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Benefits of Fasting in Adults Long Term

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Benefits of Fasting to Help Reduce Blood Pressure/Sugar in Adults Long Term

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Author Note

I dedicate this paper to Dr. Harris, who guided me through this process and gave me the best insight. I also dedicate this to my Father (Lee Jones Sr.) , Mother (Claudia Jones) and Brother (Lee Jones Jr.) for believing in me and always supporting me in my studies. I wouldn't be where I am today without the love and support my family has given me.

Abstract

In nursing education, we are often taught that through diet, exercise and medications one is able to live a healthy life. Fasting is not a subject that readily comes to mind as a way to prevent chronic illnesses from occurring. However, for years, cultures have used fasting as a way to replenish themselves and to clean themselves as if they were new beings. Nursing education does not highlight the process of fasting in any way close to the extent that medications are prescribed to control illnesses.

There are many types of fasting that are used in the United States. Fasting is not a new topic but is not talked about enough in the healthcare field. If one is able to show concise, relevant, up-to-date evidence that fasting can lead to substantial improvement in well-being and health then that has the potential to change society. There could be less stress in society when it comes to having to pay for medications or surgeries that occur as a result of chronic illnesses. Ultimately, fasting has the potential to create a healthier society. It is imperative that alternate methods of controlling chronic illnesses are studied to ensure that the health of our society is promoted.

If society continues to use the same techniques that do not fully work, the result likely will be an endless cycle of backsliding. However, if different methods are used, it could be a game-changer for the fields of medicine and nursing. The future is changing and it could very well start with fasting.

This thesis contains a review of the research literature related to fasting and a proposal for further study.

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Introduction /Problem Statement

According to the United States Centers for Disease Control (CDC), “Nearly half of the adults in the United States have hypertension defined as systolic pressure greater than or equal to 130 mmHg and diastolic pressure greater than or equal to 80 mmHg" (CDC, 2021 para.1). Also, according to the CDC, “10.5 % of the U.S. population has diabetes.” Prediabetes is defined as “ a fasting blood glucose level 100 to 125 mg/dl” (CDC, 2021 para. 1). Meanwhile, Diabetes is defined as “A fasting blood glucose level of 126 mg/dl or higher" (CDC, 2021 para. 1). These are two major issues that are impacting society every day. In Nursing Education, nurses are taught ways to prevent both hypertension and adults is through diet and exercise. However, the rate of diabetes and high blood pressure is still an ongoing issue that people are facing. New methods of prevention are needed in order for the future of society to improve. Changes must be made in order for progress to be made.

Fasting is not a new concept. In fact, is has been used in specific cultures for decades such as seen in Christianity and Muslim religions. Ramadan is a fasting that occurs from the hours of sunrise to sunset for 30 days. Ramadan Fasting requires the abstinence of food and water during these hours. Scientists in 2018 made a discovery where they learnt that fasting “can regenerate an entire immune system” in as little as three days (study by Valter Longo at the University of Southern California, Leonard Davis School). At the University of Southern California, scientists found through a six month study a process that essentially starving the body for a brief period of time kicked stem cells into producing white blood cells , which are essential in fighting off infections. If fasting is able to regenerate stem cells, what else can it do for the

human body? This paper will explore the effects of fasting in blood glucose and blood pressure management which are two illnesses that are impacting a large portion of America today.

Research Question

What Kind of Fasting, if any, could lead to a healthier lifestyle including long-term reduction of blood glucose and reversal of hypertension in adults?

Literature Review

This literature review was explored using the database, UpToDate, through the Dominican University of CA library. Articles were also found through Pubmed.gov. Six research articles outlining studies to show effects of fasting on either blood sugar or Blood pressure were found and used to create the literature review of this paper. A combination of keywords used in the search for research include: fasting; blood pressure; blood glucose; chronic illness. All articles used demonstrate that effects fasting has on blood glucose and blood pressure parameters.

The literature review of this paper will be divided into four sections: The first section investigated effects of "Daily Caloric Deficit," the second section investigated effects "Intermittent Fasting," the third section looked at "Alternate Day Fasting," and the fourth section compared "Daily Calorie Deficit Vs Alternate Day Fasting."

Daily Caloric Deficit

In the study, “Effects of intensive dietetic interventions on weight and glycemic control in overweight men with type II diabetes: a randomized trial”, the aim was to “investigate the

effectiveness of methods for dietary prescriptions on glycemic control and weight management in overweight men with type II diabetes" (Ash et al , 2003 p. 798). The study conducted was a randomized clinical trial that took place within 12 weeks. The participants were randomized and underwent a two-week clinical dietary stabilization prior to the study. This study falls under the category of daily caloric deficit since participants were divided into three groups and all the diets were isocaloric averaging 6000-700 kj/day (1400-1700 Kcal/day). The three categories consisted of "Intermittent energy restriction, pre-portioned meals, and self-selected meals". (Ash et al, 2003 p.799). The study consisted of 51 men with type 2 diabetes and featured a mean average of 54 years old. The population was recruited through newspaper advertisements. The mean body index was 71.7 kgm2. Weight, waist circumference, Glycaemic control and blood lipids were measured in this study. Results for this study showed that there was a significant mean reduction in HbA1C of 1.0±1.4 % after 12 weeks (Ash et al, 2003 p. 800). Also, "triglyceride levels significantly reduced by 0.3 ± 0.6 mmol/l at the end of the intervention" (Ash et al, 2003 p. 801). The study showed that there was a positive effect on glycemic control within the moderate caloric restriction that took place within the 12 weeks. Limitations of this study included results after the follow-up. There was an 18-week follow-up where clinical outcomes were measured. The HBA1C was similar to baseline levels after the 18 weeks which suggests that more research needs to be conducted in order for these results to be explained. Another limitation was that the subjects were not informed about the follow-up and therefore some of the subjects were unable to be contacted for the follow up.

The Study "Blood Pressure Changes in 1610 subjects with and without Antihypertensive Medication During Long-Term Fasting", Grundler et.al (2020) aimed to study daily blood pressure changes during fasting periods ranging from 4 to 41 days. There was a cohort of 1610

subjects and 377 consisted of hypertensive medicated individuals. The age range was between 18-99 years. The minimal fasting period was four days and the subjects were obligated to stay at the BWC during the period of restriction. This study falls in the category of daily caloric deficit because of 250 Kcal daily intake the subjects completed. During the fasting period, weight and stress were documented and a well-being index was given. Subjects were divided into three groups: normotensive non medicated (BP less than 140.90 mmhg), HTNM(BP greater than or equal to 140/90 mmhg) , and HTM, either normotensive or still hypertensive. Daily supervision from nurses were conducted and BP /Pulse were measured by trained nurses every morning between 7 am and 9 am. Subjects also reported daily well-being under nurse supervision. Baseline blood samples were collected at the start of the stay and statistical analysis was "performed using R on a Macbook Pro" (Grundler; et al 2020, p. 2). Results showed that BP mean values decreased from " 126.2 ± 18.6/81 ±11.0 to 119.7 ±15.9/77.6 ±9.8 mmhg" (Grundler; et al 2020 p. 8). Also, in the normotensive group, " BP decreased moderately by 3.0/1.9 mmhg". (Grundler; et al 2020 p. 8). This study showed that " decrease in BP was larger in subjects who fasted longer" (Grundler; et al 2020, p. 8), which is exactly what the goal intended. Conclusions drawn from this study included long term- fasting tends to decrease blood pressure. This study strengths include being able to show that Long term fasting is a safe and tolerable method to normalize blood pressure. This study however had limitations including only checking blood pressure once a day and having a low follow up response. This study was able to lay the foundation for fasting and provide a plan for more research.

Intermittent Fasting

The next study, " Early Time- Restricted feeding Improves Insulin Sensitivity, Blood Pressure, and Oxidative Stress Even without Weight loss in Men with Prediabetes" by Sutton, Beyl, Early,

Cefalu, Ratuvissin and Peterson (2018) aimed to determine whether “eTRF can improve cardiometabolic health and if Intermittent fasting can have benefits independent of weight loss and food intake” (Sutton; et al 2018 p. 1212). The study consisted of a “five week randomized, crossover, isocaloric, and eucaloric controlled feeding trial testing eTRF in men with diabetes”. (Sutton; et al 2018 p. 1213). The eTRF Schedule consisted of a six-hour daily eating period, with dinner before 15:00. This would be classified under Intermittent fasting because subjects are given a time frame when they are allowed to eat. There was also a control schedule consisting of a 12-hour eating period. Participants selected a “habitual time between 6:30 and 8:30 hr to start eating breakfast every day, and lunch and dinner were timed accordingly”. (Sutton; et al 2018 p. 1213) . 130 men were screened and 18 of those had both elevated HBa1C levels and impaired glucose tolerance indicative of prediabetes. No serious adverse events occurred and compliance to required meal times was “98.2% ±2.9 %” (Sutton; et al 2018 p. 1214). Results showed that “Mean glucose levels were unchanged however eTRF did affect insulin levels by 3.4 ±1.6 mU/L and decreased insulin levels at t=60 min and 90 min post-load” (Sutton; et al 2018 p. 1214). The study also found that “5 weeks of eTRF lowered morning levels of systolic and diastolic blood pressure by 11± 4 mmhg (p-0.03) and 10 ± 4 mmhg (P = 0.03)” (Sutton ;et al 2018 p. 1216).The strengths of this study were that they were able to prove that insulin levels and blood pressure improved in as little as five weeks of intermittent fasting. Limitations of this study included a small sample size of 8 men. In order for this study to be reliable, a larger sample size must be tested including both genders. Another limitation to this study was that prior to testing they did not match the fasting duration which “may have underestimated the improvements in insulin sensitivity and also likely explains the increase in triglycerides and total cholesterol” (Sutton ; et al 2018 p. 1218). Another limitation was that they did not measure blood glucose

and blood pressure values within a 24 hour period. Instead, they measured these values in the morning which could overestimate the results.

Alternate Day Fasting

The next study “Alternate day fasting and endurance exercise combine to reduce body weight and favorably alter plasma lipids on obese humans" examined whether “alternate day fasting plus exercise produces changes in lipid levels and body composition” (Bhutani S; et al 2013, p.1370) . The study defined alternate day fasting as “ Participants consumed 25 % of their baseline energy needs on the “fast day” (24 h) and consumed food ad libitum on each feed day (24 h)” (Bhutani S; et al 2013, p. 1371). All of the fast meals were prepared in the kitchen of the Human Nutrition Research unit. Participants were encouraged to drink plenty of water and were permitted to consume calorie-free foods on days of the fast.Examples of calorie-free foods included black coffee, tea and sugar-free gum. The study consisted of 64 obese subjects who were randomized into four groups. The four groups consisted of: 1) combination of ADF and exercise; 2) ADF: 3) Exercise; and 4) control. The participants were recruited from University of Illinois through advertisement of flyers. 64 participants were eligible according to BMI and preliminary questionnaire. BMI had to be between 30 and 39.9 kg.m^2. Weight also had to be stable three months prior to the study. No history of cardiovascular disease and nondiabetic participants were eligible. Peri-menopausal women were “excluded from the study and the study was approved by the Office for the Protection of Research Subjects at University of Illinois” (Bhutani et al, 2013 p. 1370).

This was a 12-week study and subjects were instructed to eat only the food that was provided and to report any extra food item consumed in a log. Blood collection protocol was “twelve-hour fasting blood samples between 6 am and 10 am” (Bhutani S; et al 2013 p. 1370)

Blood pressure and heart rate were measured using a digital automatic blood pressure/heart rate monitor" (Bhutani S; et al 2013 p. 1371). Insulin resistance was "calculated using the HOMA method and fasting plasma glucose measurements were measured using hexokinase reagent kit"(Bhutani S; et al 2013 p. 1372).

LDL and HDL particle size were measured using "linear polyacrylamide gel electrophoresis" (Bhutani S; et al 2013 p. 1370) and results were presented as mean ±SEM. Results showed that "LDL cholesterol decreased and HDL cholesterol increased in the combination group only"(Bhutani S; et al 2013 p. 1370). Another key finding was that " systolic and diastolic blood pressure was reduced ($P<0.05$) in the ADF group only by 3 ± 1 % and 2 ± 2 %, respectively" (Bhutani S; et al 2013 p. 1371).

In conclusion, these findings suggest that ADF plus exercise results in lipid altering effects than that of each intervention alone. Another conclusion that can be drawn from these results include the "combination of fasting and exercise may be used to help obese individuals lower their risk of CHD" (Bhutani S; et al 2013 p. 1372). These findings help determine the positive impact fasting has on the cardiovascular system. However, Limitations in this study include the short trial duration of 12 weeks. Another major limitation includes only selecting individuals from University of Illinois. In order for this study to be generalizable, a much more diverse population needs to be included. However, this study can be used to set the platform for fasting as a method of intervention for blood pressure management.

Another study that falls under the category of alternate day fasting is "Effects of Modified alternate-day fasting diet on weight loss and CAD risk factors in overweight and obese women" by Samira Eshghinia and Fatemeh Mohammadzadeh (2013). In this study, the aim was to investigate the impact ADF had on lowering cardiovascular risk factors and facilitating weight

loss. The study consisted of 15 adult subjects who were all women undergoing a 8 week trial (2 weeks of observation and 6 weeks of ADF). Criteria for inclusion were "Age 20-45 y, BMI ≥25 Kg/m2, normotensive" (Eshghinia & Mohammadzadeh, 2013 p.2). None of the subjects were taking medications that are known to impact glucose metabolism or lipids in the last six months. A low-calorie diet was consumed on the fast day and "Usual diet on the other day" (Eshghinia and Mohammadzadeh 2013 p. 2). Fat mass, blood pressure, and body weight were measured in this study. On the first and 57th day of trial blood samples were collected for biochemical analysis. Pregnant women were excluded from this study and all subjects had similar levels of physical activity. During the six week alternate day fast, subjects "consumed 25 to 30 % energy needs on the 3 fast days" (Eshghinia & Mohammadzadeh, 2013 p. 3) and then consumed the usual diet based on "Key recommendations of Dietary Guidelines for Americans". (Eshghinia & Mohammadzadeh, 2013 p. 4). Foods were "prepared in the home and served in 2 or 3 snacks and 3 meals" (Eshghinia & Mohammadzadeh, 2013 p. 4). Twelve hour fasting blood samples were "collected at the first day of ADF diet and after 6 weeks diet for biochemical analysis". Significant results of the study showed that " systolic blood pressure decreased (P, 0.002) from 114.8 ± 9,16 mmHg to 105. 13 ± 10.19 mm Hg and diastolic BP (P< 0.02) from 82.86 ± 10.6 mm hg to 74.5 ± 10.6 mm Hg" (Eshghinia & Mohammadzadeh, 2013 p. 10). Another significant finding was "Changes in mean blood lipid and fasting blood sugar concentrations were not significant after 6 weeks of modified ADF." (Eshghinia & Mohammadzadeh, 2013 p.10) . This study found that blood pressure lowered respectively but fasting glucose did not change significantly in obese women. The reasoning could be because it was a limited study consisting only of women and a small duration of 8 weeks. Longer studies need to be conducted to confirm findings.

Daily Calorie Deficit Vs Alternate Day Fasting

Lastly, "A randomized pilot study comparing Zero-calorie alternate-day fasting to daily caloric restriction in adults with obesity " by Victoria A. Cantenacci, Zhaoxing Pan et. al (2016) looked at the tolerability and safety of ADF to compare changes in body composition, lipids, weight, and Insulin sensitivity index. Adults with a BMI ≥ 30 Kg/m2 were randomized into either zero-calorie deficit or CR of 400 kcal.day. The age range was between 18-55. At the end of eight-week intervention, follow up was conducted. There was also a 24 week unsupervised follow-up. 14 people completed the Zero Calorie ADF while 12 people completed the daily CR. This study was completed at University of Colorado and was approved by the Colorado Multiple Institutional Review Board. Between December 2006 and May 2010 was the time frame of the study. Participants were recruited "from C-AMC and the surrounding community" (Victoria A. Cantenacci; et al 2016, p. 1876) Participants were examined for blood pressure, heart rate, height, weight before the fast and signed a written consent form. Participants who had diabetes, cancer thyroid disease, seizures, migraines, binge eating disorder, women who were pregnant, current depression, history of bariatric surgery, taking medications known to affect appetite or energy metabolism, CVD, controlled hypertension, severe dyslipidemia were not allowed in the study. Safety measures were taken and participants in both groups were asked to maintain their usual physical activity level. For outcome measures, "Serum glucose measurements were measured by oxidase method and serum insulin levels were measured by standard, double antibody, radioimmunoassay techniques" (Victoria A. Cantenacci; et al 2016 p. 1876). Statistical analysis was performed using pilot weight loss data and SAS 9.4 was used for all analyses. Significant results showed that "At week 8, total cholesterol, HDL, and LDL decreased significantly in both groups and triglycerides significantly in ADL." (Victoria A. Cantenacci; et

al 2016 p.1877) . Also, “Fasting Glucose decreased significantly at 8 week in ADF” (Victoria A. Cantenacci p. 1877). This finding was different from the previous finding mentioned above - Eshghinia and Mohammadzadeh 2013. However, because this study was conducted randomly with both men and women and in a controlled setting, that could influence the outcome of the design. This is a strong finding that supports the theory of fasting in the role of blood sugar and blood pressure parameters. However, sample size is still small and more research needs to be done to validate findings.

Summary of the Research Literature

Considering all of the research in the literature review, the studies provide clear evidence that fasting has the potential to lead to changes in blood pressure, blood glucose and other parameters of the cardiovascular system. When looking at the category of daily caloric deficit, findings were found in which triglyceride levels and blood pressure decreased. When looking at intermittent fasting the same findings of insulin and blood pressure were found. Finally, in regard to alternate day fasting (ADF), major findings included improvement of HDL, LDL’s and blood pressure. However, the study by Eshghinia and Mohammadzadeh (2013) showed that there was not a statistically significant difference in blood glucose within six weeks of ADF.

While results of the six studies showed that fasting had a positive impact on either blood pressure or blood sugar parameters, more research is needed to assess consistency and determine reliability.

The initial research question posed at the beginning of this thesis was: Can fasting lead to long-term changes in blood pressure and blood sugar? The part of the question that still remains unanswered relates to long-term change. All six literature reviews showed that fasting, regardless of which kind, can lead to a positive change. However, there are limitations within each study

that impact the reliability of fasting as an intervention for lasting change. For instance, most of these studies were done in less than a three-month period. That is not enough time to sufficiently determine whether or not results can be sustained. Follow-up in almost every study was low which means the participants could have returned to a point where they started to eat unhealthy foods and all the progress they made would have been lost. There is also a limitation of small sample size. Most of these studies were done within a sample size less than 1,000 people. In order, for a study to be reliable, it needs to be done in a large, diverse population.

Theoretical Framework

In nursing education, is it imperative to promote and model self-care for patients. It is important to keep in mind that even when patients are being taken care of, they still can exercise a degree of independence and freedom. Dorothea Orem is an advocate for self- care. According to Orem's theory, the nurse can help to connect the patient's need for independence with the need for nursing. The self-care Deficit Nursing Theory states “that all patients want to care for themselves, and they are able to recover more quickly and holistically by performing their own self-care as much as they are able” (Petiprin, 2020, section 3,"Dorothea E. Orem’s Contribution to Nursing Theory: Self-Care Deficit Nursing Theory," para. 2).

This can be seen when patients have a desire to change their behaviors, such as to eat more healthfully, to ensure they are taking their medications properly, or to quit smoking. These are all steps used at the hands of the patient. In most cases, it is up to the patient when they want to make a difference in their lives that can improve their overall well-being.

When looking at the literature review discussed in this paper, all of these studies were done by volunteers. Volunteers dealing with hypertension and diabetes made the decision to take account of their health and investigate how they can change their health. The Orem model

is a prime example of one using their voice and deciding to change their habits. Someone that has hypertension and diabetes is capable of being independent. Being independent means the ability to change what you eat every day, how much water you drink, and how much you smoke or how much alcohol you drink per day. These harmful habits ultimately are the cause of putting patients in the hospital in the first place. Patients need to see that they have control in their health decisions and nurses need to be the ones to remind them.

The Orem model focuses on three major parts. The first part is “universal self care requisites, which are needs that all people have” (Petipren, 2020, section 3, para. 3). Resting, food/water intake, air, and activity are subjects that fit in this category. The second part is developmental self-care requisites which has two sub-categories. The first subcategory is maturational which “progresses the patient to a higher level of maturation” (Petipren, 2020, section 3, para. 3) The second subcategory is situational, which “prevent against harmful effects in development”(Orem 2020, section 3, para. 3). The third category focuses on needs that come up based on condition of patient and is classified as “health deviation requisites'” (Petipren, 2020, section 3, para. 3).

Proposal for Further Study

A five-day water fast (Monday through Friday, alternating every other week) for a period of 12 weeks will be investigated to identify the impact that fasting has on participants' blood pressure and blood sugar. After the 12 weeks of alternate week fasting, follow-ups will take place after six and 12 months. The study that will be proposed will be conducted through Dominican University of California Nursing department.

Research Objectives

1. To measure differences in physical exam findings, including blood pressure and blood glucose levels, in patients diagnosed with hypertension or diabetes compared to a group of healthy controls during a 12-week period of five-day water fast every other week for a total of six five-day water fasting periods.
2. To assess participants' self-assessment of their mental state and use of alcohol or tobacco before and after five days of fasting.
3. To determine if the effects of fasting for five days every other week can be sustained over the six-month and one-year time period after the fasting has been completed.

Study Design

The study will use a longitudinal, quantitative design to compare participants' blood pressure and blood glucose measurements along with their perceptions over the course of the 12-week intervention, and at six months and one year after completion of the 12 weeks.

Sample

Participants will be adults aged 35 to 60 years. A total of 25 participants with ten participants who are diagnosed with hypertension and 10 who are diagnosed with type 2 diabetes, plus five people will be considered healthy, representing the control group. The aim will be to have an approximately equal distribution of male and female for each group. To be included in the study, those who agree to participate will undergo an initial physical exam to help establish that they can take part in fasting without negative consequences.

Recruitment for the study will be conducted through an announcement on the researchers FaceBook page and flyers posted around Marin County.

Ethical Considerations

Prior to beginning, the study will be approved by the Dominican University of California Internal Review Board (IRB) and will have trained nurses and physicians conducting the study. All participants will be monitored closely by trained nurses. To ensure participants' safety, two physicians and two nurses on the research team will be on-call 24 hours per day throughout the 12-week study period. Pregnant women or those looking to bear children will be excluded from this study.

Potential participants will be assured of confidentiality. Information about name, residence and background will be kept confidential. Participants will be notified that they can refuse to answer questions at any time. The participants will also be informed that they can stop the fast at any time and discontinue their participation in the study at any time. After having the research explained and having the opportunity to ask questions, those who choose to participate will need to provide their signature to signify their informed consent.

Methods

The Dominican University of California Skills and Simulation Lab will serve as the research center where the initial meeting, physical exams, and follow-up procedures can take place. All participants also will be screened at Marin general hospital for Type 2 diabetes and Hypertension. Diabetes will be defined as blood glucose level greater than 126 mg/dl. Hypertension will be defined as systolic pressure greater than or equal to 130 mmHg and diastolic pressure greater than or equal to 80 mmHg.

Participants will receive an initial health assessment, including a physical exam at the beginning of the study, after 12 weeks, and six months and one year after the last fasting day. A complete health history will be compiled during the first assessment and changes will be recorded at each assessment thereafter.

Participants will take a self-assessment survey before and after each fast, and after six months and one year, in which they will answer questions, such as the following:

1. How are you feeling mentally (using a five-point Likert scale, 1 = very unwell; 2 = unwell; 3 = don't know or neutral; 4 = well; 5 = very well).
2. Are you wanting a change in health? (using a five-point Likert scale, 1 = no, definitely not; 2 = no, not much; 3 = don't know or neutral; 4 = yes, somewhat; 5 = yes, definitely).
3. Do you drink alcoholic beverages?
    a. If yes, how many times per week do you drink alcoholic beverages?
4. Do you smoke cigarettes or use other devices to smoke tobacco (such as cigars, pipes, etc)?
    a. If yes, how many times per day do you currently smoke?
    b. For how many years have you smoked?
5. Do you feel happy in your body? (using a five-point Likert scale, 1 = no, definitely not; 2 = no, not much; 3 = don't know or neutral; 4 = yes, somewhat; 5 = yes, definitely).

Blood pressure and blood sugar will be collected through a digital glucometer and automatic blood pressure cuff that will be provided to each participant in the morning, evening and night before bed every day of the 12-week period and will be checked at the six-month and 12-week assessments. Assessments will take place at the Simulation and Skills Lab at Dominican University of California.

Data Analysis

Statistical analysis will be conducted using SPSS software. To compare the thrice daily blood pressure and blood sugar results between fasting and non-fasting days, paired T tests will be used. Analysis of variance (ANOVA) will be used to compare the differences in blood pressure and blood sugar results between the hypertension, diabetes, and control groups. Multiple regression will be used to compare differences in physical assessment findings and the self-assessment survey responses over the 12 weeks of the study period, plus at the follow-up six-month and one year time visits.

Conclusion

Fasting should become a standard for management of blood pressure or blood glucose. The proposed study for further research may be able to help fulfill that role. The healthcare system in the United States is changing out of necessity and improvements are on their way. Forward thinking leaders in nursing and medicine are moving in the direction of health management beyond surgeries and medicine. Fasting may well provide an opportunity for such a change.

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Appendix A: Literature Review Table

Purpose	Investigator	N	Sample	Design	Major Findings	Strengths	Limitations
To investigate effectiveness of methods for dietary prescriptions on glycemic control and weight management in overweight men with type II diabetes.	Ash, S., Reeves, M., Yeo, S. *et al.* Effect of intensive dietetic interventions on weight and glycaemic control in overweight men with Type II diabetes: a randomised trial. *Int J Obes* 27, 797–802 (2003). https://doi.org/10.1038/sj.ijo.0802295	51 Men	The study consisted of 51 men with type 2 diabetes and featured a mean average of 54 years old. The population was recruited through newspaper advertisements. The mean body index was 71.7 kgm2.	Whole blood samples of HbA1c and plasma samples of lipids were taken after a 12-h fast. HbA1c was measured by high-performance liquid chromatography (Bio-Rad, Sydney, Australia). The laboratory normal for HbA1c was less than 6%.	HbA1c improved significantly over the 12-week period, independent of dietary intervention. Overall, 6.5% reduction in weight was associated with 1% reduction in HbA1c. Additionally, subjects who achieved normal glycaemia (HbA1c <6%) had a significantly greater weight loss	In people with Type II diabetes, modest weight loss is associated with improvements in markers for diabetes. In this study, HbA1c improved significantly over the 12-week period, independent of dietary intervention.	The HBA1C was similar to baseline levels after the 18 weeks which suggests that more research needs to be conducted in order for these results to be explained. Another limitation was that the subjects were not informed about the follow-up and therefore some of the subjects were unable to be contacted for the follow up.

					over the 12-week		
To study daily blood pressure changes during fasting periods ranging from 4 to 41 days.	Grundler, F., Franziska Grundler https://orcid.org/0000-0002-4352-3990 Buchinger Wilhelmi Clinic, Mesnage, R., Robin Mesnage https://orcid.org/0000-0003-1732-4741 Gene Expression and Therapy Group, Michalsen, A., Andreas Michalsen https://orcid.org/0000-0002-9145-7246	1610	There was a cohort of 1610 subjects and 377 consisted of hypertensive medicated individuals. The age range was between 18-99 years.	Monitored blood pressure values and qualitative well-being questionnaire	BP mean values decreased from 126.2 +- 18.6/81 +- 11.0 to 119.7 +- 15.9/77.6 +- 9.8 mmhg	Conclusions drawn from this study included long term-fasting tends to decrease blood pressure. This study strengths include being able to show that Long term fasting is a safe and tolerable method to normalize blood pressure.	The BP measurements, repeated daily, were conducted only once every day, and details on preexisting antihypertensive treatments were not documented. Despite the large number of participants, it was not possible to match the groups because of the size of the groups of hypertensive and medicated subjects and the

							observational study design. In addition, the follow-up response was low, introducing selection bias and limiting interpretation. Long-term effects remain to be investigated.
To determine if early Time-Restricted Feeding Improves Insulin Sensitivity, Blood Pressure, and Oxidative Stress Even without Weight Loss in Men with Prediabetes	Sutton EF;Beyl R;Early KS;Cefalu WT;Ravussin E;Peterson CM; (n.d.). *Early time-restricted feeding improves insulin sensitivity, blood pressure, and oxidative*	8 men	five week randomized, crossover, isocaloric, and eucaloric controlled feeding trial testing eTRF in men with diabetes". Subjective measures of appetite, plasma levels, blood pressure, blood glucose	Participants selected a "habitual time between 6:30 and 8:30 hr to start eating breakfast every day, and lunch and dinner were timed accordingly".	Results showed that Mean glucose levels were unchanged however eTRF did affect insulin levels by 3.4 +- 1.6 mU/L and decreased insulin levels at t=60 min and 90 min	The strengths of this study were that they were able to prove that insulin levels and blood pressure improved in as little as five weeks of intermittent fasting	Limitations of this study included a small sample size of 8 men. In order for this study to be reliable, a larger sample size must be tested including both genders. Another limitation to this study was that prior to

	stress even without weight loss in men with Prediabetes. Cell metabolism. Retrieved November 21, 2021, from https://pubmed.ncbi.nlm.nih.gov/29754952/.				post-load" (Sutton EF, Beyl R, Early KS , Cefalu Wt, Ratuvissin E and Peterson 2018). The study also found that "5 weeks of eTRF lowered morning levels of systolic and diastolic blood pressure by 11 +- 4 mmhg (p-0.03) and 10 +- 4 mmhg (P = 0.03).		testing they did not match the fasting duration which "may have underestimated the improvements in insulin sensitivity and also likely explains the increase in triglycerides and total cholesterol
To examine whether the combination of alternate day fasting (ADF) plus	Bhutani, S, Klempel, MC, Kroeger, CM et al. (2013)	64	Obese subjects (n = 64) were randomized to 1 of 4 groups for 12 weeks: 1) combination	Quantitative, blood pressure, weight, Lipid parameters	Body weight was reduced (P < 0.05) by 6 ± 4 kg, 3 ± 1 kg, and 1 ± 0 kg in	Weight also had to be stable three months prior to the study. No history	Limitations in this study include the short trial duration of 12 weeks.

exercise produces superior changes in body composition and plasma lipid levels when compared to each intervention alone.	Alternate day fasting and endurance exercise combine to reduce body weight and favorably alter plasma lipids in obese humans. *Obesity* 21, 1370–1379		(ADF plus endurance exercise), 2) ADF, 3) exercise, or 4) control.		the combination, ADF, and exercise groups, respectively. Fat mass and waist circumference decreased ($P < 0.001$), while lean mass was retained in the combination group. Low-density lipoprotein (LDL) cholesterol decreased ($12 \pm 5\%$, $P < 0.05$) and high-density lipoprotein (HDL) cholesterol increased ($18 \pm 9\%$, $P < 0.05$) in the	of cardiovascular disease and nondiabetic participants were eligible. Peri-menopausal women were “ excluded from the study and the study was approved by the Office for the Protection of Research Subjects at University of Illinois	Another major limitation includes only selecting individuals from University of Illinois.

					combination group only. LDL particle size increased ($P < 0.001$) by 4 ± 1 Å and 5 ± 1 Å in the combination and ADF groups, respectively. The proportion of small HDL particles decreased ($P < 0.01$) in the combination group only.		
To assess effects of modified alternate-day fasting diet on weight	Catenacci, V. A., Pan, Z., Ostendorf, D., Brannon, S.,	29	Participant BMI ranged from 30-52 kg/m2. CR and ADF were similar in age,	The study design was an 8-week intervention, followed by 24-weeks of	At week 8, total cholesterol, HDL, and LDL decreased	Results suggest zero-calorie ADF is safe and tolerable, and is	This was a pilot study primarily aimed at assessing safety and

loss and CAD risk factors in overweight and obese women	Gozansky, W. S., Mattson, M. P., Martin, B., MacLean, P. S., Melanson, E. L., & Troy Donahoo, W. (2016, September). *A randomized pilot study comparing zero-calorie alternate-day fasting to daily caloric restriction in adults with obesity*. Obesity (Silver Spring, Md.). Retrieved November 21, 2021, from		sex, and ethnic/racial distributions. At baseline, mean±SD body weight (CR 114.0±20.0 kg, ADF 94.7±10.6 kg, $p<0.01$), FM, trunk FM, fasting insulin, and RMR were significantly greater in CR than ADF.	unsupervised follow-up to assess risk for weight regain after completion of the intervention. Participants in both groups were admitted to the CTRC during the first week of the intervention to monitor safety; the subsequent 7 weeks were performed as an outpatient intervention. Participants were asked to maintain their usual level of physical activity (PA) during the 8-week intervention. Upon	significantly in both groups and triglycerides decreased significantly in ADF; however there were no between-group differences in any lipid parameter changes. Fasting glucose decreased significantly at week 8 in ADF; however, there were no other within- or between-group differences in changes in fasting insulin, glucose, or	equivalent to moderate CR in producing short-term weight loss and improving body composition and metabolic parameters.	tolerability, and the small sample size may explain the lack of statistical significance in some outcomes between groups. For example, effect sizes for between-group differences in changes in weight at weeks 8 and 32 are small (-0.35 and -0.12, respectively), confirming we would need a larger sample size to observe a significant between-group difference.

	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5042570/#:~:text=A%20randomized%20pilot%20study%20comparing%20zero-calorie%20alternate-day%20fasting,Martin%2C9Paul%20S.%20MacLean%2C1%2C2Edward%20L.%20Melanson%2C1%2C10and%20William%20Troy%20Donahoo1%2C6.			completion of the 8-week intervention, participants received standardized weight maintenance advice (maintain a low-fat diet, increase PA) but were free to choose whether to continue their respective dietary intervention strategies (CR or ADF). Participants had no contact with study staff during the follow-up period and dietary adherence was not assessed.	Si at week 8 or week 32.		Randomization was stratified by sex only and resulted in a significantly higher mean baseline body weight in CR. Because of the small number of males (n=3 per group), we could not determine if there were any sex effects.
To evaluate	Catenacci,	26	Adults with	Quantitative,	No adverse	Strengths of	This was a

the safety and tolerability of alternate-day fasting (ADF) and to compare changes in weight, body composition, lipids, and insulin sensitivity index (Si) with those produced by a standard weight loss diet, moderate daily caloric restriction (CR).	V, Pan, Z, Ostendorf, D et al. (2016) A randomized pilot study comparing zero-calorie alternate-day fasting to daily caloric restriction in adults with obesity. *Obesity* 24, 1874–1883		obesity (BMI ≥30 kg/m2, age 18-55) were randomized to either zero-calorie ADF (*n* = 14) or CR (−400 kcal/day, *n* = 12) for 8 weeks. Outcomes were measured at the end of the 8-week intervention and after 24 weeks of unsupervised follow-up.	The study design was an 8-week intervention, followed by 24-weeks of unsupervised follow-up to assess risk for weight regain after completion of the intervention. Participants in both groups were admitted to the CTRC during the first week of the intervention to monitor safety; the subsequent 7 weeks were performed as an outpatient intervention. Participants were asked to maintain their usual level of	effects were attributed to ADF, and 93% completed the 8-week ADF protocol. At 8 weeks, ADF achieved a 376 kcal/day greater energy deficit; however, there were no significant between-group differences in change in weight (mean ± SE; ADF −8.2 ± 0.9 kg, CR −7.1 ± 1.0 kg), body	the current study include the randomized design, measurement of EI using analysis of returned food, and metabolic measurements obtained during a controlled inpatient setting	pilot study primarily aimed at assessing safety and tolerability, and the small sample size may explain the lack of statistical significance in some outcomes between groups

				physical activity (PA) during the 8-week intervention. Upon completion of the 8-week intervention, participants received standardized weight maintenance advice (maintain a low-fat diet, increase PA) but were free to choose whether to continue their respective dietary intervention strategies (CR or ADF). Participants had no contact with study staff during the follow-up	composition, lipids, or Si. After 24 weeks of unsupervised follow-up, there were no significant differences in weight regain; however, changes from baseline in % fat mass and lean mass were more favorable in ADF.		

				period and dietary adherence was not assessed.			