health Promotion. NAFLD can be reversed for most patients, as long as it has not advanced to cirrhosis. This study utilized lifestyle medicine to affect positive change in patients with NAFLD leading to weight reduction and improved fibrosis staging.

IV. Patient Centered Care. Participants had improved health status through delivery of patient centered care that promoted overall health and wellbeing. It incorporated Lifestyle Medicine, utilizing principles from the Neuman Systems Model and CREATION Health Model along with nursing knowledge and current practice guidelines.

V. Quality and Safety. Quality and safety concerns exist with regard to progression of fibrosis, rather than improvement. Quality of care was maintained through utilizing current

practice guidelines while seeking to expand on these through incorporating principles of lifestyle medicine into the treatment of NAFLD. Risk to the patient was minimal, as invasive procedures were limited to venipuncture.

VI. Informatics and Innovation. Examples of how informatics was used within this study include, utilization of the electronic medical record (ensuring all patient information was protected as required by HIPPA), and conducting internet-based research for this project. Diagnostics, such as ultrasound and lab analysis, were used for evaluating outcomes of lifestyle interventions. Additionally, SPSS was used for analysis of data collected from this scholarly project.

VII. Teamwork and Collaboration. This scholarly project required an extensive collaborative team, demonstrating teamwork in identifying potential study participants, advising, lab/diagnostic collection and analysis, and dissemination of information. Additionally, SON mentors and faculty provided valuable critique and guidance for this project.

VIII. Professionalism. Professionalism was demonstrated through honoring and respecting the right to self-determination of each study participant, and promoting self-efficacy while guiding them toward improved health.