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The Effect of Time-Restricted Feeding on Body Weight, Energy, Mood, Sleep, and Hunger Levels of Adults on Social Media

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THE EFFECT OF TIME-RESTRICTED FEEDING ON BODY WEIGHT, ENERGY, MOOD, SLEEP, AND HUNGER LEVELS OF ADULTS ON SOCIAL MEDIA

by

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ABSTRACT

The purpose of this study was to investigate the effect of time-restricted eight-hour feeding on body weight, self-reported energy, mood, and hunger scores, and self-reported sleep patterns of adult men and women on social media. Generally healthy adults ages 18 to 65 were invited on social media to participate in a five-week study which involved a one week of following their normal dietary patterns succeeded by four weeks of practicing time-restricted feeding of eight hours per day, also known as 16 hours of fasting. Daily surveys were created in Survey Monkey and distributed through the messaging platform, Remind, that gathered data concerning self-reported energy, mood, and hunger scores, sleep patterns, and times participants began and ended fasting for the previous day. Initial, midpoint, and final body weights were also self-reported and sent to the researcher.

One hundred twenty-nine subjects participated in the study but only 86 met the requirements of submitting all three body weights and completing a minimum of five out of seven surveys each week. The majority of participants were female (81.39%), ages 18-25 (36.05%), and worked in the health science/health care field (23.26%). There was a significant decrease in body weight and BMI from baseline to midpoint (2.03±5.11; .318±.742) and from baseline to final (3.49±7.08; .567±.742). Mood scores also decreased significantly, showing an increase in irritability/agitation throughout the study (.876±1.34). Hours of sleep increased significantly from baseline to after two weeks of intermittent fasting (.0781 ± .342) but not from baseline to after four weeks of intermittent fasting. There were no significant changes in self-reported hunger or energy scores.

This study found supportive evidence that following time-restricted feeding in the short term may be effective for weight loss. Mood, specifically irritability and agitation, may also be negatively affected by time-restricted feeding. People may experience increased sleep duration but more research is needed to make conclusions at this time, particularly examining its effect long term.

CHAPTER 1

INTRODUCTION

The term “fad diet” has been associated with claims of fast and easy weight loss, involving little to no exercise, use of supplements, pills, or “magic foods,” elimination of certain foods or food groups, and liquid diets. This term is used to describe the multiple weight loss methods developed and advertised each year, with “fad” implying a gain in popularity and then a fading away (Roy, Brantley, & Heymsfield, 2011). Adherence is the greatest predictor of long-term weight loss maintenance (Del Corral, Bryan, Garvey, Gower, & Hunter, 2011; Gibson & Sainsbury, 2017). Some of the components associated with long-term sustainability of weight loss include individualization, support systems, attendance, and a focus on dietary modification (Beto, Schury, & Bansal, 2016; Lemstra, Bird, Nwankwo, Rogers, & Moraros, 2016).

One of the most recent trends in dieting for weight loss is intermittent fasting (Google Trends, 2018). Intermittent fasting is defined as the consumption of little to no food or beverage intake for a period of time and may last from 12 hours to several weeks. Unlike the majority of diets, this dietary pattern emphasizes the timing of meals rather than the number of calories consumed (Longo & Mattson, 2014). Also, unlike many popular or “fad” dietary patterns, intermittent fasting has been researched over the past few decades and shown to have a strong association with weight loss maintenance (Johnson et al., 2007; LeCheminant, Christenson, Bailey, & Tucker, 2013). Since it has become an increasingly popular diet only over the last few years, more strong, conclusive evidence is needed before it can be recommended as a true, safe, and lasting health intervention (Horne, Muhlestein, & Anderson, 2015).

Statement of the Problem

Obesity and chronic disease prevalence are increasing in the United States (US) (Finkelstein et al., 2012; Robert Wood Johnson Foundation, 2010). Risk of obesity and chronic diseases such as cardiovascular disease (CVD), type 2 diabetes mellitus (T2DM), cancer, kidney disease, and Alzheimer's disease, have been associated with poor dietary intake and lifestyle patterns (CDC, 2017). Approaches to weight loss have been studied for many years. The most researched areas include dietary intake, physical activity, support systems, pharmacological treatments, surgical methods, and technology (Raynor & Champagne, 2016; Montesi et al., 2016; Thomas, Bond, Phelan, Hill, & Wing, 2014). Multiple companies and authors have developed dietary patterns that have been advertised as the solution or cure to weight loss and health. While many dietary patterns may produce immediate results, the term "fad diet" has been used to describe diets that are time sensitive and do not have lasting outcomes (Roy, Brantley, & Heymsfield, 2011). Problems with fad diets may include limiting specific foods or food groups, encouraging small portions, and are often unsupported by scientific evidenced-based research. In addition, there are limited studies supporting long-term weight loss success (Johnson & Wardle, 2014).

While it has been practiced throughout history, intermittent fasting has become more popular in the last few years (Brongers, 1997; Patterson et al., 2015). It has been claimed to "heal the body" and marketed as the "simple secret" to losing weight, staying, healthy, and living longer (Fung & Moore, 2016; Moseley & Spencer, 2014). It was one of the top 10 most popular diets in 2018, according to Google (Google Trends, 2018). However, there has been inadequate research using humans to conclude that intermittent fasting is more effective than other diets and should be the solution to weight maintenance and health (Harvie et al., 2011; Schubel et al., 2018).

Time-restricted feeding is defined as daily limitations in the timing of food intake, spanning from four to 12 hours, without reduction in caloric intake (Di Francesco, Di Germanio, Bernier, & de Cabo, 2018). It is a regimen of intermittent fasting that may be more easily followed than other types and have positive effects on weight loss (LeCheminant, Christenson, Bailey, & Tucker, 2013; Sutton et al., 2018). However, there is insufficient scientific evidenced-based research to establish this diet approach as an effective and safe method for promoting and sustaining long-term weight loss. In addition, there is less evidence on the relationship of time-restricted feeding on other health behaviors and physical and mental side effects including energy levels, mood, sleep, and hunger levels (Patterson et al., 2015).

Purpose

The purpose of this study was to investigate the effect of time-restricted eight-hour feeding on body weight, self-reported energy levels, self-reported mood, self-reported sleep patterns, and self-reported hunger levels of adult men and women on social media.

Hypotheses

1. There will be no significant change in body weight after four weeks participation in time-restricted feeding.
2. There will be no significant change in self-reported energy scores after four weeks participation in time-restricted feeding.
3. There will be no significant change in self-reported hunger scores after four weeks participation in time-restricted feeding.
4. There will be no significant change in self-reported mood scores after four weeks participation in time-restricted feeding.
5. There will be no significant change in self-reported sleep hours after four weeks participation in time-restricted feeding.

Justification

Prevalence of obesity and chronic disease are increasing in the United States, causing healthcare costs to rise (Centers for Disease Control and Prevention (CDC), 2018; Finkelstein, et al., 2012). Obesity is not only extremely harmful and fatal to one's health but is costing the country millions of dollars. In 2016, it was estimated that obesity costs were over $150 billion dollars, with the average cost between $279 to $768 dollars per person per year (Kim & Basu, 2016, Wang et al., 2015). Chronic diseases are also accounting for over 75% of the US health care costs (Heron, 2013; Moses et al., 2013). Excess caloric intake is associated with chronic disease and obesity (Romieu et al., 2017). Frequent snacking has also increased in the United States, particularly among adolescents, although evidence of its effect on body weight is conflicting (Nuru & Mamang, 2015; Sebastian, Cleveland, & Goldman, 2008).

Intermittent fasting has become an attractive diet trend and several books have been published in the past decade concerning the topic (International Food Information Council (IFIC) Foundation, 2018, Patterson et al., 2015). While intermittent fasting is not a new dietary practice, a majority of the research has been conducted on animal subjects (Collier, 2013; Harvie & Howell, 2017). Time-restricted feeding is a type of intermittent fasting and may have higher adherence, although it has been the least researched (Gabel et al. 2018; Patterson et al., 2015). More information is needed to determine not only if intermittent fasting works, but what types and parameters of intermittent fasting are the most beneficial. Determining realistic, achievable, and sustainable healthy dietary practices is important if it is to be used as a recommendation for lasting weight loss maintenance (Seagle, Strain, Makris, Reeves & AND, 2009).

CHAPTER 2

REVIEW OF LITERATURE

Incidence of Obesity

Prevalence of obesity has tripled worldwide since 1975, with 13% of the adult population in the world categorized as obese in 2016 (World Health Organization (WHO), 2018). According to Behavioral Risk Factor Surveillance System (BRFSS) data from 2009, overall crude incidences, or increases, in obesity and extreme obesity were four percent and 0.7% per year, respectively (Pan, Freedman, Gillespie, Park, & Sherry, 2011). From 2015 to 2016, 39.8% or 93.3 million of US adults 20 years old and older were obese and 71.6% were categorized as overweight or obese (CDC, 2017). By 2030, researchers have predicted that 51% of the US population will be obese and that there will be a 33% increase in obesity rates from 2010 (Finkelstein et al., 2012; Flegal, Carroll, Ogden, & Curtin, 2010).

Impact of Body Weight on Health

Obesity, compared to normal, healthy weight, increases risk for many diseases and health conditions (Bhaskaran et al., 2014; United States Department of Health and Human Services (USDHHS) & National Heart, Lung, and Blood Institute (NHLBI), 2013).). These risks may include but are not limited to increases in mortality; hypertension; high low-density lipoprotein (LDL) cholesterol, low high-density lipoprotein (HDL) cholesterol, or high levels of triglycerides; type 2 diabetes mellitus

(T2DM); coronary heart disease (CHD); stroke; gallbladder disease; osteoarthritis; sleep apnea or breathing problems; cancers such as endometrial, breast, colon, kidney, gallbladder, and liver; fatty liver disease; low quality of life; mental illness such as depression or anxiety; health problems in pregnancy such as pre-eclampsia, gestational diabetes, or need for Cesarean section; and body pain and difficulty with motility and physical functioning (Kasen, Cohen, Chen, & Must, 2008; Luppino et al., 2010; National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), 2015). Most of these health conditions listed are categorized as chronic disease, which can be defined as a disease that lasts three months or longer (Adams, Kirzinger, & Martinez, 2013). Interestingly, a five to 10 percent body weight loss in those who are obese may decrease the risk of many of these chronic diseases and risk factors as well as improve mental functioning such as mood, body image, and binge eating (Barte et al., 2010; Dalle Grave et al., 2010; Dalle Grave et al., 2007; Ingram & Mussolino, 2010; Jensen et al., 2014; Magkos et al., 2016; Wing et al., 2011).

Impact of Diet on Mental and Physical Functioning

Consumption of food stimulates the release of hormones and peptides such as insulin and glucagon-like peptide 1 (GLP1), which may signal to various sites including the hypothalamus and hippocampus that promote cognitive function, learning and memory (Gómez-Pinilla, 2008; McNay, 2007). A decreased amount of food in the stomach will trigger ghrelin, the hunger hormone, to be released while the gut and hypothalamus work together to release leptin, the satiety hormone, when full (Gómez-Pinilla, 2008; Klok, Jakobsdottir, & Drent, 2007). A decrease in leptin has been associated with excess body fat, inflammation, and slower metabolism, and ghrelin has also been found to be reduced in the obese and play a role in regulating fat stores (Bloomgarden, 2007; Friedman & Mantzoros, 2015; Skelton, DeMattia, Miller, & Olivier, 2006). The parasympathetic system corresponds with the gut via the vagus nerve, which provides sensory information to the brain and stimulates emotions (Gómez-Pinilla, 2008). Mood has been associated with intake of certain foods, body weight, and the signaling of hunger and satiety, which may affect emotions such as depression, anxiety, stress, pleasure, and reward (Hryhorczuk, Sharma, & Fulton, 2013; Lenoir, Serre, Cantin, & Ahmed, 2007; Sharma & Fulton, 2013; Singh, 2014). Sleep may regulate mood and affect cognitive functioning as well (Dewald-Kaufmann, Oort, & Meijer, 2013; Nixon et al., 2008; Ratcliff & Van Dongen, 2009; Talbot, McGlinchey, Kaplan, Dahl, & Harvey, 2010;). Poor sleep quality, shorter duration of sleep, and later bedtimes have been associated with increased body weight and dietary intake, poor diet quality, and increased reported hunger (Chaput, 2014; Schmid, Hallschmid, Jauch-Chara, Born, & Schultes, 2008).

Impact of Obesity in the United States

Obesity strongly increases risk of many chronic diseases and mortality risk factors (CDC, 2015; Berrington de Gonzalez et al., 2010; Jensen et al., 2014). Chronic disease affects approximately 133 million Americans, or 40% of the US population (Adams, Kirzinger, & Martinez, 2013; CDC, 2009). By 2020, it is estimated that 157 million Americans will have a chronic disease, and in 2030, half of the American population will have multiple diseases (Bodenheimer, Chen, & Bennett, 2009; Robert Wood Johnson

Foundation, 2010). Seven out of 10 Americans die from chronic diseases each year, with the most common being heart disease and stroke, cancer, diabetes, obesity, and Alzheimer's disease (CDC, 2017; CDC, 2018).

Obesity also attributes to the increase in health care expenses, accounting for up to $190 billion annually and 21% of all medical costs in the United States (Cawley & Meyerhoefer, 2012). Obese employees may also cost employers up to $4,000 per year related to disability, absenteeism, workplace injuries, sick leave, and covered medical costs, compared to non-obese employees (Schmier, Jones, & Halpern, 2006; Van Nuys et al., 2014). Another study revealed a significant loss in cost from productivity among obese employees (Goettler, Grosse, & Sonntag, 2017). Obesity may also be significantly associated with more school absences, behavioral problems, having to repeat a grade, poorer math and reading test scores, and lower brain volume (Carey, Singh, Brown, & Wilkinson, 2015; Datar, Sturm, & Magnabosco, 2012; Ho et al., 2010). Overweight is also currently the primary medical reason for denying entrance into the military service (Christeson, Taggart, & Mesner-Zidell, 2010; Gagnon & Stephens, 2015).

Methods to Promote Weight Loss and Weight Maintenance

According to the Academy of Nutrition and Dietetics, the treatment of overweight and obesity in adults for weight loss and maintenance should include lifestyle and behavior modifications regarding dietary intake and physical activity (Christian, Tsai, & Bessesen, 2010; Raynor & Champagne, 2016; Thomas, Bond, Phelan, Hill, & Wing, 2014). Support systems, pharmacological treatments, surgical methods, and use of technology may also be used to support in weight loss and maintenance (Burke, Wang, &

Sevick, 2011; Christian, Tsai, & Bessesen, 2010; Patel, 2015; Raynor & Champagne, 2016; Seagle, Strain, Makris, Reeves, & AND, 2009; Thomas, Bond, Phelan, Hill, & Wing, 2014).

Dietary Intake

A caloric deficit of 500-1000 kilocalories (kcals) per day has shown strong, imperative evidence to produce one to two pounds of weight loss per week according to the AND's Evidence Analysis Library (ANDEAL) (ANDEAL, 2006; Seagle, Strain, Makris, & Reeves, 2009). Small, food-based and behavioral changes such as a deficit of 100-200 kcals per day and a reduction in fast food and sugar sweetened beverage (SSB) intake may be recommended for weight management (Raynor & Champagne, 2016; Hill, 2009; Hills, Byrne, Lindstrom, & Hill, 2013). Changes in energy and macronutrient distribution and increases in specifically fruit, vegetables, and calorie control have also been associated with more successful weight loss (Abete, Astrup, Martínez, Thorsdottir, & Zulet, 2010; Champagne et al., 2011; Jensen et al., 2014). Portion control has been strongly associated with regulating excessive energy consumption, although more research is needed to conclude its direct relationship to obesity (Dietary Guidelines Advisory Committee, 2015; Rolls, Roe, & Meengs, 2006; Seagle, Strain, Makris, & Reeves, 2009; Stroebel, Ogden, & Hill, 2009). Methods of portion control may include single-serving meals, using measuring utensils, or the MyPlate resource provided by the United States Department of Agriculture (USDA) (Raynor & Champagne, 2016).

Breakfast Consumption. Breakfast consumption has been encouraged as a healthy dietary pattern to follow for weight loss and weight maintenance (Barnes & Kimbro, 2012; Brikou, Zannidi, Karfopoulou, Anastasiou, & Yannakoulia, 2016; Brown, Bohan

Brown, & Allison, 2013). Research has shown that although there may be some association between breakfast consumption and weight, it has been identified as primarily a presumption, since a causal relationship has not been concluded (Brown, Bohan Brown, & Allison, 2013; Casazza et al., 2013). The association of breakfast consumption with weight management may not be associated with the type of food, but rather the earlier time of day it is consumed (Garaulet et al., 2013; Jakubowicz, Barnea, Wainstein, & Froy, 2013).

Low Calorie Diets. Low calorie diets, usually ranging from 1,200 to 1,600 kcals per day, and very low-calorie diets, equal to or less than 800 kcals per day, are usually composed of small portions, higher protein quality, and liquid meal replacement supplements (Mulholland, Nicokavoura, Broom, & Rolland, 2012; Tsai & Wadden, 2006). While these diets have been associated with short term weight loss, research evidence has indicated that on-going dieting with low-calorie intake may not have lasting results (Mann et al., 2007; Pinto et al., 2008; Tsai & Wadden, 2006; Wadden et al., 2013).

Energy Density and Type of Foods Consumed

Energy density is defined as the amount of energy or calories per gram of food and is affected by its water, fiber, and fat content (Raynor & Champagne, 2016). A lower density food means that it has less calories for a greater amount of food and has been associated with satiety and reduced energy intake (Rolls, 2009; Rolls, 2010). The Dietary Approaches to Stop Hypertension (DASH) diet is composed of fruits, vegetables, whole grains, nuts, legumes, seeds, low-fat dairy products, lean meats, and limited sodium and has been strongly associated with lowering blood pressure (Challa & Uppaluri, 2018).

The Mediterranean diet is plant-based and includes many of the same foods as the DASH diet, while also emphasizing olive oil as the primary source of fat, with limited dairy products, fish, poultry, and red meat, and red wine in moderation (Davis, Bryan, Hodgson, & Murphy, 2015). Both of these dietary patterns have been associated with weight loss, weight maintenance, and decreasing risk of chronic disease, potentially without restricting energy intake (Esposito et al., 2011; Esposito, Kastorini, Panagiotakos, & Giugliano, 2011; Fung et al., 2008; Jannasch, Kröger, & Schulze, 2017; Shai et al., 2008; Soltani, Shirani, Chitsazi, & Salehi-Abargouei, 2016; Sofi, Macchi,, Abbate, Gensini, & Casini, 2014). Consuming frequent meals may be associated with weight loss but has less of a relationship on weight and health than a normal dietary eating pattern of three meals per day (Cameron, Cyr, & Doucet, 2010; Kulovitz et al., 2014).

Physical Activity

Increasing physical activity enhances energy expenditure and has been used to treat and prevent obesity (Donnelly et al., 2009; Ekelund et al., 2011; Jakicic, Rogers, Davis, & Collins, 2018). Moderate-to-vigorous intensity physical activity, defined as the ratio of oxygen uptake per kilogram(kg) of body weight per minute greater than three metabolic equivalents for task (MET) for the average adult, has been determined to be the most beneficial for energy expenditure and cardiovascular health (Donnelly et al., 2009; Kubota et al., 2017; WHO, 2010). While increasing physical activity alone has not been found to have the greatest weight loss results, combining it with reduced dietary intake has been strongly associated with weight loss (Donnelly et al., 2009; Johns, Hartmann-

Boyce, Jebb, Aveyard, & Behavioral Weight Management Review Group, 2014; Santos, Mata, Silva, Sardinha, & Teixeira, 2015).

Current recommendations for physical activity for healthy adults are a minimum of 150 minutes of moderate intensity per week, or 30 minutes on most days of the week (United States Department of Health and Human Services (USDHHS), 2015; WHO, 2010). For sustained weight loss, higher moderate-to-vigorous intensity exercise may be needed up to 200-300 minutes per week (Donnelly et al., 2009; Jakicic et al., 2014). Sedentary activity can be defined as sitting or lying down for long periods of time at an energy expenditure of 1-1.5 METs, with some of the most popular activities including screen time such as television, cell phone, computer, and tablet use (Pate, O'Neill, & Lobelo, 2008). The recommendation is not only to decrease inactivity and increase movement but to replace the sedentary activities with active ones such as light physical activity or exercise, along with decreasing energy intake (Otten, Jones, Littenberg, & Harvey-Berino, 2009; Raynor et al., 2013).

Technology and Support Systems

Self-monitoring is one of the key pieces to weight loss and long-term weight maintenance (Burke, Wang, & Sevick, 2011; Peterson et al., 2014; Wang et al., 2012). Advanced technology has enabled individuals to use their phones as a tracking device for monitoring body weight, dietary intake, and physical activity (Gilmore, Duhé, Frost, & Redman, 2014; Spring et al., 2013). Methods such as mobile devices or applications, referred to as “apps,” have led to successful weight outcomes (Beasley, Riley, Davis, & Singh, 2008; Burke et al., 2009; Burke, Wang, & Sevick, 2011). Not only is the use of technology convenient for users, but participants may find it more effective and satisfactory than a face-to-face meeting (Mohr, Cuijpers, & Lehman, 2011; Rao et al., 2011). Technology may also encourage weight loss and maintenance through social support of social media peer groups and use of interactive apps. However, additional research is needed to determine if these assistive devices and programs promote weight maintenance over the long term (Jane, Hagger, Foster, Ho, & Pal, 2018; Morgan, Lubans, Collins, Warren, & Callister, 2009; Pellegrini et al., 2012). Support systems, including family members, counselors, and health care professionals, may improve weight maintenance, especially when offering routine positive feedback rather than instruction alone (Carter, Burley, Nykjaer, & Cade, 2013; Jensen et al., 2014; Karfopoulou, Anastasiou, Avgeraki, Kosmidis & Yannakoulia, 2016; Wang, Pbert, & Lemon, 2014).

Medication and Surgery

For people who have had failed success of weight loss and meet certain criteria, specific medications and bariatric surgery options are available (Colquitt, Pickett, Loveman, & Frampton, 2014; NIDDK, 2016). The three treatment medications that have been approved for weight loss for longer term use up to two years are Orlistat, Lorcaserin, and Phentermine, also known as topiramate (Champagne, Greenway, & Cefalu, 2014). Although medications may be successful, they may also result in multiple negative side effects (Kang & Park, 2012; Rucker, Padwal, Li, Curioni, & Lau, 2007).

There are various types of bariatric surgery available depending on the needs and criteria of a patient with the most common including Roux-en-Y, sleeve gastrectomy, and laparoscopic adjustable gastric banding (Colquitt, Pickett, Loveman, & Frampton, 2014). While weight loss success may be obtained over a short period of time, weight regain may occur long term, along with many potential side effects including gastric leakage, stricture, gastroesophageal disease, delayed gastric emptying, bowel obstruction, hernias, and micronutrient deficiencies (Himpens, Dobbeleir, & Peeters, 2010; Magro et al., 2008; Mechanick et al., 2008; Shah, Simha, & Garg, 2006).

Recent Diet Weight Loss Trends

From 2013 to 2016, 49.1% of United States adults attempted to lose weight. Exercising and reduced energy intake were identified as the most common approaches to weight loss (National Health and Nutrition Examination Survey (NHANES), 2018). According to the International Food Information Council (IFIC) Foundation from adults ages 18 to 80 years old, the most frequently followed diets were intermittent fasting at 10%, Paleo at seven percent, gluten-free at six percent, and Whole 30, low-carbohydrate, and the Mediterranean diet tying for fourth at five percent each (IFIC, 2018). According to Google, the most searched diets of 2018 were Carnivore, Dr. Gundry Paradox, ketogenic, and intermittent fasting (Google Trends, 2018).

Ketogenic Diet

The ketogenic diet was traditionally recommended for children with epilepsy and is defined as a strictly limited carbohydrate intake at less than 20 or 30 grams per day, high fat intake at 70 to 80 percent of total calories, and moderate protein consumption (Amidor, 2017). The diet gained popularity with the Adkins diet in the 1990s and has become increasingly popular over the last few years (Amidor, 2017). The physiology behind the ketogenic diet emphasizes limited carbohydrate. This results in glycogen store depletion thereby stimulating the body to use fat as its main energy source. The body then produces ketone bodies, putting the body into ketosis (Fukao, Lopaschuk, & Mitchell, 2004).

Those who practice the ketogenic diet have had success in losing weight over the short term but have not had long term success, with many reporting weight regain and negative effects on energy levels (Bueno, Vieira de Melo, Lima de Oliveira, & da Rocha Ataide, 2013; Ellenbroek et al., 2014; Johnstone, Horgan, Murison, Bremner, & Lobley, 2008; Santos, Esteves, da Costa Pereira, Yancy, & Nunes, 2012). Also, the long-term effects concerning the ketogenic diet on health have not been determined and may negatively disturb renal function and reduce bone minerals (Bergqvist, Schall, Stallings, & Zemel, 2008; Paoli, 2014). On the other hand, the ketogenic diet may also have a positive, significant effect on hunger and some studies have shown improvement of mood and sleep (Afaghi, O'Connor, & Chow, 2008; Brietzke et al., 2018; Johnstone, Horgan, Murison, Bremner, & Lobley, 2008; Mancinelli, 2015).

Whole Foods Diets

"Whole foods" is a term generally used to describe foods that are not processed, refined, or have other added ingredients (Wolfram, 2017). One of the popular whole food diets is Paleo, a food pattern that seeks to mirror the eating habits of those from the Paleolithic era or "Stone Age." The diet emphasizes consuming fruits, vegetables, nuts, seeds, healthful oils such as olive, coconut, and avocado, meat, fish, shellfish, poultry, and eggs, excludes consumption of grains, dairy, legumes, potatoes, refined sugar, and refined vegetable oils, and has been associated with inflammation and increased risk of chronic disease (Amidor, 2018; Masharani et al., 2015; Sido et al., 2017). Some studies have shown the Paleo diet may improve blood sugar, insulin sensitivity, and lipid profiles, although conflicting evidence has been produced on its effect on weight loss (Amidor, 2018; Frassetto, Schloetter, Mietus-Synder, Morris, & Sebastian, 2009; Masharani, et al., 2015; Pitt, 2016). This dietary pattern contradicts the 2015-2020 Dietary Guidelines, which recommends consumption of whole grains (USDA & USHHS, 2015). Research involving whole grains has documented decreases in inflammation and risk of coronary heart disease, cardiovascular disease, cancers, respiratory and infectious diseases, and diabetes (Aune et al., 2016; USDA & USHHS, 2015; Vanegas et al., 2017). Very little research has been conducted concerning this dietary pattern and although one study found short term improvements in chronic disease risk factors, there are gaps in its results and conclusions (Fenton & Fenton, 2016; Manheimer, van Zuuren, Fedorowicz, & Pijl, 2015). Claims have been made that Paleo may decrease hunger and increase mood, energy levels, and sleep according to books, blogs, and online articles, but no scientific research studies have been conducted on these topics (Dave, 2014; Wolf, 2017).

The Whole 30 diet is another dietary pattern that focuses on whole foods and allows consumption of meat, seafood, eggs, vegetables, fruits, and natural fats. It prohibits consumption of sugar, alcohol, grains, legumes, or dairy and is followed for 30 days (Hartwig & Hartwig, 2015). While little scientific evidence has been conducted on the Whole 30 diet, the book by which it originates claims it may improve or "cure" multiple diseases and health conditions including diabetes, gastrointestinal illness such as Crohn's or diverticulitis, skin conditions, depression, high blood pressure and decrease inflammation (Hartwig & Hartwig, 2015). Currently, there has been little to no scientific evidence-based research to support these claims.

Gluten-Free Diet

Celiac disease is an autoimmune disease that may affect one in 141 Americans, although most do not know that they have it (Rubio-Tapia, Ludvigsson, Brantner, Murray, & Everhart, 2012). According to NHANES data, people who adopted the gluten-free diet who did not have celiac disease rose from 0.52% to 1.69% from 2009-2010 and 2013 to 2014 (Kim, Patel, & Orosz, 2016). Of those who did not have celiac disease who followed the diet, only 0.55% reported they had a gluten sensitivity (DiGiacomo, Tennyson, Green, & Demmer, 2013). In the past several years, claims have been made that gluten-free diets may aid in weight loss and prevention of other medical conditions (Davis, 2011). Although there is little evidence, one study found that following a gluten-free diet may lower body fat, inflammation, and insulin resistance (Soares et al., 2013). However, other studies have found that following a gluten-free diet may result in a higher risk of metabolic syndrome, chronic disease, and inflammation (Jamnik, García-Bailo, Borchers, & El-Sohemy, 2015; Tortora et al., 2015). According to the AND, there is currently no scientific evidence to defend that following a gluten-free diet will lead to weight loss (Marcason, 2011). Following a gluten-free diet results in a dietary pattern lower in carbohydrates, iron, folate, niacin, zinc, and fiber, and higher in calories and fat (American Dietetic Association, 2009; Valletta et al., 2010; Vici, Belli, Biondi, & Polzonetti, 2016). One study found that celiac disease patients may experience weight gain after following the gluten-free diet (Kabbani et al., 2012).

Intermittent Fasting

Intermittent fasting has been practiced throughout history not only in ancient and biblical times, but by Hippocrates, Plutarch, and Mark Twain. It is also traditionally practiced in several religions today including Ramadan by Muslims as well as various days and holidays fasted throughout the year by Christians, Jews, Buddhists, and Hindus (Fung & Moore, 2016). Intermittent fasting gained popularity as a weight loss dietary pattern in 2013, when the book, “The FastDiet,” was published in England by British journalists Michael Mosley and Mimi Spencer (Patterson et al., 2015). Intermittent fasting is defined as consuming little to no food or beverage intake for a period of time, which may range from 12 hours to three weeks. Unlike most diets, intermittent fasting does not focus on calorie restriction but on the frequency and timing of meals (Longo & Mattson, 2014).

Mechanism and Theory Behind Intermittent Fasting

There are several theories behind the success of intermittent fasting including the positive effects on circadian biology, gastrointestinal microbiota, ketosis and brain functioning, and insulin sensitivity (Longo & Mattson, 2014; Patterson et al., 2015). Circadian rhythm regulates mental and physical characteristics throughout the course of a day (National Institutes of Health (NIH), 2016). Time of day plays the primary role in hormone regulation, metabolism, energetics, and sleep (Froy & Misikin, 2010). Light and darkness also help regulate the circadian rhythm, with darkness associated with slowing metabolism and a production of more melatonin, a hormone that can cause drowsiness. (Challet, 2013; NIH, 2016). When energy consumption occurs during the evening, at the time when the circadian rhythm would be slowing and preparing for rest, a disruption in hormonal and energy imbalance occurs and may specifically affect mood and the metabolic hormones, insulin and leptin (Challet, 2013; Harvey, 2007; Moult & Harvey, 2008; O'Malley et al., 2007; Starr & Convit, 2007). Fasting may regulate circadian biology by allowing the body to rest and continue its natural cycle and lead to a decrease of chronic disease by decreasing oxidative stress and inflammation and producing more regulated sleep patterns, hormone production, energy metabolism, and body weight (Grundy et al., 2013; Hatori et al., 2012; Lavin et al., 2011; Savvidis & Koutsilieris, 2012; Scheer, Hilton, Mantzoros, & Shea, 2009; Stevens et al., 2007; Straif et al., 2007). Research involving intermittent fasting and circadian rhythm has been conducted on animals but evidence has shown that consuming meals earlier in the day may decrease weight and enhance health (Bo et al., 2014; Collier, 2013; Cahill et al., 2013; Eckel-Mahan et al., 2013; Harvie & Howell, 2017; Jakubowicz, Barnea, Wainstein, & Froy, 2013; Vander Wal, 2012).

Functioning of the gastrointestinal tract may also be affected by the circadian rhythm, with a normal cycle resulting in greater gastric emptying and blood flow during the day and slower metabolism and functioning during the evening (Goo, Moore, Greenberg, & Alazraki, 1987; Sanders & Moore, 1992). Some studies propose that disruptions in the circadian rhythm may also hinder the proper growth and production of good gut microflora and increase the obesity-associated microflora, which may in turn lead to increased inflammation and risk of obesity-related diseases (Ridaura et al., 2013; Shen, Obin, & Zhao, 2013; Thaiss et al., 2014; Tilg & Kaser, 2011; Turnbaugh et al., 2006).

After fasting for a longer period of time, of at least 10 to 14 hours, glycogen stores in the liver are depleted and adipose cells release fatty acids, which the liver converts into ketone bodies that will be used as the major cellular fuel source (Camandola & Mattson, 2017; Courchesne-Loyer et al., 2017; Mattson, Moehl, Ghena, Schmaedick, & Cheng, 2018). Evidence has shown that the switch to fat as the major fuel source may enhance cognitive and physical performance when in a state of fasting (Longo & Mattson, 2014; Mattson, 2012). Being in a state of ketosis has also been associated with increased memory and brain functioning, along with slowed brain disease, although most studies have been conducted on rodents (Kashiwaya et al., 2013; Maalouf, Rho, & Mattson, 2009; Murray et al., 2016). Due to this relationship with ketosis, the ketogenic diet has often been paired with intermittent fasting **(**Clark, 2017; Perillo, 2019). However, Li, Wang, & Zuo conducted an 11-month study and found that mice who practiced intermittent fasting had better learning and memory while those that were fed a high fat diet had hyperlipidemia, obesity, decreased exercise tolerance, and did not have significantly better learning or cognitive functioning (Li, Wang, & Zuo, 2013).

In prolonged periods of fasting, ketones and ghrelin are elevated and glucose, leptin, and pro-inflammatory cytokines are decreased (Mattson, Moehl, Ghena, Schmaedick, & Cheng, 2018). Insulin is an anabolic, or building, hormone that takes glucose into the cell to use as energy. Insulin resistance is when the body does not react as quickly or easily to glucose for cellular uptake and is associated with excess body fat and weight (Kursawe et al., 2010; NIDDK, 2018). A state of prolonged fasting results in fat being used as the major fuel source for energy in the form of ketones (Mattson, Moehl, Ghena, Schmaedick, & Cheng, 2018). This process may increase insulin sensitivity by strengthening the uptake and use of glucose and triggering the release of the hormone GLP-1, which stimulates insulin to be released from the pancreas and boosts insulin sensitivity (Mattson, Moehl, Ghena, Schmaedick, & Cheng, 2018). Because of the potential relationship between insulin and fasting, some studies are researching the effect of intermittent fasting on diabetes, with results showing a decrease in fasting glucose and insulin resistance and increases in insulin sensitivity (Arnason, Bowen, & Mansell, 2017; Kahleova et al., 2014; Mager et al., 2006).

Intermittent fasting is not traditionally associated with caloric restriction but rather focuses on the timing of meals, which should result in a caloric reduction and ultimately a deficit (National Institute on Aging, 2018; Patterson et al., 2015). Counting calories in not encouraged but instead reducing overall intake and how often it is consumed (Longo & Mattson, 2014). In one study, mice who practiced intermittent fasting experienced increased muscle coordination, activity, and energy expenditure towards the end of their feeding period (Hatori et al., 2012).

Benefits of Intermittent Fasting on Health

In studies of laboratory rats and mice, intermittent fasting resulted in beneficial effects against cardiovascular disease, diabetes, cancer, Alzheimer's disease, Parkinson's, and stroke due specifically to its association with lower glucose and insulin levels, increased lipid metabolism, reduced visceral fat, blood pressure, inflammatory response and oxidative stress (Azevedoa, Ikeokab, & Caramellia, 2013; Fontana et al., 3007; Mager et al., 2006; Mattson, Longo, & Harvie, 2017; Tajes et al., 2010; Varady, Bhutani, Church, & Klempel, 2009; Varady et al., 2007; Wei et al., 2018). Many studies regarding fasting have been conducted on participants observing Ramadan, a Muslim holiday in which fasting is practiced for approximately one month. The health benefits recognized in these studies concluded a reduction in inflammation and improvement in blood pressure, and lipid and glucose levels (Dewanti, Watanabe, Sulistiawati, & Ohtsuka, 2006; Faris et al., 2012; Hassanein, 2010; Khan, Khan, Shaikh, & Khanani, 2010; Shehab, Abdulle, El Issa, Al Suwaidi, & Nagelkerke, 2012).

Studies regarding intermittent fasting have also found similar results in both obese and healthy weight participants and may be associated with decreases in body weight, waist circumference, total and LDL cholesterol levels, adipokines like leptin, and oxidative stress (Harvie et al., 2011; Johnson et al., 2007; Kroeger et al., 2012; Michalsen & Li, 2013; Varady, Bhutani, Church, & Klempel, 2009). One study found that short term intermittent fasting may promote long-term gut health (Catterson et al., 2018). Most of these studies have been short term, lasting one to two months (Johnstone, 2015; Johnson et al., 2007; Patterson et al., 2015; Varady, Bhutani, Church, & Klempel, 2009). Overall, there are few studies reporting long-term results with intermittent fasting (Patterson et al., 2015).

Intermittent fasting has been associated with weight loss, although not significantly more than a general calorie restricted or conventional weight loss diet (Harris et al., 2018; Harvie et al., 2011; Keogh, Pedersen, Petersen, & Clifton, 2014; Schubel et al., 2018; Seimon et al., 2015). Fasting has been associated with rapid early weight loss that may include an average of two pounds per day, some of which may be regained upon eating again (Fung & Moore, 2016). Reductions in weight loss are found in overweight and obese subjects, although most cohorts are small, at less than 100 participants (Eshghinia & Mohammadzadeh , 2013; Horne et al., 2013; LeCheminant, Christenson, Bailey, & Tucker, 2013; Tinsley & La Bounty, 2015; Varady, Bhutani, Church, & Klempel, 2009). Percent body fat, waist circumference, and fat mass may also decrease with fasting, although some subjects were participating in physical activity concurrently (Keogh, Pedersen, Petersen, & Clifton, 2014; Minsuk et al., 2018).

Although a small number of studies have been conducted concerning the effect of intermittent fasting on mood and behavioral side effects, those that have been researched have found that fasting may lead to less irritability, anger, tension, and confusion, mood enhancement, and positive psychological experience that results in a sense of pride, achievement, and control (Harvie et al., 2011; Harvie et al., 2013; Hussin, Shahar, Teng, Ngah, & Das, 2013; Michalsen, 2010; Patterson et al., 2015; Watkins & Serpell, 2016). One study found that mood enhancement may begin during fasting from days two to seven (Fond, Macgregor, Leboyer, & Michalsen, 2013). In women who fasted, it was found that a less positive mood was not associated with hunger (Appleton & Baker, 2015). Fasting may also decrease both ghrelin and leptin, the appetite hormones (Natalucci, Riedl, Gleiss, Zidek, & Frisch, 2005; Varady et al., 2013). In studies of night and shift workers, appetite hormone changes resulted in increased energy intake (Crispim et al., 2011; Schiavo-Cardozo, Lima, Pareja, & Geloneze, 2013; Wirth et al., 2014). As for energy levels, some subjects reported fatigue during fasting as well as daytime sleepiness (Almeneessier & BaHammam, 2018; Chtourou, et al., 2011). In rodent studies, intermittent fasting enhanced cognitive performance (Fontán-Lozano et al., 2007; Singh et al., 2012). Few studies were found that examined the association between intermittent fasting and sleep, although an older study reported that fasting promoted sleep quality and daytime performance while another reported no association between fasting and sleep (Almeneessier & BaHammam, 2018; Michalsen et al., 2003a; Patterson et al., 2015).

Intermittent Fasting Regimens

There are a variety of intermittent fasting categories from the traditional 12-hour fast to up to several months (Fung & Moore, 2016). The more common and most studied include alternate day fasting, modified fasting regimens, time-restricted feeding, and religious fasting. Alternate day fasting is comprised of days of complete fasting, in which no energy-containing food or beverages are consumed, followed by days of energy consumption as liberally as desired (Patterson et al., 2015). This intermittent fasting pattern has been associated with weight loss, although hunger was reported on the alternate fasting days, which did not decrease with time (Heilbronn, Smith, Martin, Anton, & Ravussin, 2005; Horne et al., 2013; Oh et al., 2018; Tinsley & La Bounty, 2015). One of the challenges of intermittent fasting may be experiencing hunger although researchers have found that consuming at least one small meal may lessen the effects (Heilbronn, Smith, Martin, Anton, & Ravussin, 2005; Varady, Bhutani, Church, & Klempel, 2009).

Modified fasting regimens generally follow a 5:2 pattern, which involves a 20-25% energy restriction on two non-consecutive days of the week and five days of normal energy consumption (Moseley & Spencer, 2014; Patterson et al., 2015). Several studies following this fasting pattern were associated with significant weight loss over a two to six-month period of time and showed more weight loss than energy restricted diets alone (Barnosky, Hoddy, Unterman, & Varady, 2014; Bhutani, Klempel Kroeger, Trepanowski, & Varady, 2013; Johnson et al., 2007). Modified fasting regimens have also been associated with positive mood and reductions in fatigue, stress, and anger. Negative side effects reported by a small number of participants have been irritability, low energy, hunger, and feeling cold (Harvie et al., 2011; Harvie et al., 2013; Johnson et al., 2007; Varady et al., 2013).

Time-Restricted Feeding

Time-restricted feeding involves consuming energy liberally or "ad libitum," meaning "as much or often as desired," within a 12 to 20-hour window on a routine daily basis, with the majority of fasting taking place overnight (Longo & Panda, 2016; Patterson et al., 2015). One of the more studied time-restricted feeding schedules is the eight-hour window for energy consumption, also phrased as "16-hour fasting." (Chaix, Zarrinpar, Miu, & Panda, 2014; Gabel et al., 2018). Time-restricted feeding alone has been associated with a decreased risk of chronic diseases in both human and animal studies, although it is the least researched of all regimens (Rothschild, Hoddy, Jambazian, & Varady, 2014; Sutton et al., 2018). Alternate day and modified fasting regimens are associated with poor long-term adherence (Trepanowski et al., 2017). Time-restricted feeding may be more attractive due to daily liberalization of energy intake, requiring no calorie counting, is simple to follow, and may improve muscular strength and endurance (Gabel et al., 2018; Longo & Mattson, 2014; Tinsley et al., 2017).

Effects of Time-Restricted Feeding on Body Weight

Time-restricted feeding, without a physical activity factor, has been associated with significant weight loss, especially compared to those who consumed three meals per day (Carlson et al., 2007; LeCheminant, Christenson, Bailey, & Tucker, 2013; Stote et al., 2007). Gill and Panda found that subjects who fasted during a 10-hour window had four percent sustained weight loss for one year (Gill & Panda, 2015). Restricting energy intake to eight hours per day may specifically protect against weight gain and chronic disease and result in leaner body mass (Chaix, Zarrinpar, Miu, & Panda, 2014; Hatori et al., 2012; Stote et al., 2007). Gabel et al. found that time-restricted feeding may only mildly affect caloric reduction but is still associated with weight loss without calorie counting (Gabel et al., 2018). Other studies have found that four to eight-hour restricted feeding time may result in reduced caloric intake as well as significantly decrease fat mass without affecting lean body mass (Moro et al., 2016; Tinsley et al., 2017).

Effects of Time-Restricted Feeding on Energy, Mood, Sleep, and Hunger

Very little research has been conducted on energy levels, hunger levels, sleep, mood, and behavior side effects of time-restricted feeding (Longo & Panda, 2016; Patterson et al., 2015). Hunger was reported higher in the morning for subjects who consumed one meal per day with time-restricted feeding, but no significant changes were reported regarding negative mood or fatigue (Carlson et al., 2007; Patterson et al., 2015; Stote et al., 2007). Another study found improvement in appetite in those who practiced time-restricted feeding of six to 12-hour windows (Sutton et al., 2018).

As for sleep, a study of mice who practiced six-hour feeding times found improvements in locomotor activity rhythm and sleep awakening time (Wang et al., 2018). Gill and Panda found time-restricted feeding of a 10 to 11-hour window resulted in improved sleep at night and increased alertness during the day (Gill & Panda, 2015).

Summary

Obesity is increasing in the United States and is significantly impacting chronic disease, health care costs, academic performance, and employment (Carey, Singh, Brown, & Wilkinson, 2015; Cawley & Meyerhoefer, 2012; CDC, 2015; Gagnon & Stephens, 2015; Pan, Freedman, Gillespie, Park, & Sherry, 2011; Van Nuys et al., 2014). Obesity has been strongly associated with excessive energy intake and physical inactivity and has been treated by many methods throughout the years including calorie restriction, breakfast consumption, energy dense foods, increased exercise, medication, surgery, and technology (Raynor & Champagne, 2016). Many dietary patterns have also been followed over the years for weight loss, with the most popular of the past year including Mediterranean, ketogenic, Paleo, Whole 30, gluten-free, and intermittent fasting (IFIC, 2018).

Intermittent fasting has demonstrated to significantly impact weight loss and chronic disease risk (Tinsley & La Bounty, 2015). However, the results have not proven to be more than the weight loss associated with calorie restricted diets (Keogh, Pedersen, Petersen, & Clifton, 2014; Schubel et al., 2015). Moreover, more long-term studies are needed to assess its sustainability with long term health effects (Harris et al., 2018; Tinsley & La Bounty, 2015). Intermittent fasting may also have a positive effect on mood, fatigue, sleep, and hunger, although there have been no significant associations due to minimal available research (Hussin, Shahar, Teng, Ngah, & Das, 2013).

Time-restricted feeding is a regimen of intermittent fasting in which energy is consumed ad libitum each day during a feeding window from four to 12 hours, with a state of fasting during all other hours of the day (Patterson et al., 2015). This fasting regimen has also been strongly associated with significant weight and fat loss and decrease of chronic disease, although it has been the least studied type of fasting (Stote et al., 2007; Tinsley et al., 2017). There has been very little research conducted concerning mood, energy levels, sleep, and hunger and time-restricted feeding and thus no conclusions can be made on the relationship at this time (Longo & Panda, 2016; Patterson et al., 2015).

CHAPTER 3

METHODS

The purpose of this study was to investigate the effect of time-restricted eight-hour feeding on body weight, self-reported energy levels, self-reported mood, self-reported sleep patterns, and self-reported hunger levels of adult men and women on social media. The research design allowed for the collection of information regarding body weight and health behavior side effects including energy, mood, sleep, and hunger scores. Approval was obtained from the Louisiana Tech University Human Use Committee before data collection began.

Subjects

The participants were generally chronic disease-free men and women, ages 18 to 65 years, with body mass indexes (BMI) in the normal, overweight, or obese classifications. Chronic disease exceptions were those with hypertension. Subjects who were pregnant, breastfeeding, or on any medications other than nutritional supplements, multivitamins, birth control, and blood pressure medications were excluded. Participants whose BMI were classified as underweight were also excluded from the study. Lastly, participants who were currently practicing intermittent fasting were excluded from the study as well. Participant data was used in the final study analysis if they reported all three body weights which included the baseline, midpoint, and final weights and if they had completed at least five out of the seven (71.4%) daily surveys each week.

Data Collection Instrument

At the beginning of the study, participants filled out an initial, fifteen-question survey that gathered information regarding their self-selected identification number, gender, race, age, height, initial self-reported weight, occupation, frequency of exercise (average per week), time spent sitting at their job (per day), preexisting health conditions, current medication use, and whether they were practicing intermittent fasting currently or had in the past via Survey Monkey posted in the messaging platform, Remind (Appendix A-1). In this survey, participants chose a four-digit number to use for the remainder of the study, including the daily surveys.

An eight-question daily survey developed by the researcher was used for the collection of reported energy levels, mood, sleep patterns, hunger levels, and times participants began and ended fasting for the previous day. This daily survey was also created in Survey Monkey and distributed via Remind (Appendix A-2). Once the study began, the researcher sent the eight-question survey link to participants daily until the second to last day of the conclusion of the study. On the last day of the study, participants were asked to fill out the same daily survey, minus that day's date, but with eight additional questions, for a total of fifteen questions. These questions were regarding their opinion of intermittent fasting and if they would practice it again, if they changed their dietary pattern or made any change in health behaviors while participating in the study and if so, what did they do, if they liked the use of technology and the Remind app in this study, and if they would be interested in participating in similar studies in the future (Appendix A-3). Data collected by the Survey Monkey was downloaded by the researcher as an Excel spreadsheet for analysis.

Self-reported body weight was collected separately via direct message through Remind. Participants submitted their baseline weight via the initial survey one week prior to the study. For the midpoint and final weights, participants were given a period of four days following the second and fourth weeks of the intervention, to send their updated self-reported weight to the researcher. A total of three weight measurements were potentially collected for each participant.

Data Collection Procedure

An initial recruitment post was made via Facebook and Instagram using the researcher's personal accounts. The posts were made "public" with over 60 shares of the video by both the researcher and her friends and followers. This recruitment post included a short video of the researcher explaining the study in more detail and included a brief description of intermittent fasting, basic format of the study, time frame, criteria to enter, instructions of enrolling in the study, how to record one's accurate weight, and incentives for completion of the study. An email was also sent to all Louisiana Tech University faculty and staff with the same information and video attached. As mentioned in the video's instructions, those who were interested in participating could sign up for the study by texting "Sign me up intermittent fasting" along with their first and last name to the researcher's personal phone number. Once the researcher received the subject's contact information, it was inputted into the Remind software. Participants were then invited to register for Remind via text, which is a one-step process by sending "YES" to the text invitation. The researcher then sent them an initial survey and instructional video within 24 hours of their registration. These instructions were described in the initial video.

After the participant group was finalized and approximately one week before data collection began, another short video was sent to participants individually through Remind, which included instructions for time-restricted eight-hour feeding and a detailed description of the study's process. At that time, participants also received a link to the baseline survey.

During the baseline week of the study, participants were asked to follow their normal eating patterns, while recording their energy, mood, sleep, and hunger levels once daily through the survey sent via Remind. The daily surveys were sent at twelve o'clock noon each day throughout the study.

During the intervention weeks, participants were expected to follow a self-determined diet with a feeding window of ≤ eight hours, also referred to as a minimum of 16-hours of fasting, per day. The eight hours selected to eat each day was left up to the individual participant and the researchers relied on participant truthfulness of the self-reported data obtained by the daily surveys. At the midpoint and the end of the intervention weeks, participants sent their measured body weight in a direct message to the researcher. By the end of the study period, data was received from over 75 subjects as proposed, so a repeat of the study with an additional participant group was not necessary.

As an incentive, participants who completed the study, including all three weigh-ins and providing a minimum of 37 completed surveys, were entered into a drawing for a Series 4 GPS 40mm Apple Watch and four Amazon gift cards. At the completion of the study, the researcher performed the drawings for the Apple Watch and gift cards and the winning participants were notified.

Data Analyses

The statistical software that was used to analyze the data of this study was Statistical Package for the Social Sciences (SPSS) BASE for Students, version 25, and Excel. Data was ordinal and interval. Body weight and BMI were organized into baseline, midpoint, and final weights. Eating times, energy, mood, sleep, and hunger scores were classified as baseline; weeks one to two of intervention, using the end of week two as midpoint; and weeks three to four for second half of intervention, with final data from the conclusion of week four. Descriptive statistics were calculated to characterize body weight, self-reported energy scores, self-reported mood scores, self-reported sleep patterns, self-reported hunger scores, and eating times. A paired samples t-test was used to compare self-reported body weight and BMI from baseline to midpoint and baseline to the final week of the study. Paired samples t-tests were also used to compare self-reported energy scores, self-reported mood scores, self-reported sleep patterns, self-reported hunger scores, and eating times from baseline to midpoint of intermittent fasting and baseline to the final week of intermittent fasting. Pearson and Spearman Correlations were also conducted to explore additional associations. In this study, the independent variable was a four-week time-restricted feeding of ≤ eight hours per day and the dependent variables were body weight, self-reported energy scores, self-reported mood, self-reported sleep patterns, self-reported hunger, and eating times.

CHAPTER 4:

RESULTS

One-hundred twenty-nine participants initially participated in the study. Of this number, eighty-six (66.67%) completed the study and met the criteria set for adequacy of responses to be analyzed. Forty-three participants (33.33%) did not meet the criteria due to completing four or less daily surveys per week or not reporting body weight for all three time points. The majority of the participants were female (*n*= 70; 81.39%) and were white or Caucasian (*n*=76; 88.37%). The most common age groups of the participants were 18-25 (*n*=31; 36.05%) and 26-35 (*n*=24; 27.91%) years of age. The most frequently reported employment was Health Science or Health Care field (*n*=20; 23.26%), followed by responses in the “Other” category (n=15; 17.44%). Twenty-five participants (29.07%) reported having practiced intermittent fasting prior to the study. Additional information gathered from the baseline survey indicated that 31.39% (*n*=27) of participants spent six to seven hours sitting at their job each day, 23.26% (*n*=20) spent two to three hours, and 23.26% (*n*=20) spent four to five hours. The most commonly reported frequency of exercise was two to three times per week by 45.35% (*n*=39) of participants (Table 1).

Table 1

Demographic Characteristics of Participants (*N*=86)

Characteristic	*n* (%)
Have you ever practiced intermittent fasting before?	
Yes	25 (29.07)
No	61 (70.93)
Gender	
Male	16 (18.60)
Female	70 (81.39)
Age (yrs)	
18-25	31 (36.05)
26-35	24 (27.91)
36-45	12 (13.95)
46-55	13 (15.12)
56-65	6 (6.98)
Race	
White or Caucasian	76 (88.37)
Black or African American	8 (9.30)
American Indian or Alaska Native	0 (0)
Asian or Asian American	1 (1.16)
Native Hawaiian or Pacific Islander	0 (0)
Other	1 (1.16)

Table 1 Cont'd

Characteristic	*n* (%)
Occupation	
Administration, Business, Finance	13 (15.11)
Architecture, Construction, Manufacturing	2 (2.33)
Arts and Entertainment	2 (2.33)
College Student	16 (18.60)
Education and Training	12 (13.95)
Government and Public Administration	1 (1.16)
Health Science and Health Care	20 (23.26)
Hospitality and Human Services	2 (2.33)
Currently Unemployed	3 (3.49)
Other	15 (17.44)
Hours Spent Sitting At Job Per Day	
0-1 hours	12 (13.95)
2-3 hours	20 (23.26)
4-5 hours	20 (23.26)
6-7 hours	27 (31.39)
8+ hours	7 (8.14)
Number of Times of Exercise Per Week	
None	15 (17.44)
Once weekly	12 (13.95)
2-3 times per week	39 (45.35)
4-5 times per week	18 (20.93)
6+ times per week	2 (2.33)

At baseline, the average span of hours of feeding each day was 11.53 hours ±1.75. During both the first two weeks of time-restricted feeding (7.72 hours ±.73) and the total four weeks of time-restricted feeding (7.53 hours ±.91), the average of participants adhered to the instructed eight-hour feeding restriction (Table 2).

Table 2

Self-Reported Number of Hours of Food Consumption Each Day (*N*=86)

	Baseline (*Mean* ± *SD*)	Weeks 1-2 IF (*Mean* ± *SD*)	Week 5 IF (*Mean* ± *SD*)
Daily Hours of Feeding	11.53±1.75	7.72±.73	7.53±.91

Note: IF = Intermittent Fasting

The majority of participants (n=86) lost weight from baseline to the study midpoint (*M*= 2.03, *SD* 5.11) and from baseline to the final self-reported weight (*M*= 3.49, *SD* = 7.08). This difference was statistically significant for both time periods, respectively ($t(85) = 3.679$, $p < 0.05$; $t(85) = 4.570$, $p < 0.05$). As expected, BMI also decreased from baseline to midpoint (*M*= .318, *SD* = .742) and baseline to final BMI (*M* = .567, *SD* = 1.10) which was also statistically significant for both time periods ($t(85) = 3.979$, $p < 0.05$; $t(85) = 4.782$, $p < 0.05$), respectively (Table 3).

Table 3

Baseline, Midpoint, and Final Body Weight and BMI Changes (*N*=86)

	Baseline to Midpoint (*Mean* ± *SD*)	Baseline to Final (*Mean* ± *SD*)	*P*-value Baseline to Midpoint	*P*-value Baseline to Final
Weight loss (lb)	2.03±5.11*	3.49±7.08*	< 0.01	< 0.01
BMI (kg/m^2)	.318±.742*	.567±.1.10*	< 0.01	< 0.01

Note: *$p < 0.05$

A Pearson correlation was run to examine the relationship between initial BMI and eating times after starting intermittent fasting. The test showed a significant negative correlation, indicating that the higher the BMI at baseline, the shorter the eating time window while fasting during the first two weeks, the last two weeks, and the final week of intermittent fasting (Table 4).

Another Pearson correlation was conducted between the change in BMI at baseline weeks one through five and eating times. A strong positive correlation was found meaning that as BMI change increased, the eating times lengthened while still staying within the allotted eight hour feeding time (Table 4).

Table 4

Pearson's Correlations for Initial BMI and Eating Times Hours After Intermittent Fasting Began and Change in BMI at Baseline Weeks 1 Through 5 (*r* = 86)

		r	*P*-value
Initial BMI and Eating Times After IF Began			
	Two Weeks IF	-.254*	.018
	Four Weeks IF	-.253*	.019
	Final Week IF	-.226*	.037
Changes in BMI at Baseline Weeks 1-5			
	ET Week 1	.247*	.022
	ET Weeks 2-3	.290*	.007
	ET Weeks 4-5	.277*	.010
	ET Week 5	.250*	.020

Note: *p <0.01. IF = intermittent fasting. ET = Eating time in hours.

Mean mood scores increased significantly from baseline to the midpoint of intermittent fasting ($t(85) = 4.010$, $p < 0.05$) and from baseline to the final week of intermittent fasting ($t(85) = 6.055$, $p < 0.05$). Reported energy level and hunger did not differ significantly after any amount of time (Table 5).

Table 5

Self-Reported Energy, Mood, and Hunger Changes (*N*=86)

	Baseline (*Mean* ± *SD*)	Baseline to 2 Wks IF (*Mean* ± *SD*)	Baseline to 4 Wks IF (*Mean* ± *SD*)	*P*-value Baseline to 2 Wks IF	*P*-value Baseline to 4 Wks IF
Energy	5.567±1.13	-.040±.881	-.252±1.29	.678	.075
Mood	3.494±1.278	.459±1.06*	.876±1.34*	< 0.01	< 0.01
Hunger	4.622±1.293	-.215±1.23	.304±1.57	.107	.075

Note: *$p < 0.05$. IF = Intermittent fasting. Ratings were on a 1 to 10 scale for energy: 1 = little energy, 10 = lots of energy; mood: 1 = little irritability/agitation, 10 = extremely irritable/agitated; hunger: 1 = not hungry, 10 = extremely hungry.

Categories of hours of sleep were transformed to scores for analysis. Baseline hours of sleep were 3.230±.393. The change in hours of sleep increased significantly from baseline to two weeks of intermittent fasting (M = .078, SD = .342; $t(85) = -2.114$, $p < 0.05$). Sleep increased from an average of four to five hours of sleep at baseline to greater than five hours of sleep after two weeks of fasting. However, no significant change was found from baseline to the fourth week of intermittent fasting (M = -.071, SD = .402) (Table 6).

Table 6

Difference of Self-Reported Sleep Changes (N=86)

	Baseline (*Mean* ± *SD*)	Baseline to 2 Wks IF (*Mean* ± *SD*)	Baseline to 4 Wks IF (*Mean* ± *SD*)	*P*-value Baseline to 2 Wks IF	*P*-value Baseline to 4 Wks IF
Sleep	3.230±.393	3.308±.471	3.301±.484		
Sleep Change		-.078±.342*	-.071±.402	.037	.11

Note: *$p < 0.05$. IF = intermittent fasting. Hours slept were coded as: 1 = 0-3 hours; 2 = 4-5 hours; 3 = 6-7 hours; 4 = 8-9 hours; 5 = 10+ hours.

A Spearman correlation was also run with this study's results, investigating the relationship between weight loss and sleep. The test revealed a strong positive correlation between hours of sleep and mean difference in body weight from weeks three through five (Table 7).

Table 7

Spearman's Correlation Sleep and Mean Difference Body Weight Weeks 3-5 (N=86)

Mean Difference Week 3-5 Body Weight Weight	*P*-value Mean Difference Week 3-5 Body
.046*	$p < 0.01$

Note: *$p < 0.01$.

For the final self-report, 81 (94.19%) out of 86 participants completed the survey. Responses to the final eight survey questions showed 18 (22.22%) participants rated their overall opinion of intermittent fasting a seven out of 10 score and 17 (20.99%) gave it an eight out of 10 score, with one being they found little benefit and 10 being they found it extremely beneficial. The majority of the participants (*n*= 50; 61.73%) reported planning to continue intermittent fasting after the study's completion and 42 (51.85%) recorded they would specifically follow the 16:8 regimen. Sixty-one participants (75.31%) reported they changed health behaviors while participating in the study. The most frequently reported changes included drinking more water (*n*=34, 41.98%), changing portion sizes (*n*=25, 30.86%), and eating out less (*n*=25, 30.86%). Thirty participants (37.03%) changed their diet in some way while engaging in the study, with the most frequently reported being increasing fruits and vegetables (*n*=17, 20.99%) and decreasing carbohydrate (*n*=12, 14.81%) intake. Most participants liked the use of technology (*n*=80, 98.77%) and the Remind app (*n*=81, 100%). Seventy-four (91.36%) agreed they would be interested in participating in studies similar to this one in the future (Table 8).

Table 8

Participant Opinions of Intermittent Fasting and Diet Pattern Changes (*N*=81)

Rating	*n* (%)
What is your overall opinion of intermittent fasting?*	
1	2 (2.47)
2	3 (3.70)
3	6 (7.41)
4	5 (6.17)
5	7 (8.64)
6	10 (12.35)
7	18 (22.22)
8	16 (19.75)
9	6 (7.41)
10	8 (9.88)
After the conclusion of this study, do you plan to continue intermittent fasting?	
Yes	50 (61.73)
No	13 (16.05)
Not now, but one day in the future	18 (22.22)

Table 8 Cont'd

Question	*n* (%)
Do you plan to continue to follow the same 16:8 intermittent fasting regimen (16 hours fasting:8 hours feeding) after this study is completed?	
Yes	42 (51.85)
No	17 (20.99)
No plans to follow intermittent fasting.	21 (25.93)
While intermittent fasting during this study, did you change your health behaviors in any way? (Please select all that apply.)	
I changed the foods I ate.	14 (17.28)
I changed the portion sizes I ate.	25 (30.86)
I drank more water.	34 (41.98)
I started exercising.	10 (12.35)
I increased my weekly exercise.	10 (12.35)
I cooked meals at home more.	21 (25.93)
I ate out less.	25 (30.86)
I tried to get more sleep.	14 (17.28)
Other	6 (7.41)
No, I did not change my health behaviors in any way.	20 (24.69)

Table 8 Cont'd

Question	*n* (%)
While participating in this study, did you change your dietary pattern in any way? (Please check all that apply).	
Low carbohydrate	12 (14.81)
Low fat	0 (0)
Low sodium	2 (2.47)
Low sugar	7 (8.64)
Increased fruits and vegetables	17 (20.99)
Paleo	0 (0)
Ketogenic ("Keto")	4 (4.94)
Vegetarian/Vegan	1 (1.23)
Calorie counting	5 (6.17)
Mediterranean Diet	0 (0)
Gluten-Free	2 (2.47)
Other	2 (2.47)
No, I did not change my dietary pattern in any way.	51 (62.96)

*Ratings were on a scale from 1 to 10. 1= little benefit, 10 = extremely beneficial.

CHAPTER 5

DISCUSSION

This study examined the effect of an eight-hour time-restricted feeding on body weight, self-reported energy scores, self-reported mood scores, self-reported sleep patterns, and self-reported hunger scores in adult men and women. The hypothesis that there would be no significant change in body weight at the end of four weeks of time-restricted feeding was rejected. Results revealed a statistically significant decrease in both body weight and BMI from baseline to two weeks of time-restricted feeding and baseline to four weeks. The findings of this study were consistent with those found in multiple studies by Carlson et al., LeCheminant, Christenson, Bailey, & Tucker, and Stote et al. who found that time-restricted feeding, without a physical activity factor, was associated with significant weight loss (Carlson et al., 2007; LeCheminant, Christenson, Bailey, & Tucker, 2013; Stote et al., 2007). The findings of this study support that following intermittent fasting will most likely result in weight loss. However, due to other changes in diet not accounted for in this study, more research is needed regarding if fasting alone will produce weight changes.

On average, participants lost 3.49 pounds ± 7.08 pounds after four weeks of intermittent fasting, resulting in a decrease in BMI by .567 ± 1.10 kg/m^2. Similar findings by Varady, Bhutani, Church, and Klempel found that after eight weeks of alternate day fasting, participants who self-selected foods rather than were told what to eat, lost an average of 12.32 pounds (Varady, Bhutani, Church, & Klempel, 2009). Similarly, Gabel et al. found that after 12 weeks of time-restricted feeding at eight hours each day, participants' body weight decreased by 6.6 pounds compared to the control group, whose weight remained stable. One inclusion criterion for participants was a sedentary to lightly active physical activity regimen (<7500 steps per day) and there were no dietary restrictions on quantities or types of foods or monitoring caloric intake. Gabel et al. concluded that time-restricted feeding may only mildly affect a decrease in calories but was still associated with weight loss without calorie counting (Gabel et al., 2018). These results are comparable to the findings of the current study as only five participants (6.17%) reported calorie counting while following time-restricted feeding.

Participants reported compliance with the eight-hour feeding window during all four weeks of time-restricted feeding. One of the additional associations examined in this study examined the relationship between initial BMI and eating times after starting intermittent fasting. The test showed a significant negative correlation, indicating that the higher the BMI at baseline, the shorter the eating time window while fasting during the first two weeks, the last two weeks, and the final week of intermittent fasting. It was not determined if the participants with the higher BMI lost more weight due to these shorter eating times because of confounding factors that need to be further explored. There may have been an increase in motivation for these participants with the most weight to lose to choose a more extreme fasting time. No prior or similar study has been found examining this topic.

Another additional association investigated the change in BMI at baseline weeks one through five and eating times. A strong positive correlation was found meaning that as BMI change increased, the eating times lengthened while still staying within the allotted eight hour feeding time. This can also be translated as participants who lost the most weight ate on the higher end of the daily eight-hour guideline throughout the study. This finding is interesting to note because a longer fasting and shorter feeding period, specifically alternate day and modified fasting regimens, have been strongly associated with significant weight loss, compared to shorter periods of fasting and longer periods of feeding such as time-restricted feeding (Fung & Moore, 2016; Horne et al., 2013; Johnson et al., 2007; Varady, Bhutani, Church, & Klempel, 2009). However, according to some researchers, this may be an assumption due to lack of research for time-restricted feeding at this time (Gabel et al., 2018; Patterson et al., 2015). Thus, with more research, including findings from this additional correlation, it may be indicated that time-restricted feeding, particularly of an eight-hour window, is equally as or more beneficial than other intermittent fasting regimens.

Self-reported energy scores did not change significantly after two weeks or four weeks of fasting. The hypothesis that there would be no significant change in energy levels at the end of four weeks of time-restricted feeding is supported. Although very few studies have been conducted concerning the relationship of intermittent fasting to energy levels, the findings of this study are similar to those of Nugraha, Ghashang, Hamdan, and Gutenbrunner (2017). These researchers examined males practicing Ramadan who fasted approximately 19 hours per day and identified there was no significant impact on fatigue, mood, or quality of life (Nugraha, Ghashang, Hamdan, & Gutenbrunner, 2017). Harvie et al. also found that few participants reported any lack of energy while intermittent fasting (Harvie et al., 2011).

Self-reported hunger scores also did not change significantly after two or four weeks of time-restricted feeding. The hypothesis that there would be no significant change in hunger scores at the end of four weeks of time-restricted feeding is supported. This is contrary to Sutton et al. who identified improvement in appetite in those who practiced time-restricted feeding of six to 12-hour windows (Sutton et al., 2018). Contrarily, Stote et al. discovered there was a significant increase in hunger for subjects when time-restricted feeding (Stote et al., 2007).

Self-reported mood scores significantly increased both after two and four weeks of time-restricted feeding. Mood was defined as one being little irritability/agitation and 10 being extremely irritable/agitated. Thus, the results reflected an increase in irritability/agitation from baseline to both midpoint and final weeks of intermittent fasting. The hypothesis that there would be no significant change in mood scores at the end of four weeks of time-restricted feeding was rejected. This is contrary to what Hussin, Shahar, Teng, Ngah, and Das (2013) found in which following a fasting and calorie restricted diet significantly improved mood status in men. Older studies have also identified that mood significantly improved with fasting, although it was not related to weight loss. In these studies, Michalsen et al. 2006 asked participants to self-rate mood using the visual analogue scale (VAS) with zero representing worst mood and 10 representing best mood each day while Michalsen et al. 2003b used the Profile of Mood States (PMOS) at baseline and on the last day (Michalsen et al. 2006; Michalsen et al., 2003b). This study’s findings are also contrary to the those of Wilhelmi de Toledo, Grundler, Bergouignan, Drinda, & Michalsen (2019) who identified that participants who fasted for a longer period of time, defined as up to 21 consecutive days, reported a better self-rated emotional well-being than those who fasting for a shorter period of time. On the other hand, similar to the findings of the current study, Watkins and Serpell discovered that the fasting of 18 hours per day led to increased reported irritability. However, they also found that as participants continued fasting, and irritability and hunger increased, positive experiences such as pride, achievement, and control also increased (Watkins & Serpell, 2016). Since this study only required a reported score of a negative aspect of mood, defined as irritability and agitation, this may be related to why the self-reported mood significantly decreased.

The hypothesis stating that there would be no change in number of sleep hours after practicing time-restricted feeding is supported because by the end of the four weeks, there was no significant change in sleep. Reported hours of sleep did not change significantly from baseline to the end of the study, although they did significantly increase initially from baseline to the second week of fasting. Hsouna et al. similarly discovered that in participants practicing Ramandan, from 15 days prior to starting a fast to 10 days into fasting, sleep duration significantly increased, but by the last 10 days of the fasting period, hours of sleep had decreased (Hsouna et al., 2019). An earlier study reported that fasting promoted sleep quality and daytime performance while another found no association between sleep and fasting (Almeneessier & BaHammam, 2018; Michalsen et al., 2003a). In addition, Gill and Panda found that time-restricted feeding improved sleep at night and increased alertness during the day (Gill & Panda, 2015). While the current study did not examine the quality of sleep, the reported hours slept each night could have increased or decreased due to an endless number of factors. However, the similarities between the current study and Hsouna et al. regarding how hours of sleep both increased at the beginning but decreased by the end of the fasting period, are noteworthy (Hsouna et al., 2019).

A Spearman correlation was also run with this study's results, investigating the relationship between weight loss and sleep. The test revealed a strong positive correlation between hours of sleep and mean difference in body weight from weeks three through five (Table 8). This also may be translated to mean that as hours of sleep increased, weight loss increased from weeks three through five. Multiple studies have found a relationship between decreased self-reported sleep duration and increased obesity (Anic, Titus-Ernstoff, Newcomb, Trentham-Dietz, & Egan, 2010; Buxton & Marcelli, 2010; Lyytikäinen, Rahkonen, Lahelma, & Lallukka, 2011). In addition, it has been suggested that increased sleep duration may decrease obesity or body weight, although excessive sleep of more than nine to 10 hours may also be associated with weight gain and obesity (Bo et al., 2011; Chaput, Després, Bouchard, & Tremblay, 2008). Thus, it cannot be determined whether intermittent fasting itself was the primary reason for the relationship between increased sleep and increased weight loss at this time. More research is needed on this topic to determine conclusions at this time.

A large component of this study was the use of technology in the announcement of the study and data collection process. Technology is becoming a very beneficial and common method of data collection in research, in particular the use of mobile devices and web applications (Aanensen, Huntley, Feil, Al-Own, & Spratt, 2009). In a systematic review, the majority of the studies examined showed that the use of text messaging or mobile device applications promoted weight loss and healthy habits (Stephens & Allen, 2014). Patrick et al. (2009) found that text messages specifically may be a useful means of communication to promote weight loss. In this study, the Remind app text messaging system was well-liked by all participants (100%) and the use of technology was also reported as favorable by the majority (98.8%).

There were a few limitations noted with this study. Because the study was conducted using technology and not in-person, all data was self-reported by participants. There are possibilities that participants misinterpreted instructions and/or incorrectly submitted altered or miscommunicated data. Also, the scale of one to 10 may not have been the most accurate way to determine daily energy, mood, and hunger levels and a different measurement may have been more favorable for data collection. Body weight was also self-reported which may have been expressed as an estimated rather than actual body weight, an errored measurement from unbalanced scales, or inaccurate weight if taken later during the day. Optimally, all data, particularly body weight, would be obtained in person and on the same scale by the researcher. The study was also conducted over a short period of time, with participants intermittent fasting for four weeks. This time frame is more difficult to determine substantial, long term use of the dietary practice. Lastly, no food records were obtained during the study, which may have had an effect on weight loss or reported energy, mood, sleep, and hunger scores and could have validated the self-reports.

This study also had several strengths. This study had a significantly larger cohort than other studies of the same topic, with the majority of previous research ranging from 10 to 30 subjects (Patterson et al., 2015). The study also examined multiple topics in relationship to time-restricted feeding, specifically energy, mood, sleep, and hunger levels, whose current available evidence and research is limited.

CHAPTER 6:

CONCLUSIONS AND FUTURE WORK

This study found supportive evidence that following time-restricted feeding in the short term may be a strategy that promotes weight loss. Mood, specifically irritability and agitation, may also be negatively affected by time-restricted feeding. People may experience increased sleep duration but more research is needed to make conclusions at this time, particularly examining its effect long term. The initiation of this weight loss regimen may be associated with additional positive diet and health behavior changes.

Future studies should be conducted for a greater length of time to determine long term effects of weight, energy, mood, sleep, and hunger. It may also be beneficial to examine the dietary intake records of participants while fasting to determine if the types and caloric amounts of food consumed are associated with the outcomes. Regarding mood, it may be helpful to investigate not only the negative senses of mood, such as irritability and agitation, but also the effect of fasting on positive senses such as pride, achievement, and control simultaneously. It may also be useful to examine the outcome of time-restricted feeding not only on sleep quantity, but sleep quality, along with its relationship with weight. Lastly, it may be beneficial to study how many hours of fasting are needed to produce the most successful, sustainable weight loss and health status improvements. Time-restricted feeding may be a beneficial strategy for weight loss.

APPENDIX A:

SURVEYS

A-1 INITIAL SURVEY

A-2 DAILY SURVEY

A-3 FINAL SURVEY

A-1 INITIAL SURVEY

1. Do you have any preexisting health conditions (other than high blood pressure) that may cause intermittent fasting to be harmful to your health, such as diabetes, kidney disease, cancer, thyroid disorders, etc. or are you currently pregnant or breastfeeding?
    - Yes
    - No

2. Do you take any medication OTHER THAN a multivitamin, nutritional supplement, birth control, or blood pressure medication?
    - Yes
    - No

3. Have you ever practiced intermittent fasting before?
    - Yes
    - No

4. Are you currently still practicing intermittent fasting?
    - Yes
    - No

5. What is your age (in years)?
    - 18-25
    - 26-35
    - 36-45
    - 46-55
    - 56-65
    - Older than 65
    - Younger than 18

6. What is your current weight? (Right after you wake up, going to the bathroom)

    ____

7. What is your current height? (Feet’ Inches”)

    ____

8. What is your gender?
    - Male
    - Female

9. What is your race?
    - White or Caucasian
    - Black or African American
    - American Indian or Alaska Native
    - Asian or Asian American
    - Native Hawaiian or Pacific Islander
    - Another race

10. What is your occupation?
    - Administration, Business, Finance
    - Architecture, Construction, Manufacturing
    - Arts and Entertainment
    - College Student
    - Education and Training
    - Government and Public Administration
    - Health Science and Healthcare
    - Hospitality and Human Services
    - Law, Public Safety, Corrections, and Security
    - Science, Technology, Engineering, and Mathematics
    - Currently unemployed
    - Other (please specify): ____________

11. How much time do you spend SITTING at your job, per day?
    - 0-1 hours
    - 2-3 hours
    - 4-5 hours
    - 6-7 hours
    - 8+ hours

12. How often do you exercise per week?
    - None
    - Once weekly
    - 2-3 times per week
    - 4-5 times per week
    - 6+ times per week

13. What is your first and last name?

    ____

14. What is your cell phone number, including area code? This will be used for your text reminders for the daily survey.

    ____

15. Please choose a FOUR-digit number that you will remember. You will input this number as the first question of each of your surveys. This is how the researcher will identify your data.

    ____

A-2 DAILY SURVEY

1. What is your FOUR-digit assigned number? (this is the number that you selected at the beginning of the study)

   ____

2. What day of the week are you reporting for?
   - Sunday, May 26
   - Monday, May 27
   - Tuesday, May 28
   - Wednesday, May 29
   - Thursday, May 30
   - Friday, May 31
   - Saturday, June 1

3. How much sleep did you get last night?
   - 0-3 hours
   - 4-5 hours
   - 6-7 hours
   - 8-9 hours
   - 10+ hours

4. What time of the day did you start eating yesterday?

   ____

5. What time of the day did you stop eating yesterday?

   ____

6. On a scale of 1-10 (with 1 being not hungry and 10 being extremely hungry), how would you rate your hunger level on this day?

   ____

7. One a scale of 1-10 (with 1 being little energy and 10 being lots of energy), how would you rate your energy level on this day?

   ____

8. On a scale of 1-10 (with 1 being a little irritability/agitation and 10 being extremely irritable/agitated), how would you rate your mood on this day?

   ____

A-3 FINAL SURVEY

1. What is your FOUR-digit assigned number? (this is the number that you selected at the beginning of the study)

   ____

2. How much sleep did you get last night?
   - 0-3 hours
   - 4-5 hours
   - 6-7 hours
   - 8-9 hours
   - 10+ hours

3. What time of the day did you start eating yesterday?

   ____

4. What time of the day did you stop eating yesterday?

   ____

5. On a scale of 1-10 (with 1 being not hungry and 10 being extremely hungry), how would you rate your hunger level on this day?

   ____

6. One a scale of 1-10 (with 1 being little energy and 10 being lots of energy), how would you rate your energy level on this day?

   ____

7. On a scale of 1-10 (with 1 being a little irritability/agitation and 10 being extremely irritable/agitated), how would you rate your mood on this day?

   ____

8. What is your overall opinion of intermittent fasting? (1 being you find little benefit and 10 being extremely beneficial).

   ____

9. After the conclusion of this study, do you plan to continue intermittent fasting?
   - Yes
   - No
   - Not now, but one day in the future

10. If you answered "yes" to the question above, do you plan to continue to follow the same 16:8 intermittent fasting regimen (16 hours fasting:8 hours feeding) after this study is completed?

- Yes
- No
- I answered “no” to the question above.

11. While intermittent fasting during this study, did you change your health behaviors in any way? (Please select all that apply.)
    - I changed the foods I ate.
    - I changed the portion sizes I ate.
    - I drank more water.
    - I started exercising.
    - I increased my weekly exercise.
    - I cooked meals at home more.
    - I ate out less.
    - I tried to get more sleep.
    - Other
    - No, I did not change my health behaviors in any way.

12. While participating in this study, did you change your dietary pattern in any way? (Please check all that apply).
    - Low carbohydrate
    - Low fat
    - Low sodium
    - Low sugar
    - Increased fruits and vegetables
    - Paleo
    - Ketogenic (“Keto”)
    - Vegetarian/Vegan
    - Calorie counting
    - Mediterranean Diet
    - Gluten-Free
    - Other
    - No, I did not change my dietary pattern in any way.

13. Did you like the use of technology in this study?
    - Yes
    - No

14. Did you find the daily survey and "Remind" easy to use and navigate?
    - Yes
    - No

15. Would you be interested in participating in other studies similar to this one in the future?
    - Yes
    - No

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