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Examination of Perceptions of Weight Loss and Weight Loss Methods

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Examination of Perceptions of Weight Loss and Weight Loss Methods

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ABSTRACT

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The purpose of this study was to examine individuals' perceptions of weight loss and weight loss methods. Respondents were employees and customers attending health/wellness events at local supermarkets in June, July, and August 2019. Participants completed a survey to assess their understanding and perceptions of weight loss and methods used to achieve weight loss. The majority of participants were white females, 60 years or older with a college degree and a Body Mass Index (BMI) classified as overweight or obese. Data revealed most participants had a variety of misconceptions relating to weight loss and weight loss methods that were obscure and fad-diet oriented, including low-carbohydrate diets. Participants did understand benefits of weight loss but expressed maintaining weight loss was a challenge. These findings suggest that fad diets are alluring to individuals and individuals did not incorporate evidence-based behavior changes to promote or sustain weight loss.

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CHAPTER 1

INTRODUCTION

More than 2 out of 3 adults (70.2%) in the United States (U.S.) are considered overweight or obese, denoting a pronounced health concern ("Adult Obesity Causes & Consequences", 2019). Tennessee ranks 15th of all 50 states as the highest adult obesity rate and 20th for obesity rate in youth ages 10 to 17 ("State Briefs", 2019). Among the aforementioned 70.2% of adults in the nation, 32.5% are overweight and 37.7% are obese. (Overweight & Obesity Statistics, 2017). The National Center for Health Statistics Data Brief from 2013-2016, reports nearly half (49.1%) of adults in the U.S. tried to lose weight within the last 12 months (Herrick, Ogden, & Sarafrazzi, 2018). With the endless onslaught of nutrition information from celebrities, weight experts, federal agencies, and self-proclaimed experts, healthy weight loss and sustainable weight maintenance can be challenging.

Overweight and obesity not only increase health risks, but also accrue high healthcare costs (Finkelstein, Trogdon, Cogen & Dietz, 2009). Obesity is a major independent risk factor for developing costly diseases such as type 2 diabetes, with more than 90% of persons with type 2 diabetes being overweight or obese (Jensen et al., 2014). The American Diabetes Association estimates the total costs of diagnosed diabetes has risen to $327 billion in 2017 from $245 billion in 2012 when the cost was last examined (Yang et al., 2018). This is a 26% increase over a 5-year period (Association, 2019). Overweight and obesity also significantly impact health expenditures with additional occurrences of chronic medical problems, impairment of health-related quality of life, and increasing health care and medication spending (Kelishadi, Djalalinia, Qorbani, Peykari & Kelishadi, 2014). Research has clarified relationships between diet and disease, enabling the promotion of dietary recommendations for preventing chronic disease.

The 2015-2020 Dietary Guidelines for Americans translates science into succinct, food-based guidance that can be relied upon to help Americans choose foods that provide a healthy and enjoyable diet ("2015-2020 Dietary Guidelines", 2019). These guidelines provide a comprehensive set of evidence-based recommendations for healthy eating and physical activity patterns Americans can adopt to help reduce their risk for many chronic diseases. The recommendations are intended to inform public policy and practice guidelines for healthcare professionals to help individuals improve and maintain overall health and reduce the risk of chronic disease while focusing on disease prevention ("2015-2020 Dietary Guidelines", 2019). Recommendations include eating the appropriate number of calories, making half your plate fruits and vegetables, half your grains whole grains, switching to low-fat or fat-free milk or yogurt, choosing lean proteins, and limiting saturated and *trans* fats, added sugars, and sodium ("2015-2020 Dietary Guidelines", 2019).

The typical American eating pattern does not meet recommendations in the Dietary Guidelines for Americans. National intakes of total grains are close to target amounts, but do not meet the recommendations for whole grains and exceeds limits for refined grains ("2015-2020 Dietary Guidelines ", 2019). Average intakes of dairy for most age-sex groups are far below recommendations of the healthy U.S.-style pattern. Recommended oil intakes are far below recommendations for almost every age-sex group, with most oils being consumed in packaged foods from salad dressings, mayonnaise, and snack chips. Calories from added sugars are particularly high in U.S. diets. Added sugars account for an average of almost 270 calories, or more than 13% of calories per day for individuals in the U.S. population. Primary sources of added sugars in the U.S. diet are derived from soft drinks, fruit drinks, sweetened coffee and tea, energy drinks, alcoholic beverages, and flavored waters. Almost half (47%) of all added sugars

are consumed through beverages. Lastly, only 29% of individuals in the U.S. consume saturated fats consistent with the recommendation of less than 10% of calories from saturated fats ("2015-2020 Dietary Guidelines", 2019).

Health and nutrition professionals agree that the key to long-term weight loss management is permanent lifestyle changes. While research is limited, the American culture seems to be saturated with advertisements promoting rapid weight loss. The purpose of this study is to explore self-directed dieting methods commonly used by individuals in East Tennessee as well as their perceptions and understanding of both short-term and long-term weight loss success and maintenance.

CHAPTER 2

REVIEW OF THE LITERATURE

Health Risks of Obesity

A myriad of increased health risks are associated with overweight or obese including, heart disease, type 2 diabetes, hypertension, sleep apnea, cancer, poor bone health, and stroke ("Adult Obesity Causes & Consequences", 2019). Research has shown that for every 10-kilogram (kg) increase in body weight, there is an associated increase of 3 millimeters of mercury (mmHg) and 2 millimeters of mercury (mmHg) in systolic and diastolic blood pressure, respectively (Ogunbode, Fatiregun & Ogunbode, 2009). Body Mass Index (BMI), a measurement of body fatness using an individuals' weight and height, is often used as an indicator of one's health and is strongly correlated with various metabolic and disease outcomes ("About Adult BMI", 2019)**.** Table 1 below categorizes BMI and weight class:

Table 1.

Classification of Overweight and Obesity by BMI

BMI	**Weight Classification**
Below 18.5	Underweight
18.5 – 24.9	Normal or Healthy Weight
25.0 – 29.9	Overweight
30.0 and above	Obese
≥ 40	Extreme or Severe Obesity

("About BMI | Healthy Weight | CDC", 2019)

A BMI of $\geq$25kg/m^2 and abdominal adiposity are associated with an increased risk of the leading cause of death in the U.S., heart disease (Aune et al., 2016; Murphy, Xu, Kochanek & Arias, 2019). When large amounts of adipose tissue are stored in the body, high levels of free fatty acids are produced, accumulating in organs, leading to the development of hypertriglyceridemia and an increase in the production of low-density lipoproteins (LDL) (Ogunbode, Fatiregun, & Ogunbode, 2009). Elevated levels of LDL-cholesterol are a strong precursor for atherosclerotic build up in arteries, increasing the risk for heart attack and stroke (Imamura et al., 2009). Studies have confirmed that obesity is one of the greatest determinants in decreased life expectancy (Kelishadi et al., 2014).

Obesity Etiology

Causes of overweight and obesity are multifactorial and are poorly understood (Wright, 2012). However, excessive energy consumption in relation to energy expenditure, i.e. energy lost through metabolism and physical activity, is the most common physiological cause of obesity (Wright, 2012). Nonetheless, the etiology of obesity is highly varied, involving genetics, physiologic, environmental, psychological, social, economic, and even political factors that interact in varying degrees that promote weight gain (Aronne, 2009). The obesogenic environment is of prominent concern, being defined as "the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations" (Lipek, Igel, Gausche, Kiess, & Grande, 2015). As time has gone on, physical activity has declined, and food availability has drastically increased. This equates to greater calories in than out, resulting in weight gain. For many cases, obesity is "the result of people responding normally to the obesogenic environment they find themselves in." (Lipek et al., 2015).

The Centers of Disease Control (CDC) reported that during January-September 2018, 54% of U.S. adults aged 18 and over met the 2008 federal physical activity guidelines of 150 minutes per week of moderate-to-intense physical activity (CDC, 2017). The majority of children and youth in the U.S. do not meet physical activity recommendations (78.4%) with a decline in physical activity levels as individuals transition into adolescence (Katzmarzyk, 2016). Technological advancements have decreased physical activity further by many daily tasks being sedentary through the use of TV remotes, automatic garage doors, riding lawn mowers, escalators, etc. (Wright, 2012).

Moreover, a large percentage of meals for Americans are obtained from outside the home from fast food chains and dining restaurants ("Fast Food Consumption Among Adults in the United States, 2013-2016", 2017). The CDC revealed that in 2013-2016, 36.6% of adults consumed fast food each day and of adults who consumed fast food, the most commonly reported eating occasions were lunch (43.7%) and dinner (42.0%), followed by breakfast (22.7%) and snacks (22.6%) ("Fast Food Consumption Among Adults in the United States, 2013-2016", 2017).

The problem with eating fast food routinely is these foods are considered ultra-processed, meaning they have been manufactured using several ingredients and a series of different processes (Steele, 2017). Ultra-processed ingredients are lower-cost industrial sources of dietary energy and nutrients, and additives are used to imitate sensorial qualities of other foods (Steele, 2017). These products are popular hyper-palatable, and attractive foods that have an extended shelf life, are able to be consumed anywhere, and at any time (i.e. sweet, fatty or salty packaged snack products, ice cream, sugar-sweetened beverages, chocolates, confectionery, French fries, burgers and hot dogs, and poultry and fish nuggets) (Monteiro et al., 2017).

The National Health and Nutrition Examination Survey (NHANES), a continuous public health survey to assess the health and nutritional status of adults and children in the U.S., found that in 2009-2010 the average U.S. daily energy intake was 2,069.5 kilocalories (kcal), and nearly 3 in 5 calories (57.9%) came from ultra-processed foods (Steele, 2016). Notably, 89.7% of all daily added sugars were derived from ultra-processed foods. Unprocessed or minimally processed foods contributed 29.6% of total calories (Steele, 2016). The most common ultra-processed foods in terms of providing the most energy were breads, soft drinks, fruit drinks and milk-based drinks; cakes, cookies and pies; salty snacks; frozen and shelf-stable plates; pizza and breakfast cereals (Steele, 2016).

Out-of-home eating patterns and routine consumption of fast food have been proposed as determinant factors in the prevalence of obesity and severe weight gain over time, an association which has been confirmed in both prospective and cross-sectional studies (Bahadoran, 2015; Dansinger, M. et al., 2006). Consumption of fast food and higher exposure to multiple sources of accessible cheap, energy-dense foods, increases the risk of coronary heart disease and type 2 diabetes (Bahadoran, 2015).

The causes of fast foods' undesirable health effects are wide-ranging. The main factor is the extremely high energy density, with an estimation that fast food meals typically have twice the recommended calories for a healthy diet (Bahadoran, 2015). Other deleterious factors include high-fat content and undesirable fatty acid composition, with 28-52% of total fat estimated as saturated fat. Up to 24 grams (g) of *trans* fat was found in popular fast foods (Stender, 2006). A daily intake of approximately 5 grams of *trans* fat is associated with a 25% increase in the risk of ischemic heart disease, and therefore intake should be as low as possible (Oomen, 2001).

Another point of interest regarding the etiology of obesity is the metabolic activity of adipocytes and adipose tissue (Jo et al., 2009). Adipocytes can increase in two ways: in size or in number. When energy intake exceeds energy expenditure, hypertrophy (enlargement) of adipocytes occurs, and with weight loss, they become smaller. However, as obesity increases, adipocytes reach their maximum triglyceride storage capability and then experience hyperplasia (an increase in number). At this point, adipocytes begin dividing and multiplying to create more space to store more triglycerides (Jo et al., 2009).

The clinical implication of hypertrophy and hyperplasia in combination is pertinent. When individuals undergo only enlargement of adipocytes, they experience more success at maintaining lost weight than individuals who have undergone both enlargement and increased numbers of adipocytes (Cao, 2014). As obese individuals lose weight, adipocyte mass decreases, but the number does not. Essentially, individuals with obesity who have experienced both hypertrophy and hyperplasia will face additional struggles of keeping the weight off because excessive energy intake is more easily stored when a greater number of adipocytes have been generated (Spalding, 2015). Achieving a healthy body weight, preferably a BMI between 18.5 – 24.9kg/m^2, and retaining relatively the same weight throughout life is more likely if an increase in adipocyte number can be averted (Spalding, 2015).

Defining a Fad Diet

A fad diet can be defined as a nutritional regimen, in which an individual eats a very restrictive diet with few foods or an unusual combination of foods for a short period of time resulting in rapid weight loss (British Dietetic Association, 2017). These diets are typically not evidence-based and do not result in long-term weight loss. In fact, some fad diets can actually be dangerous to health (“Staying Away from Fad Diets”, 2019). Some popular fad diets include, but

are not limited to, the Ketogenic Diet, Paleo Diet, South Beach Diet, Juice Cleanses, Atkins, Cabbage Soup Diet, Raw Food Diet, Blood Type Diet, Lemon Detox Diet, Baby Food Diet, Alkaline Diet, and Liquid Diet (Migala, 2017). Fad dieting often perpetrate the idea that, "if it sounds too good to be true, it probably is." ("Staying Away from Fad Diets", 2019). The human body is not as easily manipulated as fad diets claim. There are no diet pills, specific foods, or food preparations that will "melt fat" or "shrink fat" as claimed in fad diet advertisements.

Regarding macronutrient composition of diets, a large study of 811 subjects with varying targeted percentages of energy derived from fat, protein, and carbohydrates concluded that reduced-calorie diets result in clinically meaningful weight loss regardless of which macronutrient is emphasized (Nieman, 2010). In the same study, weight loss remained stable by two years to those who were assigned a diet with 15-25% protein, 20-40% fat, and 35-65% carbohydrates. Claimed advantages for weight loss with diets emphasizing specific macronutrient ranges have not been established for there are few studies that extend beyond one year (Nieman, 2010).

Physical and Metabolic Consequences of Fad Dieting

Fad diets become particularly insidious when media reports highlight specific eating behaviors and nutrients, substances, or foods as "to be avoided", which provide minimal context and insufficient evidence (Stein, 2014). These claims frequently rely on uncredentialled professionals, including celebrities, who extol and justify extreme dietary restrictions, whereas the Academy of Nutrition and Dietetics emphasizes a total diet approach and physical activity (Freeland-Graves, 2013). The total diet approach to healthy eating states, "that all foods can fit within this pattern if consumed in moderation with appropriate portion size and combined with physical activity." Labeling some foods as "good" or "bad" foods is inconsistent with the total

diet approach. The total dietary pattern should be emphasized rather than restrictive reliance on food components (Freeland-Graves, 2013). Fad diets tend to have recommendations based on studies published without peer review, that draw simple conclusions from complex studies, are based on a single study, or the primary goal of the fad diet recommendations are to sell a product ("Fad Diets", 2019).

The focal point of fad diets typically centers around drastic weight loss, however, if weight is lost too quickly, i.e. more than 1 to 2 pounds per week, loss of muscle, bone, and water can occur while increasing the probability of regaining weight more quickly ("Staying Away from Fad Diets", 2019). Although metabolic differences are unclear between losing weight rapidly versus slowly (i.e. 1-2 pounds per week) studies show that body weight and total intra-abdominal fat mass in rapid and slow weight loss tends to decrease to the same extent, but muscle atrophy is significantly higher with rapid weight loss than with slow weight loss (Ashtary-Larky et al., 2017; Yudai N, Shin T., 2015). Moreover, a consequence of fad dieting is the elimination of food groups and nutrient-dense foods. Because of this omission of food groups, fad diets may cause the following symptoms: dehydration, weakness, nausea, headaches, constipation, and inadequate vitamin and mineral intake (Khawandana, 2016). Little to no research supports fad diets and their long-term safety and potential risks are unknown (Ruden, 2007).

Fad Diets Eliminating Carbohydrate

Some confusion regarding carbohydrates may stem from the classifications and misunderstanding of the two classes: complex and simple (refined) carbohydrates (Mozaffarian, 2011). Complex carbohydrate sources include fruit, vegetables, legumes, and whole grains.

These foods are rich in vitamins, minerals, phytochemicals, antioxidants, and fiber, making them well suited to a healthy dietary plan (Slavin & Lloyd, 2012).

Complex carbohydrates digest slower because they contain fiber, vitamins and minerals, which take longer to digest, meaning they have less of an immediate impact on blood sugar, causing it to rise slower (Willet, 2002). More time is needed to breakdown these larger molecules into their smaller constituents. Higher intake of fiber, a nondigestible carbohydrate, reduces the risk of developing several chronic diseases, including cardiovascular disease, type 2 diabetes, and some cancers has been associated with lower body weight (Dahl & Stewart, 2015). Adequate intake for fiber is 14 grams (g) per 1,000 calories, or 25g for adult women and 38g for adult men. Only 5% of the American population meets this recommendation (Dahl & Stewart, 2015).

In comparison to refined carbohydrates, whole grains contain the intact grain including the bran, the fiber-filled outer layer with B vitamins and minerals, the endosperm, the starchy carbohydrate middle with some proteins and vitamins, and the germ, the nutrient-packed core with B vitamins, vitamin E, phytochemicals, and healthy fats (Wu et al., 2015). Refined carbohydrates have been stripped of valuable nutrients in the refining process (Aune, Norat, Romundstad, & Vatten, 2013). The lost vitamins and minerals are added back by a process termed “enrichment”, but the fiber is lost and is not added back (Aune, Norat, Romundstad & Vatten, 2013). A Harvard-based Nurses’ Study showed that eating whole instead of refined grains substantially lowers total cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, and insulin levels (Liu et al., 1999). The participants who ate two to three servings of whole grain products each day were 30% less likely to have an adverse cardiovascular event

over a 10-year period than women who ate less than a serving per week of whole grains (Liu et al., 1999).

The human brain depends on glucose as its main source of energy (Howarth, 2012). In the adult brain, neurons have the highest demand, requiring continuous delivery from the blood. (Howarth, 2012). Glucose cannot be replaced as an energy source, but it can be supplemented by other substrates, such as when blood lactate levels are elevated (e.g. during strenuous physical activity) (Hall, 2009), or during prolonged starvation when blood levels of ketone bodes are elevated and the blood brain barrier transporter levels are upregulated (Lutas, 2013). To meet energy needs, the 2015-2020 Dietary Guidelines for Americans recommends 45-65% of total daily calories be from carbohydrates ("2015-2020 Dietary Guidelines", 2019). The ketogenic diet, however, is extremely low in carbohydrate and was originally developed for the treatment of intractable epilepsy (Cervenka & Kossoff, 2013). Researchers at Harvard were the first to report improvements in seizure control after two to three days of fasting, proposing that a change in metabolism occurred in the absence of food, specifically carbohydrates, forcing the body to utilize fat for energy (Wheless, J., 2004).

The mechanisms of action by which the ketogenic diet impacts seizure control is not completely understood (Roehl & Sewak, 2017). The ketogenic diet is theorized to be effective by decreasing glucose concentration while increasing fatty acid oxidation and ketone body production. As blood glucose is reduced, glycolysis decreases, and ketone levels rise. The ketone bodies then serve as the primary fuel for neurons. The decrease in glycolysis alone has been found to play a role in seizure reduction, with increased seizure activity noted when carbohydrates are reintroduced. As carbohydrate intake decreases and ketone bodies become the primary fuel source, blood glucose stabilizes and ketone bodies offer a steady fuel source for the

neurons, decreasing the likelihood of disruptions in energy availability, thus reducing episodes of seizure activity (Roehl & Sewak, 2017). Today's version of the ketogenic diet has been marketed as a weight loss diet by means of burning fat as an alternative energy source instead of carbohydrate (Mohan & Shilpa, 2018). Possible benefits of the ketogenic diet include short-term weight loss, improved blood sugar control, and reduction in serum triglycerides. Adverse effects of the ketogenic diet include flu-like symptoms (the keto-flu) for the first three days of following the diet, muscle cramps, odorous breath, changes in bowel habits due to the lack of high-fiber foods, and loss of energy. Studies show that although the ketogenic diet may have some positive outcomes, moderation is key and should be used with any long-term diet plan (Mohan & Shilpa, 2018; Veech, 2004; Buscemi, 2018). Most studies reveal short-term benefits of following a ketogenic diet, but maintaining the diet long-term has shown to be rarely sustainable (Mohan & Shilpa, 2018; Grandl et al., 2018)

Fad Diets Eliminating Fat

Other fad diets, such as the 80-10-10 Diet, encourage a very low-fat intake (Petre, 2017). This diet claims that 80% carbohydrate, 10% protein, and 10% fat intake provide an optimal diet that not only promotes weight loss, but also protects against cancer, diabetes, organ failure, weak bones and heart disease (Petre, 2017). Although diets such as the 80-10-10 diet include healthy fats, the quantity is inadequate. A metabolic consequence of this diet, and other diets severely restricting fat intake, is the reduced absorption of the fat-soluble vitamins A, D, E, and K, and adverse interference with the critical roles in metabolism in which fat plays a role such as being the primary form of stored energy in the human body (Caudill, 2012).

Fats also perform the function as signaling molecules, both outside and inside cells (Caudill, 2012). Fatty acids, and fatty acid derivatives, can act as ligands which interact with cell

receptors to stimulate a specific function. Sex hormones, adrenocortical hormones, and vitamin D are derived from lipids and play important extracellular signaling roles (Caudill, 2012). Moreover, polyunsaturated fatty acids (PUFAs) are essential for growth and normal physiological function and maintenance (Caudill, 2012). Two PUFAs are needed in the body because they cannot be synthesized: linolenic acid from omega-3's and linoleic acid from omega-6's, both a type of essential fatty acid. In order to maintain optimal health and prevent deficiencies, these unsaturated fatty acids must be consumed in the diet. They are involved in two important physiological processes: the synthesis of lipid biomediators and the assembling of membrane phospholipids that maintain optimal structural and signal transduction properties (Caudill, 2012). Fat also provides insultation for the body to protect organs and help control body temperature (Hui & Feng, 2018).

Total fat intake of 20-35% of energy is recommended by the Institute of Medicine, the World Health Organization, and is supported by the 2015 Dietary Guidelines for Americans (Institute of Medicine, 2005; World Health Organization, 2018; "2015-2020 Dietary Guidelines", 2019). These total fat intake percentages are recommended based on evidence that consumption beyond these ranges is associated with a greater intake of energy and saturated fatty acids (fat intake >35% of total calories) or below these ranges, with intake of excess carbohydrate in comparison to the other food groups (fat intake <20% of total calories) (Vannice & Rasmussen, 2014). An excessive intake of carbohydrates leads to plasma triglycerides and reductions in high-density lipoprotein (HDL) cholesterol levels (Vannice & Rasmussen, 2014). Any food group consumed in excess will be stored as fat. The 80-10-10 is but one example of a very low fat diet, and there is a lack of scientific evidence supporting its alleged health claims or that consuming

the macronutrients in this particular ratio has health benefits or promotes weight loss (Petre, 2017).

Fad Diets Eliminating Protein

Diets that require small amounts of protein, such as juice cleansing diets, guarantee weight loss, but with a consequence being an inadequate intake of essential amino acids (Klein & Kiat, 2014). Juice cleansing diets may direct individuals to consume only juices or other liquids for days or weeks with ingredients including but not limited to: lemon juice, water, cayenne pepper, fruit and vegetable juices, and herbal teas infused with formulated powders (Klein & Kiat, 2014). Protein is a macronutrient that the body must have in sufficient quantities for the development, upkeep, and repair for all cells (Caudill, 2012). Proteins are also involved in enzymatic and DNA synthesis and function, building and maintenance of skeletal muscle, and immune system support (Khan, 2017). The U.S. Dietary Guidelines recommend a daily protein intake, derived primarily from lean meats, poultry, fish, and seafood, dairy, and plant-based sources, between 15-25% of total calories, which equates to 0.8g/kg of body weight per day for the average healthy individual ("2015-2020 Dietary Guidelines", 2019).

Kwashiorkor and marasmus are two distinct protein deficiency-induced diseases (Khan, 2017). While these ailments are of little concern in the U.S., they still elucidate the body's physiological need for protein. Physical consequences of low-protein diets result in wasting and shrinkage of muscle tissues (Khan, 2017; Vis, 1969). When the body is not provided sufficient amounts of protein, the body begins sourcing it elsewhere, primarily from the muscles (Khan, 2017). If the body has to sustain itself through its stores of protein and not through adequate oral intake, over time, weakness and fatigue will occur due to loss of strength and overall mass (Khan, 2017).

Though juice cleansing diets do not intentionally reduce protein intake, substituting meals and protein-rich foods with primarily low-protein liquids pose insufficient protein intake amounts (Jensen et al., 2014). Currently, the strength of the evidence is lacking on the value of liquid supplementation as an aid to weight loss maintenance. There is also a lack of evidence regarding the use of liquid and meal replacements; these meal replacements are associated with increased weight loss at up to six months, in comparison with a balanced diet (Jensen et al., 2014).

Defining a Healthy Diet

Nutritional science is a relatively new discipline, evolving over the last 100 years, even though the importance of diet to maintain health was recognized much earlier (Mozaffarian & Uauy, 2018). In 1932, the first ever isolated nutrient, vitamin C, provided new evidence that specific dietary nutrients could abate and prevent disease (Mozaffarian, 2016). Captain James Lind performed one of the earliest recorded clinical trials where several groups were treated differently, but only the group receiving vitamin C prevented scurvy, a disease caused by vitamin C deficiency leading to poor collagen formation, gingival swelling, and loss of teeth (Mozaffarian, 2016; Chambial et al., 2013). In recent decades, the most important scientific development in regard to understanding nutrition science was the design and completion of multiple, complementary studies with large sample sizes, including prospective observational cohorts, and randomized clinical trials (Mozaffarian & Uauy, 2018). However, since individual diet quality is multi-factorial, defining a healthy diet can be complex.

One of the largest prospective cohort studies involved over 120,000 healthy women and men spanning 20 years, with researchers determining that changes in weight were most strongly associated with the intake of foods high in fat, sugar, or sodium including potato chips (1.69

pounds (lbs)), processed potato foods (1.28 lbs), sugar-sweetened beverages (1.00 lb), and both processed and unprocessed red meats (0.93 lb) (Mozaffarian et al., 2011). Intakes of vegetables (-0.22 lb), whole grains (-0.37 lb), fruits (-0.49 lb), nuts (-0.57 lb), and yogurt (-0.82 lb) had an inverse association, resulting in weight loss ($P \leq 0.005$ for each comparison). Differences in weight gain seen for specific foods and beverages could relate to varying portion sizes, patterns of eating, effects on satiety, or displacement of other foods or beverages (Mozaffarian et al., 2011). The World Health Organization's (2018) inclusion factors for a healthy diet align with the Dietary Guidelines' for Americans (2015) recommendations, which include:

- A variety of vegetables from all the subgroups – dark green, red and orange, legumes (beans and peas), starchy, and other
- Fruits, especially whole fruits
- Grains, at least half of which are whole grains
- Fat-free or low-fat diary, including milk, yogurt, cheese, and/or fortified soy beverages
- A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), and nuts, seeds, and soy products
- Oils

A healthy eating pattern limits:

- Saturated fats, *trans* fats, added sugars, and sodium

Key Recommendations that are quantitative are provided for several components of the diet that should be limited. These components are of particular public concern in the United States, and the specified limits can help individuals achieve eating patterns within calorie limits:

- Consume less than 10% of calories per day from added sugars

- Consume less than 10% of calories per day from saturated fats
- Consume less than 2,300 milligrams (mg) per day of sodium
- If alcohol is consumed, it should be consumed in moderation – up to one drink per day for women and up to two drinks per day for men – and only by adults of legal drinking age

These recommendations form the general basis for a healthy diet and current evidence supports that an eating pattern similar to this promotes health, prevents chronic disease, and can help individuals reach and maintain a healthy weight. ("2015-2020 Dietary Guidelines", 2019).

It is noteworthy to further define the terms: “eating pattern”, “nutrient dense”, and “variety”. An “eating pattern” is the combination of foods and beverages that constitute an individual’s complete dietary intake over time. Often referred to as “dietary patterns,” an “eating pattern” may describe a customary way of eating or a combination of foods recommended for consumption ("2015-2020 Dietary Guidelines", 2019). Specific examples of eating patterns include the United States Department of Agriculture (USDA) Food Patterns and the Dietary Approaches to Stop Hypertension (DASH) Eating Plan ("2015-2020 Dietary Guidelines", 2019).

The Food and Drug Administration (FDA) defines nutrient density as foods and beverages that contain vitamins, minerals, dietary fiber, and other beneficial substances that may have positive health effects (FDA “Vitamins and Minerals”, n.d.). Vegetables, fruits, whole grains, seafood, eggs, beans and peas, unsalted nuts and seeds, fat-free and low-fat dairy products, and lean meats and poultry – when prepared with little or no added solid fats, sugars, refined starches, and sodium – are nutrient-dense foods ("2015-2020 Dietary Guidelines", 2019). These foods can contribute to meeting food group recommendations within an individual’s calorie and sodium limits. An additional FDA regulation that can help individual’s determine nutrient

content includes the addition of the Percent Daily Value (%DV) on the Nutrition Facts Label ("New Nutrition Facts Labels to Feature Added Sugars", with Daily Value, 2016). Food manufacturers may *voluntarily* list the Percent Daily Value (%DV) of naturally occurring vitamins and minerals per serving on the Nutrition Facts Label, but they are *required* to list any vitamins and minerals that are added to the food (Center for Food Safety and Applied Nutrition, n.d.). The FDA also regulates statements made on the package labeling about the health effects of the food (i.e. health claim) or the amount and function of a nutrient contained in the food (i.e. nutrient content claim or structure function claim). Individuals reading the Nutrition Facts Label can also use the %DV as a guide to help them find products that are high or low in a certain vitamin or mineral (for example, 20% DV or more of a vitamin or mineral per serving is considered high, while 5% DV or less is low) (Center for Food Safety and Applied Nutrition, n.d.). This is just one example of how the Nutrition Facts Label can be used as a tool for consumers to consume a nutrient-dense diet.

According to the Dietary Guidelines for Americans (2015) as it applies to eating patterns, "variety" is defined as "a diverse assortment of foods and beverages across and within all food groups and subgroups selected to fulfill the recommended amounts without exceeding the limits for calories and other dietary components". For example, in the vegetables food group, selecting a variety of foods could be accomplished over the course of a week by choosing from all subgroups, including dark green, red and orange, legumes (beans and peas), starchy, and other vegetables ("2015-2020 Dietary Guidelines", 2019).

The CDC emphasizes that variety could also apply to consuming various forms and preparation of nutrient-dense foods which may be overlooked by consumers (CDC, 2017). Examples include considering not only fresh fruits and vegetables in a healthy eating plan, but

also frozen and canned; adding herbs and spices in place of butters and margarines; trying healthier cooking methods such as baking or grilling over frying; and substituting recipes with plant-based proteins in place of higher-fat meats (CDC, 2017).

Evidence-Based Methods of Weight Loss

Weight loss of only 3% to 5% of total body weight has the ability to produce clinically relevant health improvements (e.g., reductions in triglycerides, blood glucose, and risk of developing type 2 diabetes) (Jensen et al., 2014; Magkos et al., 2016; Raynor & Champagne, 2016). Additional risk factors for cardiovascular disease (e.g., low-density and high-density lipoprotein cholesterol and blood pressure) can also be reduced with weight loss (Jensen et al., 2013). A weight loss of 5% to 10 % for adults with overweight or obesity and type 2 diabetes, is associated with a reduced need for medications, especially when weight loss is maintained for at least 1 year (Jensen et al., 2014). Thus, a 5% to 10% weight loss within 6 months is recommended to achieve and maintain the associated health benefits (Jensen et al., 2014; Marchesini et al., 2016; Wing & Phelen, 2005). Albeit a 10% weight loss may not decategorize a person with obesity as non-obese, the health impact of a 10% weight loss is still well documented (Wing & Phelen, 2005.; Wing et al., 2011; Dattilo & Etherton, 1992). Using this standard definition, research has shown that approximately 1 out of every 6 U.S. adults who has ever been overweight or obese has accomplished long-term weight loss maintenance of at least 10% (Kraschnewski et al., 2010).

Weight loss goals should also be attainable and realistic for the individual. Weight loss goals of up to 2 pounds per week is recommended to avoid loss of lean muscle mass and ensure sustainability (Raynor & Champagne, 2016). The pivotal difference between evidence-based weight loss strategies and fad diets is that the former is supported by peer-reviewed research and

rigorous scientific studies such as randomized-controlled trials. Fad diets lack evidence that they produce sustainable weight loss and generally ignore or refute what is known about fundamental associations between dietary pattern and human health (Katz, 2003). Successful weight loss maintainers are defined as "individuals who have intentionally lost at least 10% of their body weight and kept it off at least one year." (Wing & Phelen, 2005). Weight loss maintenance is achieved through sustainable changes as described above (Wing & Phelen, 2005). In contrast, most individuals typically tire of fad diets and quickly regaining any lost weight (National Institute of Diabetes and Digestive and Kidney Diseases, 2017).

To achieve a reduction in weight that is sustainable over time and improve cardiometabolic health, changes in lifestyle behaviors that result in balanced energy intake and enhancements in dietary quality must occur so that the likelihood of achieving recommendations provided by the 2015 Dietary Guidelines for Americans is increased (Raynor & Champagne, 2016). Physical activity alongside a healthy diet is important for good optimal health, especially concerning weight maintenance ("Physical Activity for a Healthy Weight", n.d.). The CDC concludes that weight loss occurs due to a calorie deficit, but evidence shows that engaging in regular physical activity is dominantly conducive to *maintain* weight loss ("Physical Activity for a Healthy Weight", n.d.). Evidence supporting weight loss and weight maintenance when all three major components - diet, physical activity, and behavior therapy - are integrated is strong especially if the individual receives support from a trained interventionist (i.e. registered dietitians, psychologists, exercise specialists, health counselors, or professionals in training who adhere to formal protocols in weight management) in either group or an individual settings (Jensen et al., 2014). Further defining the essential three components in evidence-based weight loss methods is as follows:

- "**Reduced-calorie diet**: In comprehensive lifestyle interventions, overweight/obese individuals typically are prescribed a diet designed to induce an energy deficit of ≥500 kcal/day. This deficit often is sought by prescribing 1200 to 1500 kcal/day for women and 1500 to 1800 kcal/day for men.

- **Increased physical activity**: Comprehensive lifestyle intervention programs typically prescribe increased aerobic physical activity (such as brisk walking) for ≥150 minute/week (equal to ≥30 minute/day most days of the week). Higher levels of physical activity, approximately 200 to 300 minute/week, are recommended to maintain lost weight or minimize weight regain in the long term (>1 year).

- **Behavior therapy**: Comprehensive lifestyle interventions usually provide a structured behavior change program that includes regular self-monitoring of food intake, physical activity, and weight. These same behaviors are recommended to maintain lost weight, with the addition of frequent (i.e., weekly or more often) monitoring of body weight."

Comprehensive lifestyle interventions consisting of these three components directed by a trained professional produces average weight losses of up to 8 kg in 6 months (Jensen et al., 2014). Routine on-site treatment for up to one year continues to result in additional weight loss of up to 8 kg at the one-year mark, which constitutes weight losses that are greater than those resulting from typical care (Jensen et al., 2014). After one-year, gradual weight regains of 1-2 kg per year (on average) occur from the original weight that was lost in the first year (Jensen et al., 2014). Although the greatest challenge is weight maintenance, this should not discourage individuals with obesity from attempting to lose weight by guidance from a credible and qualified health professional.

Weight Loss Practices Among U.S. Adults

Only one third of Americans attempting to lose weight utilize the three aforementioned strategies (Weiss, Galuska, & Serdula, 2006). One in five Americans report using weight-loss strategies that have been shown to be counterproductive to losing weight including: skipping meals, or following popular diets (Nicklas et al., 2012; Han, You, Zeng, et. al, 2018). A randomized trial comparing the Atkins, Ornish, Weight Watchers, and Zone Diets for weight loss

revealed modest weight losses for each diet, but the most common reasons cited for discontinuation were that the assigned diet was too cumbersome to follow or did not yield enough weight loss (Dansinger et al., 2006). The 2019 NHANES collected data from 48,026 participants about popular weight loss strategies (Han, You, Zeng, et. al, 2018). The most common applied strategies were reducing food consumption, 30.8% in 2005-2006 and 31.9% in 2015-2016, exercise 29.5% in 2005-2006 and 31.5% in 2015-2016 and drinking more water 21.6% in 2005-2006 and 26.3% in 2015-2016.

Researchers examined NHANES data from 1999-2010 and found an association between socioeconomic status and choice of weight loss methods (Kakinami, Gauvin, Barnett, & Paradis, 2014). Adults with an annual income < $20,000/year were 50%; 42%; and 25% less likely to exercise; drink a lot of water; or reduce intake of fat or sweets, respectively, in order to lose weight (Kakinami, Gauvin, Barnett, & Paradis, 2014). Adults with an annual household income of $20,000 - $44,000 were 41%; 32%; and 27% less likely to exercise; drink a lot of water; or eat less fat or sweets, respectively (Kakinami, Gauvin, Barnett, & Paradis, 2014). Adults with an annual household income of $20,000 - $44,000 or $45,000 - $74,999 were 45% and 56% more likely to use non-prescription diet pills, respectively (Kakinami, Gauvin, Barnett, & Paradis, 2014).

Adults with annual household incomes < $20,000 were 50% less likely to use multiple weight-loss strategies consistent with recommendations (e.g. exercising, reducing fat or sweets, drinking more water) while youths from household income <$20,000/year were 2.5 times more likely to use inconsistent weight-loss strategies (e.g. skipping meals or fasting) (Kakinami, Gauvin, Barnett, & Paradis, 2014). Consistent literature shows that low socioeconomic status is associated with a greater likelihood of unhealthy weight-loss strategies, which is likely a driver

in misunderstanding how to realistically lose and maintain weight (Breikopf & Berenson, 2004; Jeffrey & French, 1996; Tsai et al., 2009). An association of weight loss practices vary depending on one's income, but those living in poverty (< $20,000/year) are disproportionally affected (Kakinami, Gauvin, Barnett, & Paradis, 2014). This is considerable due to 10.7% and 9.6% of U.S. households make under $15,000 and $15,000 - $24,999/per year, respectively, contributing to 20.3% of the population potentially being less likely to use evidence-based weight loss strategies ("U.S. household income distribution", 2017). The average household income of East Tennesseans is $55,012 per year, with ages over 65 averaging $33,762 per year (East Tennessee Demographics, n.d.). Additionally, obesity prevalence among men is generally similar at all income levels, however, higher income women are less likely to be obese than low income women ("Obesity and Socioeconomic Status in Adults: United States", 2010).

From previous literature, Americans are unaware or misunderstand evidence-based strategies to achieve and maintain weight loss that are safe and effective and as a result, obesity remains a significant health concern ("Prevalence of Obesity Among Adults and Youth: United States, 2015-2016", 2017). Individuals looking to lose weight often struggle to choose between credible sources for their health information that supplies sound advice and methods for achieving moderate weight loss over time or popularized, yet disreputable products or services that claim to guarantee easy or fast weight loss without changing current behaviors.

The fact that only about 20% of overweight individuals are successful at long-term weight loss (Wing & Phelen, 2005), implies that many Americans are making the latter choice. This lack of success is particularly striking since 49.1% of adult Americans reported attempting to lose weight in the last 12 months between 2013-2016, with 56.4% and 41.7% of women and

men trying to lose weight, respectively ("Attempts to Lose Weight Among Adults in the United States", 2018).

Those successful in achieving and maintaining weight loss are eligible to join the National Weight Control Registry (NWCR) which tracks over 10,000 individuals (The National Weight Control Registry, n.d.). The NWCR identifies diet and physical activity strategies and other characteristics of those who have lost significant amounts of weight and kept it off for long periods of time. These strategies are determined via self-report surveys completed by registrants. Common themes in weight loss strategies reported include engaging in approximately one hour per day of physical activity, self-monitoring weight, and being consistent with eating patterns throughout all seven days of the week (The National Weight Control Registry, n.d.).

Registered members' diets in the registry also consist of eating a low-calorie, low-fat diet, and eating breakfast regularly (The National Weight Control Registry, n.d.). Few registry participants (10%) consume sugar-sweetened beverages (SSB) on a regular basis, 53% regularly consume low or no calorie sweetened beverages (LNCSB). The majority who consume LNCSB (78%) felt these beverages helped control total calorie intake. Interestingly, 42% of registry participants considered changing beverage consumption to be very important in weight loss and 40% reported importance for weight maintenance. The most common strategy was reducing regular calorie beverages and increasing water (The National Weight Control Registry, n.d.). The NWCR further compared weight regain of 3,591 members with four different physical activity levels and found that those with the most physical activity had lost the most weight, reported lower intakes of fat, more dietary restraint, and greater reliance on many other dietary strategies to maintain weight loss (Catenacci et al., 2014).

Becoming more notable is daily weight monitoring. A study examining whether weighing every day is associated with greater adoption of weight control behaviors (e.g. reducing calorie intake by 500-1000 calories per day, reducing between meal snacks, reducing the number of times they ate out at restaurants, reducing frequency or portion sizes of desserts, making one or two small changes to activity every day), compared to less frequent weighing discovered that individuals who weighed daily lost significantly more weight compared to those weighing less than daily (Steinberg, Bennett, Askew, & Tate, 2015). Daily self-weighing may trigger the self-regulatory processes that promote behavior change, being particularly true for individuals already primed to make changes to their diet and exercise behaviors (Steinberg, Bennett, Askew, & Tate, 2015). However, other studies reveal contradictory results, concluding subjects who weigh themselves everyday report deterioration in mood, increased feelings of anxiety and depression, and increases in dietary restraint (Mercurio, Rima, 2011; Klem, Wing, McGuire, Seagle, & Hill, 1998).

Regardless of the myriad of weight loss methods and tactics, a pattern persists when it comes to weight loss and weight maintenance, individuals with the most success develop multiple behaviors that become lifestyle habits over time (The National Weight Control Registry, n.d.). These include consistent eating patterns that are planned in advance, lower in calories and begin with breakfast most days of the week. Other behaviors include making physical activity part of their daily routine, and monitoring weight on most days of the week. A significant research finding from the NWCR is that no participants report long-term success by means of any one fad diet (The National Weight Control Registry, n.d.).

Weight Loss Supplements

Although supplements are not categorized as a type of diet, they do have similarities with fad dieting, such that individuals use them for weight loss even though some dietary supplements can be good or neutral for health, while others have been proven ineffective (National Center for Complementary and Integrative Medicine, 2019). Weight loss supplements, which are not medically recommended (Austin et al., 2017), fit into the ideology that successful weight loss and weight maintenance can be achieved by a quick fix, a characteristic shared with fad diets (Thomas et al., 2008). Approximately 15% of U.S. adults have used a weight-loss supplement at one point in their lives; more commonly used by women (21%) than men (10%) (Blanck et al., 2007). Weight loss supplement industries are additionally booming businesses, collectively earning about $46 billion a year (Supplement Business Report: Nutrition Business Journal, 2019), and weight loss is one of the top reasons why people take dietary supplements (Bailey, Gahche, Miller, Thomas, & Dwyer, 2013). Federal regulations are in place that require supplement companies to be responsible for having evidence that their supplements are safe, labels are truthful and not misleading, and ensure they do not contain contaminants or impurities (The National Institute of Complementary and Integrative Medicine, 2019).

However, dietary supplements are treated more like foods instead of prescription and non-prescription drugs in regard to FDA regulation ("FDA regulation of drugs versus dietary supplements", n.d.). Since supplements are not considered drugs, they do not follow the same stringent regulations that drugs are put through that ensure safety and effectiveness. A drug's effectiveness and safety must be proven in a series of clinical trials which must show "substantial evidence" that the drug is both safe and effective for each of its claims. On the other hand, dietary supplements are considered safe until proven unsafe. Manufacturers are not required to

test new ingredients or supplements in clinical trials, so ingredients are only designed as unsafe after they have caused harm – the opposite directive of drug regulations ("FDA regulation of drugs versus dietary supplements", n.d.). By these regulations, weight loss supplements are ambiguously safe and unknowingly effective at purchase. According to a study in 2015, dietary supplements resulted in an estimated 23,000 emergency room visits every year in the U.S. with many patients having heart problems from consuming weight-loss supplements or energy products (The National Institute of Complementary and Integrative Medicine, 2019).

Even though health experts agree that lifestyle changes (i.e. healthy eating patterns, reducing caloric intake, and engaging in physical activity) are the foundation for achieving weight loss and weight maintenance, many individuals turn to weight loss supplements as an assist to weight loss efforts , despite limited evidence on their effectiveness (Pittler, Schmidt, & Ernst, 2010; Jensen et al., 2014).

Five systematic reviews and meta-analyses and 25 additional trials were reviewed by the American Journal of Clinical Nutrition and a systematic review was conducted by the International Journal of Obesity (Pittler & Edzard, 2004; Onakpoya, Wider, Pittler, & Ernst, 2010). These studies found little evidence that any specific dietary supplement is effective for reducing body weight (Pittler & Edzard, 2004; Onakpoya, Wider, Pittler, & Ernst, 2010). There are currently 5 FDA-approved weight loss drugs that have been put through 28 clinical trials involving over 28,000 participants: Xenical, Belviq, Qsymia Contrave, and Saxenda ("Prescription Medications to Treat Overweight and Obesity", 2016). These drugs, however, can be extensively expensive and potentially pose severe health risks. Although FDA-approved, these medications should not replace physical activity or healthy eating habits. FDA-approved medications are warranted for individuals with obesity when lifestyle changes are not enough to

lose weight and are not recommended without first trying healthy lifestyle modifications ("Prescription Medications to Treat Overweight and Obesity", 2016).

The Dilution Effect

In cognitive psychology, the dilution effect is the phenomenon that communicating misleading information results in less knowledge when additional messages the individual receives lead them astray (Gastil & Marriot, 2018). Gastril and Marriot (2018) suggest that public confusion about weight loss may stem from a "dilution effect", which remains constant across a wide range of subgroups (Wing & Phelen, 2005). The "dilution effect" is particularly relevant due to the high percentages of Americans with overweight or obesity who are trying to lose weight, but unable to achieve or maintain weight loss (CDC, 2017).

Evidence-based weight loss and maintenance mechanisms could potentially be either overlooked or "diluted" due to the inundation of misinformation presented to the public (Wing & Phelen, 2005). Public discourse regarding weight loss is rife with misleading claims and advertisements about effective strategies, such as fad dieting and supplements (Federal Trade Commission, "Protecting America's Consumers", 2015"). While fad diets and supplements could be potentially effective because following or using them may indirectly lead to decreased consumption of energy (Casazza et al., 2015). Irrelevant claims purported in fad diets may distract recipients from the fundamental weight loss mechanisms of energy balance and expenditure and instead increase the perception that weight loss can be attributed to the fad diet itself (Gastil & Marriott, 2018).

In other words, individuals interested in weight loss could divert too much of their attention from caloric intake and output to seeking or rationalizing other mechanisms that do not have the same direct effect (Gastil & Marriott, 2018). Some inaccurate beliefs regarding

nutrition, health, and weight loss will remain true to individuals despite evidence refuting those beliefs (Brown, A., Brown, M., & Allison, 2013). A widely believed presumption, carbohydrates cause weight gain is one example, that can disseminate through lay-media even though research refutes the claim (Sartorius, K., Sartorius, B., Madiba & Stefan, 2018). The dilution effect, in theory, may provide an explanation for why Americans trying to lose weight do not routinely follow the most straightforward, evidence-based strategies (Rosenbaum & White, 2016).

CHAPTER 3

METHODS

Survey Design

Data were gathered using a 26-question survey (Appendix A) in which participants were asked questions regarding their understanding and perceptions of weight loss and weight loss methods. The survey was developed by the principle investigator and content validity was evaluated by the investigator's thesis committee, who are also Registered Dietitian Nutritionists. The survey was then administered to 10 community individuals who were participating in a grocery store tour at a local supermarket to evaluate for face validity. The survey was revised based upon feedback from these individuals. This research study is classified as a descriptive, exploratory study. The survey provides data that explores the public's understanding and perceptions of weight loss and weight loss methods. The information from the survey respondents was used to gain insight to develop an educational workshop about debunking weight loss myths.

Study Population

Participants were recruited through a local supermarket, Food City, at employee wellness and community events in East Tennessee. The subjects included males and females, 18 years old and older, who chose to participate in the Food City community or wellness events during June, July and August of 2019 in the Tri-Cities and Knoxville area.

Variable Selection

Analysis variables included self-reported demographics, and a variety of questions (open-ended, multiple choice, Likert-type scale) addressing weight, weight loss, and weight loss

methods. Participants also reported their height and weight. Body Mass Index (BMI) was calculated using the following BMI equation: BMI = Weight (kg) / Height (m^2).

Research Questions

The following research questions were investigated using information obtained from the survey.

RQ1: What are the study populations' understandings of how to lose weight?

RQ2: What are the study populations' understandings of the mechanisms involved to lose weight?

RQ3: What are the study populations' perceptions or misconceptions of weight loss methods?

Institutional Review Board

Institutional Review Board (IRB) approval was obtained for this study from the ETSU Office for the Protection of Human Research Subjects IRB.

Data Analysis

Data analysis was conducted using IBM Statistical Package for Social Sciences (SPSS), version 25. Descriptive statistics were reported for demographic information and self-reported height and weight. Mode frequencies were conducted for questions 9 – 25 and data were coded to identify common responses for questions 11, 12, 16, 18, 19, 20, 21, 24, 25, and 26. The investigator examined characteristics of the data collected through content analysis and common responses. However, surveys have a limitation of not allowing investigators to draw conclusions about causal relationships (American Psychological Association, 2010).

CHAPTER 4

RESULTS AND DISCUSSION

Participant Demographics

Of the 76 participants who completed the survey, 75% (n=57) were female and 25% (n=19) were male. The majority of participants (92.0%) identified as White/Caucasian (n=69), followed by Asian at 4.0% (n=3), Black or African American at 2.7% (n=2), and Hispanic or Latino at 1.3% (n=1). One participant declined to identify ethnicity. Of the 76 participants, 44.7% (n=34) were 60 years of age or older, 26.3% (n=20) were 50-59, 14.8% (n=11) were 18-29, 7.9% (n=6) were 40-49, and 6.6% (n=5) were 30-39. Concerning self-reported education, 3.9% (n=3) reported some high school or no diploma, 9.2% (n=7) reported high school or GED, 27.6% (n=21) reported some college,11.8% (n=9) reported trade/technical/vocational training, and 47.4% (n=36) reported having a college degree. In regard to income, 15.8% (n=12) of the participants reported an annual income of less than $25,000, 25.0% (n=19) reported $25,000-$50,000, 19.7% (n=15) reported $51,000-$75,000, and 30.3% (n=23) reported more than $75,000. Seven participants (9.2%) declined to report annual income. Demographics for all participants are reported in Table 2.

Table 2.

Demographics of Participants (n = 76)

Age	**n**	**Percentage (%)**
18-29	11	14.8
30-39	5	6.6
40-49	6	7.9
50-59	20	26.3
60 or older	34	44.7
Gender	**n**	**Percentage (%)**
Male	19	25.0
Female	57	75.0
Ethnicity	**n**	**Percentage (%)**
White	69	92.0
Hispanic or Latino	1	1.3
Black or African American	2	2.7
Asian	3	4.0
No Answer	1	1.3
Education	**n**	**Percentage (%)**
Some high school, no diploma	3	3.9
High school or GED	7	9.2
Some college, no degree	21	27.6
Trade/Technical/Vocational training	9	11.8
College Degree	36	47.4
Annual Income	**n**	**Percentage (%)**
Less than $25,000	12	15.8
$25,000-$50,000	19	25.0
$51,000-$75,000	15	19.7
More than $75,000	23	30.3
No answer	7	9.2

In regard to self-reported weight classification (Figures 1), 18.4% (n=14) identified as "obese", 63.2% (n=48) identified as "overweight", and 18.4% (n=14) identified as "healthy

weight". When calculating participants' BMIs using weight(kg)/[height(m)]^2, actual BMI classification differed greatly from self-reported weight classification, signifying the majority of participants do not realize their BMI is greater than perceived. Of the 76 participants, 50.7% were in the obese category (n=37), 35.6% (n = 26) were in the overweight category, 13.7% (n=10) were at a healthy weight, and 4.1% (n=3) declined to answer. No participants were classified in the underweight BMI category. The majority of the participants were white, female, 60 years or older with a college degree.

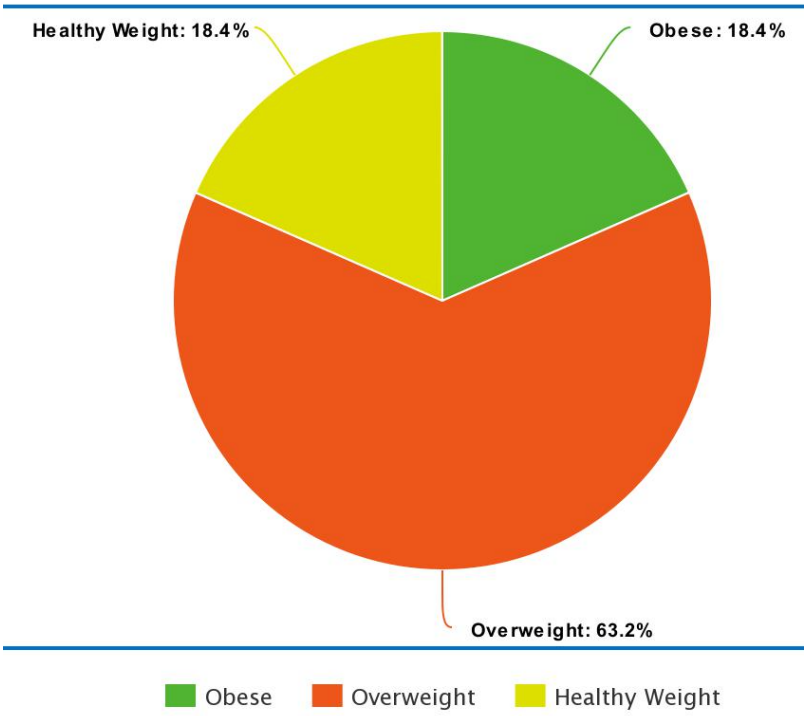

Figure 1. This figure shows self-reported classification of weight percentages

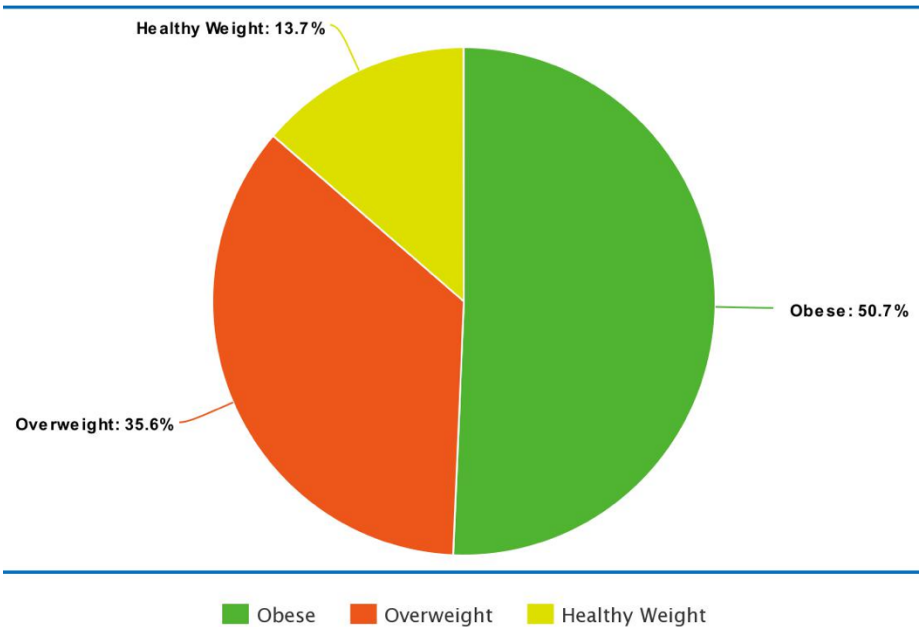

Figure 2. This figure shows actual classification of weight percentages

Research Questions

RQ1: What are the study populations' understandings of how to lose weight?

The response to survey questions 11, 14, 16, 22, and 25 pertain to this research question. Addressing question 11, "Where do you look for advice on how to lose weight?", 56.6% (n=43) reported "Physician", 34.2% (n=26) chose "Registered Dietitian", 17.1% (n=13) reported "Registered Nurse", 9.2% (n=7) chose "Other professions", 36.8% (n=28) reported "Books", 23.7% (n=18) reported "Magazines", 10.5% (n=8) reported "Blogs", 10.5% (n=8) reported "YouTube", 5.3% (n=4) reported "Instagram", 22.4% (n=17) reported "Facebook", and 14.5% (n=11) reported "Other online sources". The 9.2% (n=7) that reported "Other professions", included the responses "nutritionist", "gym owner", "health coach", "Dr. Schulze", "personal trainer", "wellness class", and "Weight Watchers." The 14.5% (n=11) that reported "Other online sources", included the responses "WebMD", "Weight Watchers", "Search Engines", "Google", "Pinterest", "Jack Lalanne and Richard Simmons", and "Fitness apps". Question 11 results are reported in Table 3.

Table 3.

Survey Question 11 "Where do you look for advice about how to lose weight?"

Responses	n	Percentage (%)
1=Physician	43	56.6
2=Registered Dietitian	26	34.2
3=Registered Nurse	13	17.1
4=Other professions	7	9.2
5=Books	28	36.8
6=Magazines	18	23.7
7=Blogs	8	10.5
8=YouTube	8	10.5
9=Instagram	4	5.3
10=Facebook	17	22.4
11=Other online sources	11	14.5

Addressing question 14, “I consider myself well qualified to judge the reliability of weight loss advice”, 2.6% (n=2) reported “Strongly disagree”, 11.8% (n=9) reported “Disagree”, 22.4% (n=17) reported “Not sure”, 42.1% (n=32) reported “Agree”, and 17.1% (n=13) reported “Strongly agree”. Question 14 results are reported in Table 4.

Table 4.

Survey Question 14 “I consider myself well qualified to judge the reliability of weight loss advice”

Responses	n	Percentage (%)
Strongly disagree	2	2.6
Disagree	9	11.8
Not sure	17	22.4
Agree	32	42.1
Strongly agree	13	17.1

Addressing question 16, “Are you currently doing any of the following to control your weight?”, 67.1% (n=51) reported “Exercising more”, 57.9% (n=44) reported “Eating less fat”, 14.5% (n=11) reported “Skipping meals”, 2.6% (n=2) reported “Taking diet pills”, 1.3%, (n=1) reported “Taking laxatives”, 7.9% (n=6) reported “Taking water pills or diuretics”, 2.6% (n=2) reported “Fasting”, 6.6% (n=5) reported “Ketogenic diet”, and 32.9% (n=25) reported “Other”. Of the 31.6% (n=24) that selected “Other”, only two significant findings were present, 37.5 (n=9) reported “Watch/low carbohydrate intake”, 29.2% (n=7) reported “Portion Control. Question 16 results are reported in Table 5.

Table 5.

Survey Question 16 "Are you currently doing any of the following to control your weight?"

Responses	n	Percentage (%)
1=Exercising more	51	67.1
2=Eating less fat	44	57.9
3=Skipping Meals	11	14.5
4=Taking diet pills	2	2.6
5=Taking laxatives	1	1.3
6=Taking water pills or diuretics	6	7.9
7=Fasting	2	2.6
8=Ketogenic Diet	5	6.6
9=Other	24	32.9

Addressing question 22, "If you are currently on a specific weight loss diet, do you consider it safe and effective?" of the 75 participants that answered this question, 41.3% (n=31) reported "I consider it safe and effective", 5.3% (n=4) reported "I consider it not safe, but effective", 8.0% (n=6) reported "Unsure", 45.3% (n=34) reported "Not on a diet/program", and 1.3% (n=1) declined to answer. Question 22 results are reported in Table 6.

Table 6.

Survey Question 22 "If you are currently on a specific weight loss diet, do you consider it safe and effective?"

Responses	n	Percentage (%)
I consider it safe and effective	31	41.3
I consider it not safe, but effective	4	5.3
Unsure	6	8.0
Not on a diet/program	34	45.3

Addressing question 25, “What have been your greatest difficulties with dieting or losing weight?”, 57.9% (n=44) reported “Keeping the weight off”, 53.9% (n=41) reported “Not being able to stick with it”, 13.2% (n=10) reported “Hating the food”, 42.1% (n=32) reported “Missing my favorite foods”, 15.8% (n=12) reported “Binging after I go off my diet”, 23.7% (n=18) reported “too expensive”, 30.3% (n= 23) reported “Gaining back all the weight or more”, and 11.8% (n=9) reported “Other”. Question 25 results are reported in Table 7.

Table 7.

Survey Question 25 “What have been your greatest difficulties with dieting or losing weight?”

Responses	n	Percentage (%)
Keeping the weight off	44	57.9
Not being able to stick with it	41	53.9
Hating the food	10	13.2
Missing my favorite food	32	42.1
Binging after I go off my diet	12	15.8
Too expensive	18	23.7
Gaining back all the weight or more	23	30.3
Other	9	11.8

These findings are helpful in providing new insight on the sample populations’ common understandings of how to lose weight and the relationship between higher income and education with obesity. The majority of participants in this study were college graduates (n=36) with an annual income ≥ $75,000 (n=23). These two specific findings with regard to education and annual income do not reflect the previous literature reporting overweight and obesity is more prevalent in lower income households and individuals without college degrees (Kakinami, Gauvin, Barnett, & Paradis, 2014). Although the majority of participants made ≥$75,000/year, the reported incomes are dispersed relatively evenly. Albeit research shows households making

≤$25,000/year are disproportionately affected by overweight and obesity, this study did not have adequate representation from this demographic to draw any conclusions.

Findings also showed a misinterpretation of how participants view their own body size. Most reported themselves to be overweight (63.2%), but when BMI was calculated, only 35.6% were overweight and 50.7% were obese. This shows that many individuals with obesity are unaware they are in the obese BMI category, making them uninformed of the multitudinous health problems that accompany obesity. This further introduces the question of what would individuals who thought they were overweight think or feel when they discovered they were actually obese? However, this question exceeds the scope of this study.

Regarding where participants typically look for advice about weight loss, 56.6% (n=43) reported "Physician". This seems probable since physicians may be emphasizing weight loss as a form of treatment for diagnoses and most people have contact with physicians, rather than dietitians. Most participants reported seeking weight loss advice from sources that have an increased likelihood of lacking credibility (i.e. books, magazines, blogs, Facebook). These sources are known to be wrought with misinformation, which may lend merit to the dilution effect of why people tend not to take the most straightforward route with weight loss (Gastil & Marriott, 2018).

Interestingly, combining participant answers of agreeing or strongly agreeing with judging weight loss advice, 61.6% (n=45) feel qualified to do so. These answers contrast with question 10, which asked participants to answer how often they have attempted to lose weight in their life with most (98.7%, n=75) answering 1-7, or more times. It would appear confident weight loss judgement would equate fewer attempts to lose weight, but the inverse is seen in this study population. Physicians are the most sought-after source for weight loss advice, but most

individuals seek advice through unregulated sources by means of the internet. Most individuals feel highly qualified to judge the reliability of weight loss advice, but contradictorily diverge from the 2020 Dietary Guidelines, the most credible and up-to-date consensus for weight loss and weight maintenance.

Exercise and eating less fat are the leading answers in current practices to control weight, however both are only two facets of the overall healthier adopted lifestyle practices that are essential for weight loss and especially weight maintenance. The greatest difficulties participants reported with dieting or losing weight were keeping the weight off and not being able to stick with it. These findings may imply a poor relationship with dietary lifestyle changes such as strict food restrictions and misconceptions about food groups and energy balance. After analyzing responses to questions to answer RQ1, "What are the sample populations' understandings of how to lose weight," appear to show a broad variety of understandings that are neither conducive to weight loss nor weight maintenance.

RQ2: What are the study populations' understandings of the mechanisms involved to lose weight?

The response to survey questions 16, 18, and 20 pertain to this research question. Question 16 was previously addressed to answer RQ1, therefore, will not be addressed in this section. Addressing question 18, "Have you attempted any of the following in the past year?", 11.8% (n=9) reported "Fasting", 26.3% (n=20) reported "Skipped meals", 3.9% (n=3) reported "Took diet pills", 0% (n=0) reported "Made myself vomit", 1.3% (n=1) reported "Used laxatives", 6.6% (n=5) reported "Used diuretics", 40.8% (n=31) reported "None", and 18.4%

(n=14) reported “Other”. In reviewing responses to the “Other” category, 4 participants reported “Monitor/low carbohydrate intake”. Question 18 results are reported in Table 8.

Table 8.

Survey Question 18 “Have you attempted any of the following in the past year?”

Responses	n	Percentage (%)
Fasting	9	11.8
Skipped meals	20	26.3
Took diet pills	3	3.9
Made myself vomit	0	0
Used laxatives	1	1.3
Used diuretics	5	6.6
None	31	40.8
Other	14	18.4

Addressing question 20, “What weight loss plans have you tried in the past?”, 32.9% (n=25) reported “Weight Watchers”, 9.2% (n=7) reported “Nutrisystem”, 38.2% (n=29) reported “Low Carbohydrate”, 26.3% (n=20) reported “Low Fat”, 6.6% (n=5) reported “South Beach”, 9.2% (n=7) reported “Ketogenic”, 1.3% (n=1) reported “Bariatric Surgery”, 60.5% (n=46) reported “Healthy Eating & Physical Activity”, 17.1% (n=13) reported “None”, 9.2% (n=6) reported “Other”. Question 20 results are reported in Table 9.

Table 9.

Survey Question 20 "What weight loss plans have you tried in the past?"

Responses	n	Percentage (%)
Weight Watchers	25	32.9
Jenny Craig	0	0
Nutrisystem	7	9.2
Low Carbohydrate	29	38.2
Low Fat	20	26.3
Paleo	0	0
South Beach	5	6.6
Ketogenic	7	9.2
Bariatric Surgery	1	1.3
Healthy Eating & Physical Activity	46	60.5
None	13	17.1
Other	6	7.9

Participants' understandings of the mechanisms involved to lose weight seem obscure. Most participants (60.5%, n=46) reported their weight loss plans consisting of healthy eating and physical activity, but when asked what healthy eating means to them personally, most answers lacked coherency. In retrospect, "Healthy Eating & Physical Activity" has the illusion of being the "correct" answer and therefore may be why most participants chose that option. "Low carbohydrate" is the second most common choice of attempted weight loss plans and is a leading response of how to lose weight. It appears numerous individuals hold a belief that carbohydrates have the most direct effect on weight gain and weight loss. Why this is the case is unclear and beyond the scope of this study. Participants may be including a low carbohydrate diet within their healthy eating and physical activity answer, believing a low carbohydrate diet is within the definition of healthy eating. Skipping meals to lose weight was one of the more commonly chosen answers with 26.3% (n=20) of participants choosing that option. Skipping meals eludes

to an understanding of a reduction in calories is conducive to weight loss, but at the cost of proper nourishment and a restricted relationship with food. Many participants (32.9%, n= 25) reported trying Weight Watchers as a means to lose weight. This may suggest that weight loss is out of one's control and individuals prefer the structure and accountability of Weight Watchers.

RQ3: What are the study populations' perceptions or misconceptions of weight loss methods?

The response to survey questions 13, 18, 19, 22, 23, and 24 pertain to this research question. Addressing question 13, "What would you be willing to pay for a weight loss plan or diet?", 40.0% (n=30) reported "I would not pay", 41.3% (n=31) reported "$1-50", 9.3% (n=7) reported "$50-100", 2.7% (n=2) reported "$100-200", and 6.7% (n=5) reported "I would pay any amount if I could lose weight". Question 13 results are reported in Table 10.

Table 10.

Survey Question 13 "What would you be willing to pay for a weight loss plan or diet?"

Responses	n	Percentage (%)
I would not pay	30	40.0
$1-50	31	41.3
$50-100	7	9.3
$100-200	2	2.7
$200-300	0	0
I would pay any amount if I could lose the weight	5	6.7

Question 18 was previously addressed to answer RQ2 and, therefore, will not be addressed in this section. Addressing question 19, "If you are trying to lose weight, what are your primary reasons?", 86.8% (n=66) reported "Improved health", 40.8% (n=31) reported "Feel more attractive", 6.6% (n=5) reported "Please others (family, friends, spouse)", 36.8% (n=28)

reported “Have more confidence”, 47.4% (n=36) reported “Fit into my favorite clothes”, 46.1% (n=35) reported “Ease joint pain”, and 13.2% (n=10) reported “Other”. Of those selecting “Other”, 4 participants reported “Better control of chronic disease”. Question 19 results are reported in Table 11.

Table 11.

Survey Question 19 “If you are trying to lose weight, what are your primary reasons?”

Responses	n	Percentage (%)
Improved health	66	86.8
Feel more attractive	31	40.8
Please others (family, friends, spouse)	5	6.6
Have more confidence	28	36.8
Fit into my favorite clothes	36	47.4
Ease joint pain	35	46.1
Other	9	11.8

Question 22 was previously addressed to answer RQ2 and, therefore, will not be addressed in this section. Addressing question 23, “Do you consider your specific weight loss diet plan as short-term, meaning the diet is temporary until I lose the weight; or long-term, meaning I plan to follow this diet as a permanent lifestyle?”, 4.2% (n=3) reported “Short-term (the diet is temporary until I lose the weight), 66.2% (n=47) reported “Long-term (the diet as a permanent lifestyle), 29.6% (n=21) reported “Unsure/Neutral”, and 6.6% (n=5) declined to answer. Question 23 results are reported in Table 12.

Table 12.

Survey Question 23 "Do you consider your specific weight loss diet plan as short-term or long-term?"

Responses	n	Percentage (%)
Short-term	3	4.2
Long-term	47	66.2
Unsure/Neutral	21	29.6

Addressing question 24, "Of the following, which are important to you on a diet?", 81.6% (n=62) reported "Healthy food plan", 15.8% (n=12) reported "Quick weight loss", 60.5% (n=46) reported "Eat foods I love", 34.2% (n=26) reported "Great support group", 47.4% (n=36) reported "Not feeling hungry", 47.4% (n=36) reported "Not feeling like I am dieting", 56.6% (n=43) reported "Losing weight at a slow, steady pace", 68.4% (n=52) reported "Learning how to maintain the weight", 6.6% (n=5) reported "No exercise required", 2.6% (n=2) reported "Just taking a diet pill/supplement for convenience", 2.6% (n=2) reported "Other" and 1.3% (n=1) declined to answer. Question 24 results are reported in Table 13.

Table 13.

Survey Question 24 "Of the following, which are important to you on a diet?"

Responses	n	Percentage (%)
Healthy food plan	62	81.6
Quick weight loss	12	15.8
Eat foods I love	46	60.5
Great support group	26	34.2
Not feeling hungry	36	47.4
Not feeling like I am dieting	36	47.4
Losing weight at a slow, steady pace	43	56.6
Learning how to maintain the weight	52	68.4
No exercise required	5	6.6
Just taking a diet pill/supplement for convenience	2	2.6
Other	2	2.6

RQ3, "What are the study populations' perceptions or misconceptions of weight loss methods?" was not clearly answered. This could be due to the complexity of the question itself. The physiological mechanisms involved in weight loss involve knowledge of complex biochemistry. The accurate perception of weight loss, e.g. lipid catabolism releasing glycerol and fatty acids from adipocytes which in turn oxidize within mitochondria to yield ATP with byproducts of water and CO2, is not common knowledge in the lay public. The fat that is "lost" during weight loss is essentially expired through the lungs. Most individuals would find this science confounding; therefore, it stands to reason answering RQ3 would not be concise. Nonetheless, the survey questions pertaining to answer RQ3 provide new insight on the populations' knowledge of weight loss methods. First, 40.0% of participants reported they would

not pay $1-50 for a weight loss plan or diet, while 41.3% said they would pay. These responses suggest that half perceive that losing weight may require external monetary support.

The most commonly chosen answers to question 18, “Have you attempted any of the following in the last year?” were “None” (40.8%, n=31) and “Skipped meals” (26.3%, n=20). Skipping meals could be interpreted as understanding the caloric-deficit needed in order to lose weight but overlooking proper nourishment. The leading response to question 19, “If you are trying to lose weight, what are your primary reasons?” was “Improved health” (86.8%, n=66). This reveals the study participants had a better understanding of the benefits of weight loss and improved physiological outcomes regardless of the methods involved to achieve a reduction in weight. Most participants (66.2%, n=47) view their weight loss plan or diet as long-term, which could be inferred as a positive perspective when making dietary lifestyle changes. When asked about what is important to you on a diet, the three leading answers were “Healthy food plan” (81.6%, n=62), “Eat foods I love” (60.5%, n=46), and “Learning how to maintain the weight” (68.4%, n=52). Unsurprisingly, most participants view a healthy food plan as important on a diet, but when asked to define what a healthy diet is, responses were mostly vague and/or unaligned with the 2015-2020 Dietary Guidelines for Americans. Learning how to maintain weight loss is consistent with previous literature that initial weight loss can be achieved by various diet methods, whether in a healthy way or not, but weight maintenance is sustained by consistent evaluation, monitoring, and behavior therapy provided by qualified persons (Jensen et al., 2014; Marchesini et al., 2016; Wing, R. R., & Phelen, S., 2005). Perhaps the population perceives weight maintenance as the greatest challenge, not the initial weight loss.

A former question which was removed from the survey, “When you lose fat, where does it go?” would have aided in answering RQ3, but as previously mentioned, responses were

predicted to be too confounded for applicability. Referencing this question eludes to more inquiry about how weight loss perceptions could change if individuals were educated on how weight loss occurs. If a more in-depth understanding of weight loss were to be provided, it gives to reason that individuals might change their weight loss behaviors to be more conducive to maintaining the lost weight over a lifetime.

Other Relevant Findings

The responses to survey questions 9, 10, 12, 21, and 26 were interesting and reported here. Question 9, "In the last 12 months, how often have you looked for advice about how to lose weight?", 17.1% (n=13) reported "Never", 31.6% (n=24) reported "1-2 times", 27.6% (n=21) reported "3-4 times", 5.3% (n=4) reported "5-6 times", and 18.4% (n=14) reported "7 or more times". Question 9 results are reported in Table 14.

Table 14.

Survey Question 9 "In the last 12 months, how often have you looked for advice about how to lose weight or control or weight?"

Responses	n	Percentage (%)
Never	13	17.1
1-2 times	24	31.6
3-4 times	21	27.6
5-6 times	4	5.3
7 or more times	14	18.4

The percentages from question 9 are similar to the 86.3% of participants who are actually overweight or obese, indicating most overweight or obese individuals in East Tennessee tend to seek weight loss advice. Although the majority of East Tennesseans with overweight or obesity often look for weight loss advice, this does not elude that they are actively attempting to lose weight, that will be addressed in question 10. The majority of participants reported seeking

advice 1 - 4 times in the past 12 months, suggesting most (59.2% n=45) are not inattentive or drastic in their search for weight loss advice. Contrarily, 17.1% (n=13) report never seeking advice, this could suggest they are confident in their current knowledge of weight loss, in no need to lose weight, or unaware. The most intriguing response is that 18.4% (n=14) reported seeking weight loss advice "7 or more times". This answer choice could suggest previous failed weight loss attempts, desperation to lose weight, or misconceptions of weight loss methods and/or mechanisms.

Addressing question 10, "How many times in your life have you made an effort to lose weight?", 1.3% (n=1) reported "Never", 21.1% (n=16) reported "1-2 times", 19.7% (n=15) reported "3-4 times", 11.8% (n=9) reported "5-6 times", and 46.1% (n=35) reported "7 or more times". Question 10 results are reported in Table 15.

Table 15.

*Survey Question 10 "How many times in **your life** have you made an effort to lose weight?"*

Responses	n	Percentage (%)
Never	1	1.3
1-2 times	16	21.1
3-4 times	15	19.7
5-6 times	9	11.8
7 or more times	35	46.1

This question in particular is interesting due to the fact that 18.4% (n=14) participants reported they were at a healthy weight, yet only 1 participant reported never in their life making an effort to lose weight. A large number of participants (98.7%, n=75) reported making an effort to lose weight in their life 1-7 or more times. This higher percentage of 98.7% is expected, albeit high, due to the obesity epidemic. The vast majority of participants (46.1% n=35) reported making an effort of 7 or more times to lose weight. This finding is consistent with previous

literature, 49.1% of Americans attempted to lose weight in the past 12 months between 2013-2016 (Herrick, Ogden, & Sarafrazzi, 2019). These responses suggest that most East Tennesseans have made an effort to lose weight, but to little success since 86.3% (n=63) of participants are classified as overweight or obese.

Addressing question 12, "If you were at your ideal weight, how would your life be different?", 48.7% (n=37) reported "I would be happier", 71.1% (n=54) reported "I would have more energy", 10.5% (n=8) reported "I would get more approval from others", 51.3% (n=39) reported "I would fit into my favorite clothes", 5.3% (n=4) reported "I could pursue my dreams", 65.8% (n=50) reported "I would have an overall sense of well-being", and 13.2% (n=10) reported "Other". Of the participants responding to the "Other" category, 4 participants reported "Better control of chronic disease." Question 12 results are reported in Table 16.

Table 16.

Survey Question 12 "If you were at your ideal weight, how would your life be different?"

Responses	n	Percentage (%)
I would be happier	37	48.7
I would have more energy	54	71.1
I would get more approval from others	8	10.5
I would fit into my favorite clothes	39	51.3
I could pursue my dreams	4	5.4
I would have an overall sense of well-being	50	65.8
Other	10	13.2

The majority of participants reported they would have more energy following an overall sense of well-being. After the fact, the answers "I would be happier" and "I would have an overall sense of well-being" should have been grouped together, not independent choices. These

choices are synonymous and perhaps skewed the data. If combined, overall positive well-being and improved happiness would be the leading answer chosen. This is analogous to other answer choices that had emotional health/well-being as a drive to lose weight or as a desired outcome. Improved physical health and being at a healthy weight is common knowledge, but improved mental health appears to be a motive in relation to weight loss. The answer choice "I would have more energy" could have related to diminished mental motivation to carry out tasks, corresponding with mental energy, not physical energy. This clarification was overlooked during survey development. This question suggests that overweight and obesity could have an extensive adverse impact on one's happiness and well-being.

Addressing question 21, "When you have been successful in losing weight, what were the main reasons?", 9.2% (n=7) reported "I loved the food", 26.3% (n=20) reported "I had great support from others", 44.7% (n=34) reported "I had the right frame of mind", 27.6% (n=21) reported "I had a strong purpose for losing (like a wedding or other event)", 10.5% (n=8) reported "I never felt hungry", 21.1% (n=16) reported "I had great accountability", 15.8% (n=12) reported "Counted calories", 13.2% (n=10) reported "Counted fat intake (grams)", and 19.7% (n=15) reported "Other." Question 21 results are reported in Table 17.

Table 17.

Survey Question 21 "When you have been successful in losing weight, what were the main reasons?"

Responses	n	Percentage (%)
I loved the food	7	9.2
I had great support from others	20	26.3
I had the right frame of mind	35	46.1
I had a strong purpose for losing	22	28.9
I never felt hungry	8	10.5
I had great accountability	16	21.1
Counted calories	13	17.1
Counted fat intake (grams)	10	23.7
Other	12	15.8

The main reason participants reported for being successful in losing weight is having the right frame of mind. Admittedly, this response is ambiguous. What constitutes having the right frame of mind? This could be intended to having the appropriate resources (i.e. credible professional guidance and support, basic needs being met first, routine monitoring), therefore, this answer lacks clarity. The second most commonly chosen answer is "I had a strong purpose for losing weight". This could have been aided by asking participants to list their purpose. Perhaps this question relates to previous literature which reports most Americans have little weight loss success, therefore main reasons are indistinct (Jensen et al., 2014; Marchesini et al., 2016; Wing, R. R., & Phelen, S., 2005).

Addressing the short-answer question 26, "What does eating healthy mean to you?", 89.5% (n=68) of participants answered with 25.0% (n=17) reported "Emotional and physical health", 26.5% (n=18) reported "More fresh fruits, vegetables, lean meats; limit sugar, fried

foods, and processed foods", 5.9% (n=4) reported "Better control of chronic disease", 4.4% (n=3) reported "Portion Control", 7.4% (n=5) reported "Make better choices", 8.8% (n=6) reported "Low/no carbohydrate", and 22.1% (n=15) responses were unrelated. These responses were irregular, with comments of religions, diets not being composed of strange foods, overall well-being, variety, flavor and other inapplicable responses. Question 26 results are reported in Table 18.

Table 18.

Survey Question 26 "What does eating healthy mean to you?"

Responses	n	Percentage (%)
Emotional and physical health	17	25.5
More fresh fruits, vegetables, lean meats; limit sugar, fried foods, and processed foods	18	26.5
Better control of chronic disease	4	5.9
Portion control	3	4.4
Make better choices	5	7.4
Low/no carbohydrate	6	8.8
Nonspecific	15	22.1

Findings from question 26 shed light that a large spectrum of different opinions defining a healthy diet extend regardless of age, income, or ethnicity. However, 26.5% (n=18) reported the most accurate answer, being a well-balanced and healthy diet defined by the 2015-2020 Dietary Guidelines for Americans. If this response rate is demonstrative of the population as a whole, only a quarter of participants properly define a healthy diet. Question 26 perhaps may have been misperceived. Many participants, 25.5% (n=17), reported healthier eating habits would make them feel emotionally and physically better, this would be an effect of healthy

eating, not personally defining healthy eating. Moreover, 22.1% (n=15), had unrelated responses, leading to believe the question was worded ambiguously.

These study participants' understandings of how to lose weight includes exercise and eating less fat. However, they reported difficulties keeping the weight off and not being able to stick with exercise and eating less fat. The study participants' understandings of the mechanisms involved to lose weight seem obscure. Numerous individuals reported believing carbohydrates have the most direct effect on weight gain and weight loss. The majority of participants reported their weight loss plans consisted of healthy eating and physical activity; however, they have attempted various fad diets. The participants in this study had a strong understanding of the benefits of weight loss but perceived weight maintenance as the greatest challenge, not the initial weight loss.

Debunking Fad Diet Myths

After analyzing the survey results and with oversight of the investigator's thesis chair, a 45-minute presentation on "Debunking Fad Diet Myths" was developed to be presented to community members of East Tennessee. The objectives included:

- Identify the calorie-yielding macronutrients (carbohydrate, protein, and fat)
- Increase knowledge of calorie-balance in relation to weight
- Understand evidence-based weight loss strategies
- Recognize why fad diets are not realistic or evidence-based

Participants were shown evidence-based recommendations from the Dietary Guidelines for Americans (2015) and Physical Activity Guidelines for Americans (2018). The presentation covered a wide range of topics involving fad diets such as why people choose fad diets, the unawareness overconsumption of high calorie foods, the energy balance thesis, pros and cons of

fad dieting, and fad diet marketing tactics. After the presentation, there was an open discussion for 20 minutes.

CHAPTER 5

CONCLUSION

Although losing weight can appear to be relatively simple by balancing energy intake and expenditure, implementing lifestyle changes with a well-balanced diet and increased physical activity is unsuccessful for most individuals. Fallacious promises are purported by diet and weight loss companies that one of the most prominent health concerns, excessive body weight, can be easily overcome by fad diets that often incorporate supplements, severe caloric restriction, diet drinks, fat burning concoctions, or combinations of various dieting methods. These misconceptions of weight loss combined with a yearning for weight loss has resulted in the use of inaccurate and ineffective dieting methods in the U.S. Businesses accrue billions of dollars each year by personating their product(s) as being the best in achieving weight loss. The products promoted by these companies may achieve success in initial weight loss, but not in weight loss maintenance, which is considered more challenging.

Weight loss mechanisms are complex and most often not understood. These misunderstandings place individuals who want to lose weight in a position to be easily coaxed by promising, yet erroneous terminology from countless social media platforms, commercials, and internet websites. Evidence-based methods derived from credible sources advocating lifestyle changes are proven to gradually aid in weight loss and improve overall health over time, while commercial products may guarantee quick weight loss but consistently fail with weight maintenance. Although fad diets promise weight loss, the long-term effects are unknown and these diets distract from evidence-based recommendations that promote evidence-based healthy and sustainable weight loss.

Limitations

This study had several limitations including participants who took the survey were predominantly White/Caucasian females, 60 years or older, earned >$75,000 per year and had a college degree. With the average household income of East Tennesseans over age 65 being $33,762 per year, this makes the participants' income in this study not representative of the population as a whole. The surveys were administered within local Food City stores at employee and community wellness events, which could explain why the majority of participants had similar characteristics. Individuals were also visiting stores for health-related programs, implying they were most likely already interested in health overall. A dietitian was also present each time the surveys were administered. This could have potentially skewed participants' answers to the survey question, "where do you go to for weight loss advice".

Consequently, these results cannot be generalized to the population as a whole. Other limitations included the small sample size of 76 participants, inaccuracies of self-reporting, and ambiguous answers to short answer survey questions. In addition, the limited research studies in addressing the populations' perceptions of weight loss and weight loss mechanisms may have limited this study's approach to addressing individual's perceptions of weight loss. It is probable having the answer choice option "Healthy Eating & Physical Activity" to Question 20 "What weight loss plans have you tried in the past?" skewed the responses to the question. Essentially, omitting that answer option most likely would have altered the responses. A pre-post- test before and after the educational workshop, "Debunking Fad Diet Myths", would have provided better insight of the participants' understandings and misconceptions of weight loss.

Future Research

According to this study's findings regarding the participants' perceptions of weight loss methods and weight loss mechanisms, much uncertainty persists among individuals about what is the most effective and evidence-based approaches to lose and maintain weight. Additional research in the area of weight loss understanding is needed to determine why most people choose options that are not evidence-based nor conducive to sustainable weight loss. The survey implemented in this study could be advantageous to a company or to public health professionals conducting a needs assessment for program development to determine what their priority population currently thinks about weight loss.

This study's population consisted of Food City employees and shoppers attending grocery store tours or wellness events led by a registered dietitian, but perhaps other groups of people more representative of the population as a whole, such as more equitable age groups and income status, would lead to more impartial results. This could be achieved by conducting future research in areas that have willing participants of all backgrounds, ages, income statuses, and educational level, such as within universities and healthcare institutions.

Weight loss is an enduring challenge, so researching individuals and inquiring about their chosen methods and understanding over time would perhaps lead to more specific outcomes and disclose common gaps of nutritional knowledge. Evidence-based weight loss educational classes could be provided over several weeks to also learn pre- and post- perceptions of weight loss methods and understanding of weight loss mechanisms. Conducting a 3-month or 6-month follow up could shed light on how individuals retain and utilize appropriate weight loss information over time.

Since the most reported answers involved struggling with weight maintenance after the initial weight loss, researchers could study if specific interventions that lead to weight loss are conducive to long-term weight loss sustainability. Although weight loss regimens are highly individualized, perhaps specific commonly used interventions are far less likely to be effective than others.

Additional research could also explore how individuals are influenced to choose the sources of weight loss information they deem credible. Most participants reported seeking advice from a physician about weight loss, which is logical since they are medical professionals, however, many participants reported seeking advice from less credible sources such as magazines, Facebook, and other online sources. Learning why people choose and believe sources of weight loss could be beneficial in discovering why weight loss is confusing for many individuals.

REFERENCES

2013 ACCF/AHA Guideline for the Management of ST-Evaluation Myocardial Infarction: Executive Summary: A Report of the American College of Cardiology Foundation/American Heart Association Task Force Practice Guidelines. (2013). *Catheterization and Cardiovascular Interventions*, *82*(1). doi: 10.1002/ccd.24776

2015-2020 Dietary Guidelines - health.gov. (2019). Retrieved 5 August 2019, from http://health.gov/dietaryguidelines/2015/guidelines/

About Adult BMI | Healthy Weight | CDC. (2019). Retrieved 5 August 2019, from https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html#Definition

Adult Obesity Causes & Consequences | Overweight & Obesity | CDC. (2019). Retrieved from https://www.cdc.gov/obesity/adult/causes.html

Albert, N., Anderson, J., Apovian, C., Ard, J., Brindis, R., Bozkurt, B., . . . Yanovski, S. (2013). Guideline for the management of overweight and obesity in adults. doi: 10.1161/01.cir.0000437739.71477.ee

American Diabetes Association (2019). The Cost of Diabetes. Retrieved 5 August 2019, from http://www.diabetes.org/advocacy/news-events/cost-of-diabetes.html

American Psychological Association. (2010). *Publication manual of the American Psychological Association*. Washington, DC.

Arima, H., Doi, Y., Ibayashi, S., Iida, M., Imamura, T., Kubo, M (2009). LDL cholesterol and the development of stroke and subtypes and coronary heart disease in a general Japanese population. Retrieved from https://www.ahajournals.org/doi/10.1161.strokeaha.108.529537

Aronne, L.J., Nelinson, D. S., & Lillo, J. L. (2009). Obesity as a disease state: A new paradigm for diagnosis and treatment. *Clinical Cornerstone*, *9*(4), 9-29. doi: 10.1016/s1098-3597(09)80002-1

Ashtary-Larky, D., Ghanavati, M., Lamuchi-Deli, N., Payami, S. A., Alavi-Rad, S., Boustaninejad, M., … Alipour, M. (2017). Rapid Weight Loss vs. Slow Weight Loss: Which is More Effective on Body Composition and Metabolic Risk Factors? *International Journal of Endocrinology and Metabolism*. doi: 10.5812/ijem.13249

Attempts to Lose Weight Among Adults in the United States (2018) Retrieved from https://www.cdc.gov/nchs/products/databriefs/db313.htm

Aune, D., Janszky, I., Norat, T., Romundstad P., Norat, T., Tonstad, S., Vatten, L (2016). Body mass index, abdominal fatness, and heart failure incidence and mortality. A systematic

review and dose-response meta-analysis of prospective studies. https://doi.org/10.1161/circulationaha.115.016801

Aune, D., Norat, T., Romundstad, P., & Vatten, L. J. (2013). Whole grain and refined grain consumption an the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of cohort studies. *European Journal of Epidemiology*, *28*(11), 845-858. doi: 10.1007/s10654-013-9852-5

Austin, S. B., Yu, K., Liu, S. H., & Tefft, N. (2017). Houeshold Expenditure on Dietary Supplements Sold for Weight Loss, Muscle Building, and Sexual Function: Disproportionate Burden by Gender and Income. *SSRN Electronic Journal*. doi: 10.2139/ssrn.2944051

Bahadoran, Z., Mirmiran, P., & Azizi, F. (2015). Fast Food Pattern and Cardiometabolic Disorders: A Review of Current Studies. *Health Promotion Perpsectives*, *5*(4), 231-240. doi: 10.15171/hpp.2015.028

Bailey, R. L., Gahche, J. J., Miller, P. E., Thomas, P. R., & Dwyer, J. T. (2013). Why US Adults Use Dietary Supplements. *JAMA Internal Medicine*, *173*(5), 355. doi: 10.1001/jamainternmed.2013.2299

Blanck, H. M., Serdula, M. K., Gillespie, C., Galuska, D. A., Sharpe, P. A., Conway, J. M., . . . Ainsworth, B. E. (2007). Use of Nonprescription Dietary Supplements for Weight Loss Is Common among Americans. *Journal of the American Dietetic Association*, *107*(3), 441-447. doi: 10.1016/j.jada.2006.12.009

Breitkopf, C. R. & Berenson, A. B. (2004). Correlates of Weight Loss Behaviors Among Low-Income African-American, Caucasian, and Latina Women. *Obstetrics & Gynecology*, *103*(2), 231-239. doi: 10.1097/01.aog.0000110244.73624.b1

British Dietetic Association (2017). The Association of UK Dietitians. Retrieved from https://www.bda.uk.com/foodfacts/fad_diets

Brown, A. W., Brown, M. M., & Allison, D. B. (2013). Belief beyond the evidence: Using the proposed effect of breakfast on obesity to show 2 practices that distort scientific evidence. *The American Journal of Clinical Nutrition*, *98*(5), 1298-1308. doi: 10.3945/ajcn. 113.064410

Buscemi, S. (2018). Ketogenic diet and type 2 diabetes. *Http://Isrctn.com/.* doi: 10.1186/isrctn28161621

Cao, H. (2014). Adipocytokines in obesity and metabolic disease. *Journal of Endocrinology*, *220*(2). doi:10.1530/joe-13-0339

Carbohydrates. (2019, May 22). Retrieved from https://www.hsph.harvard.edu/nutritionsource/carbohydrates

Casazza, K., Brown, A., Astrup, A., Bertz, F., Baum, C., Brown, M. B., . . . Allison, D. B. (2015). Weighing the Evidence of Common Beliefs in Obesity Research Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/24950157

Catenacci, V. A., Ogden, L., Phelan, S., Thomas, J. G., Hill, J., Wing, R. R., & Wyatt, H. (2014). Dietary Habits and Weight Maintenance Success in High Versus Low Exercisers in the National Weight Control Registry. *Journal of Physical Activity and Health*, *11*(8), 1540-1548. doi: 10.1123/jpah.2012-0250

Caudill, M. A. (2012). *Biochemical, physiological, and molecular aspects of human nutrition.* Elsevier – Health Sciences Div.

Center for Food Safety and Applied Nutrition (n.d.). Guidance for Industry Food Labeling Guide. Retrieved from https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-labeling-guide

Centers for Disease Control and Prevention (2017). Retrieved from http://www.cdc.gov/nchs/data/nhis/earlyrelease/Earlyrelease201709_07.pdf

Cervenka, M. C., & Kossoff, E. H. (2013). Dietary Treatment of Intractable Epilepsy. Continuum: *Lifelong Learning in Neurology*, *19*, 756-766. doi: 10.1212/01.con.0000431396.23852.56

Chambial, S., Dwivedi, S., Shukla, K. K., John, P. J., & Sharma, P. (2013). Vitamin C in Disease Prevention and Cure: An Overview. *Indian Journal of Clinical Biochemistry*, *28*(4), 314-328. doi: 10.1007/s12291-013-0375-3

Dahl, W. J., & Stewart, M. L. (2015). Position of the Academy of Nutrition and Dietetics: Health Implications of Dietary Fiber. *Journal of the Academy of Nutrition and Dietetics*, *115*(11), 1861-1870. doi: 10.1016/j.jand.2015.09.003

Dansinger, M., Gleason, J., Griffin, J., Selker, H., & Schaefer, E. (2005). Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction: A randomized trial. *ACC Current Journal Review*, *14*(4), 19. doi: 10.1016/j.accreview.2005.02.079

Dattilo, A. M. & Kris-Etherton, P. M. (1992). Effects of weight reduction on blood lipids and lipoproteins: A meta-analysis. *The American Journal of Clinical Nutrition*, *56*(2), 320-328. doi: 10.1093/ajcn/56.2.320

Dietary Fats. (2014). Retrieved from https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/dietary-fats

Dietary References Intake for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. (2018, October 08). Retrieved from

http://www.nationalacademics.org/hmd/Reports/2002/Dietary-References-Intakes-for-Energy-Carbohydrate-Fiber-Fat-Fatty-Acids-Cholesterol-Protein-and-Amino-Acids.aspx

East Tennessee Demographics. (n.d.) Retrieved from https://www.point2homes.com/US/Neighborhood/TN/East-Tennessee-Demographics.html.

Egras, A. M., Hamilton, W. R., Lenz, T. L., & Monaghan, M. S. (2011). An Evidence-Based Review of Fat Modifying Supplemental Weight Loss Products. *Journal of Obesity*, 2011, 1-7. doi: 10.1155/2011/297315

Fad diet. (n.d.) *Seden's Medical Dictionary*. (2011). Retrieved from https://medical-dictionary.thefreedictionary.com/fad+diet

Fad Diets | Cleveland Clinic. (2019). Retrieved from https://my.clevelandclinic.org/health/articles/9476-fad-diets

Fast Food Consumption Among Adults in the United States, 2013-2016 (2017). Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/nchs/products/databriefs/db322.htm

FDA regulation of drugs versus dietary supplements. (n.d.). Retrieved from https://www.cancer.org/treatment/treatments-and-side-effects/complementary-and-alternative-medicine/dietary-supplements/fda-regulations.html

Federal Trade Commission. Dietary Supplements: An Advertising Guide for Industry. (2015, October 2). Retrieved from https://www.ftc.gov/tips-advice/business-center/guidance/dietary-supplements-advertising-guide-industry

Finkelstein, E., Trogdon, J., Cohen, J., & Dietz, W. (2009). Annual Medical Spending Attributable To Obesity: Payer-And Service-Specific Estimates. *Health Affairs*, *28*(Supplement 1), w822-w831. doi: 10.1377/hlthaff.28.5.w822

Food and Drug Administration (n.d.). "Vitamins and Minerals". Retrieved from https://www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/vitamens-and-minerals.html

Freeland-Graves, J. H., & Nitzke, S. (2013). Position of the Academy of Nutrition and Dietetics: Total Diet Approach to Healthy Eating. *Journal of the Academy of Nutrition and Dietetics*, *113*(2), 307-317. doi: 10.1016/j.jand/2012.12.013

Gastil, J., & Marriott, R. (2018). How Communicating Misleading Information Dilutes Public Understanding of Weight Loss Mechanisms. *Health Communication*, 1-9. doi: 10.1080/10410236.2018.1504656

Grandl, G., Straub, L., Rudigier, C., Arnold, M., Wueest, S., Konrad, D., & Wolfrum C. (2018). Short-term feeding of a ketogenic diet induces more severe hepatic insulin resistance than an obesogenic high-fat diet. *The Journal of Physiology*, *596*(19), 4597-4609. doi: 10.1113/jp275173

Gut Check: A Reference Guide for Media on Spotting False Weight Loss Claims. (2015). Retrieved from https://www.ftc.gov/tips-advice/business-center/guidance/gut-check-reference-guide-media-spotting-false-weight-loss

Hall, G. V., Stomstad, M., Rasmussen, P., Jans, O, Zaar, M., Gam, C., . . . Nielsen, H. B. (2009). Blood Lactate is an Important Energy Source for the Human Brain. *Journal of Cerebral Blood Flow & Metabolism*, *29*(6), 1121-1129. doi: 10.1038/jcbfm.2009.35

Han L., Dingyun, Y., Zeng, F., Xiaoqi, F., Thomas, A., Shiwei D., Lu, Q (2018). Trends in Self-perceived Weight Status, Weight Loss Attempts, and Weight Loss Strategies Among Adults in the United States, 1999-2006. *JAMA Network Open.* doi:10.001/jamanetworkopen.2019.15219

Healthy diet (2018) Retrieved from https://www.who.int/news-room/fact-sheets/detail/healthy-diet

Healthy Eating for a Healthy Weight | Healthy Weight | CDC. (n.d.) Retrieved from https://www.cdc.gov/healthyweight/healthy_eating/index.html

Herrick, K. Martin, C. Ogden, C. & Sarafrazi, N. (2018). Attempts to lose weight among adults in the United States, 2013-2016. NCHS Data Brief, No. 313. Hyattsville, MD: National Center for Health Statistics. 2018.

Howarth, C., Gleeson, P., & Attwell, D. (2012). Updated Energy Budgets for Neural Computation in the Neocortex and Cerebellum. *Journal of Cerebral Blood Flow & Metabolism, 32*(7), 1222-1232. doi: 10.1038/jcbfm.2012.35

Hu, F. B., Liu, S., & Dam, R. M. (2001). Diet and risk of Type II diabetes: The role of types of fat and carbohydrate. *Diabetologia*, *44*(7), 805-817. doi: 10.1007/s00125010054

Hui, H. X., & Feng. (2018). Adipose Tissue as an Endocrine Organ. *Adipose Tissue*. doi: 10.5772/intechopen/76220

Institute of Medicine, "Dietary References Intakes for Energy, Carbohydrates, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids" at NAP.edu. (2005). Retrieved from https://www.nap.edu/read/10490/chapter/1

Jeffrey, R. W., & French, S. A. (1996). Socioeconomic status and weight control practices among 20 – to 45-year-old women. *American Journal of Public Health*, *86*(7), 1005-1010. doi: 10.2105/ajph.86.7.1005

Jensen et al., 2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults. (2014). *Journal of the American Pharmacists Association*, *54*(1). doi:10.1331/japha.2014.14502

Jo, J., Galvrilova, O., Pack, S., Jou, W., Mullen, S., Summer, A. E., . . . Periwal, V. (2009). Hypertrophy and/or Hyperplasia: Dynamics of Adipose Tissue Growth. *PLoS Computational Biology*, *5*(3). doi: 10.1371/journal.pcbi.1000324

Kakinami, K., Gauvin, L., Barnett, T., Paradis, G. (2014). The Association of Income and Age to Weight-Loss Strategies in the U.S. *American Journal of Preventative Medicine*. doi: https://doi.org/10/1016/j.amepre.2014.01.022

Katz, D. L. (2003). Pandemic obesity and the contagion of nutritional nonsense. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/14656042

Katzmarzyk, P. T., Denstel, K. D., Beals, K., Bolling, C. Wright, C., Crouter, S. E., . . . Sisson, S. B. (2016). Results From the United States of America's 2016 Report Card on Physical Activity for Children and Youth. *Journal of Physical Activity and Health*, *13*(S2). doi: 10.1123/jpah.2016-0321

Kelishadi, R., Djalalinia, S., Qorbani, M., Peykari, N., & Kelishadi, R. (2014). Health impacts of Obesity. *Pakistan Journal of Medical Sciences*, *31*(1). doi: 10.12669/pjms.311.7033

Khan, A. (2017). Health complication caused by protein deficiency. *Journal of Food Science and Nutrition*, *01*(01). doi: 10.35841/food-science. 1000101

Khawandanah, J., & Tewfik, I. (2016). Fad Diets: Lifestyle Promises and Health Challenges. *Journal of Food Research*, *5*(6), 80. doi: 10.5539/jfr.v5n6p80

Klein, A. V., & Kiat, H. (2014). Detox diets for toxin elimination and weight management: A critical review of the evidence. *Journal of Human Nutrition and Dietetics*, *28*(6), 675-686. doi: 10.1111/jhn.12286

Klem M.L., Wing R.R., McGuire M.T., Seagle H.M., Hill J.O. (1997). A descriptive study of individuals successful at long-term maintenance of substantial weight loss. American Journal of Clinical Nutrition. 66:239-246.

Klem M.L., Wing R.R., McGuire M.T., Seagle H.M., Hill J.O. (1998). Psychological symptoms in individuals successful at long-term maintenance of weight loss. Healthy Psychology. 17:336-345.

Kraschnewski, J. L., Boan, J., Esposito, J., Sherwood, N. E., Lehman, E. B., Kephart, D. K., & Sciamanna, C. N. (2010). Long-term weight loss maintenance in the United States. *International Journal of Obesity*, *34*(11), 1644-1654. doi: 10.1038/ijo.2010.94

Lipek, T., Igel, U., Gausche, R., Kiess, W., & Grande, G. (2015). Obesogenic environments: environmental approaches to obesity prevention. *Journal of Pediatric Endocrinology and Metabolism*, *28*(5-6). doi: 10.1515/jpem-2015-0127

Liu, S., Stampfer, M. J., Hu, F. B., Giovannucci, E., Rimm, E., Manson, J. E., … Willett, W. C. (1999). Whole-grain consumption and risk of coronary heart disease: results from the Nurses' Health Study. *The American Journal of Clinical Nutrition*, *70*(3), 412-419. doi: 10.1093/ajcn/70.3.412

Lutas, A., & Yellen, G. (2013). The ketogenic diet: Metabolic influences on brain excitability and epilepsy. *Trends in Neuroscience*, *36*(1), 32-40. doi: 10.1016/j.tins.2012.11.005

Magkos, F., Fraterrigo G., Yoshino, J., Luecking, C., Kirbach, K., Kelly, S., . . . Klein, S., (2016). Effects of Moderate and Subsequent Progresive Weight Loss on Metabolic Function and Adipose Tissue Biology in Humans with Obesity. *Cell Metabolism*. *23*(4), 591-601. doi: 10.1016/j.cmet.2016.02.005

Marchesini, G., Montesi, L., Ghoch, M. E., Brodosi, L., Calugi, S., & Grave, R. D. (2016). Long-term weight loss maintenance for obesity: A multidisciplinary approach. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *37*. doi: 10.2147/dmso.s89836

Mercurio A, Rima B (2011). Watching my weight: Self-weighing, body surveillance, and body dissatisfaction. Sex Roles. 65:47-55.

Migala, J. (2017, October 16). 25 Trendy Fad Diets That Are Total BS. Retrieved from https://www.redbookmag.com/body/health-fitness/g3141/do-fad-diets-work/

Mohan, V., & Shilpa, J. (2018). Ketogenic diets: Boon or bane? *Indian Journal of Medical Research, 148*(3), 251. doi: 10.4103/ijmr.ijmr_1666_18

Monteiro, C. A., Cannon, G., Moubarac, J., Levy, R. B., Louzada, M. L., & Jaime, P. C. (2017). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutrition*, *21*(1), 5-17. doi: 10.1017/s136890017000234

Mozaffarian, D. (2016). Dietary and Policy Priorities for Cardiovascular Disease, Diabetes, and Obesity. *Curriculum*, *133*(2), 187-225. doi: 10.1161/circulationha.115.018585

Mozaffarian, D., Hao, T., Rimm, E. B., Willett, W. C. & Hu, F. B. (2011). Changes in Diet and Lifestyle and Long-term Weight Gain in Women and Men. *New England Journal of Medicine, 364*(25), 2392-2404. doi: 10.1056/nejmoa1014296

Mozafarian, D., Rosenberg, I., & Uauy, R. (2018). History of modern nutrition science – implications for current research, dietary guidelines, and food police. *BMJ*. doi: 10.1136/bmj.k2392

Mul, J. D., Standford, K. I., Hirshman, M. F., & Goodyear, L. J. (2015). Exercise and Regulation of Carbohydrate Metabolism. *Progress in Molecular Biology and Translational Science Molecular and Cellular Regulation of Adaptation to Exercise*, *17-37*. doi: 10.1016/bs.pmbts. 2015.07.020

Murphy, S., Xu, J., Kochanek, K., & Arias, E. (2019). Retrieved from https://www.cdc.gov/nchs/data/databriefs/db328-h.pdf

National Center for Complementary and Integrative Medicine. Using Dietary Supplements Wisely. (2019). Retrieved from https://nccih.nig.gov/health/supplements/wiseuse.htm

National Institute of Diabetes and Digestive and Kidney Diseases (2014), "Weight-loss and Nutrition Myths". Retrieved from https://www.niddk.nih.gov/health-information/weight-management/myths-nutrition-physical-activity

New Nutrition Facts Labels to Feature Added Sugars, with Daily Value. (2016). Retrieved from https://cspinet.org/news/new-nutrition-facts-labels-feature-added-sugars-daily-value-20160520

Nicklas, J. M., Huskey, K. W., Davis, R. B. & Wee, C. C. (2012) Successful Weight Loss Among Obese U.S. Adults. *American Journal of Preventative Medicine*, *42*(5), 481-485. doi: 10.1016/j.amepre.2012.01.005

Nieman, D. (2010). Comparison of Weight-Loss Diets with Different Compositions of Fat, Protein, and Carbohydrates. *Yearbook of Sports Medicine*, 2010, *196-197*. doi: 10.1016/s0162-0908(09)79506-6

Obesity and Socioeconomic Status in Adults: United States (2010). Retrieved from https://www.cdc.gov/nchs/products/databriefs/db50.htm#key

Office of Dietary Supplements – Dietary Supplements for Weight Loss. (n.d.) Retrieved from https://ods.od.nih.gov/factsheets/WeightLoss-HealthProfessional#en11

Ogunbode, A. M., Fatiregun, A. A., & Ogunbode, O. O. (2009, December). Health risks of obesity. Retrieved from https://www.ncbi.nlm.nih.gov.pmc.articles/PMC4111009/

Onakpoya, I. J., Wider, B., Pittler, M. H., & Ernst. (2010). Food Supplements for Body Weight Reduction: A Systematic Review of Systematic Reviews. *Obesity*, *19*(2), 239-244. doi: 10.1038/oby.2010.185

Oomen, C. M., Ocke, M. C. Feskens, E. J., Erp-Baart, M. J., Kok, F. J. & Kromhout, D. (2001). Association Between trans fatty acid intake and 10-year risk of coronary heart disease in the Zutphen Elderly Study: A prospective population-based study. *The Lancet, 357*(9258), 746-751. doi: 10.1016/s0140-6736(00)04166-0

Overweight & Obesity Statistics. (2017). Retrieved from https://www.niddk.nih.gov/health-information/health-statistics/overweight-obesity

Pereira, M. A., Kartashov, A. I., Ebbeling, C. B., Horn, L. V., Slattery, M. L., Jacobs, D. R., & Ludwig, D. S. (2005). Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis. *The Lancet*, *365*(9453), 36-42. doi: 10.1016/s0140-6736(04)17663-0

Petre, A. (2017). The 80/10/10 Diet: Healthy Diet or Dangerous Fad? Retrieved from https://www.healthline.com/nutrition/80-10-10-diet

Physical Activity for a Healthy Weight | Healthy Weight | CDC. (n.d.). Retrieved from https://www.cdc.gov/healthyweight/physical_activity/index.html

Pittler, H, M., & Edzard. (2004). Dietary Supplements for body-weight reduction: A systematic review. Retrieved from https://academic.oup.com/ajcn/article/79/4/529/4690126

Pittler, M., Schmidt, K., & Ernst, E. (2010). Adverse events associated with herbal dietary supplements for body weight reduction: Systematic review. *Focus on Alternative and Complementary Therapies*, *9*, 40-40. doi: 10.1111/j.2042-7166.2004.tb04548.x

Prescription Medications to Treat Overweight and Obesity. (2016). Retrieved from https://www.niddk.nih.gov/health-information/weight-management/prescription-medications-treat-overweight-obesity

Prevalence of Obesity Among Adults and Youth: United States, 2015-2016 (2017). Retrieved from https://www.cdc.gov/nhs/products/databriefs/db288.htm

Raynor, H. A. & Champagne, C. M. (2016). Position of the Academy of Nutrition and Dietetics: Interventions for the Treatment of Overweight and Obesity in Adults. *Journal of the Academy of Nutrition and Dietetics*, *116*(1), 129-147. doi: 10.1016/j.jand.2015.10.031

Roehl, L., & Sewak, S. L. (2017) Practice Paper of the Academy of Nutrition and Dietetics: Classic and Modified Ketogenic Diets for Treatment of Epilepsy. *Journal of the Academy of Nutrition and Dietetics*, *117*(8), 1279-1292. doi: 10.1016/j.jand.2017.06.006

Rosenbaum, D. L., & White, K. S. (2016). Understanding the complexity of biopsychosocial factors in the public health epidemic of overweight and obesity. *Health Psychology Open, 3*(1), 205510291663436. doi: 10.1177/2055102916634364

Ruden, D. M., Rasouli, P., & Lu, X. (2007). Potential Long-Term Consequences of Fad Diets on Health, Cancer, and Longevity: Lessons Learned from Model Organism Studies. *Technology in Cancer Research & Treatment*, *6*(3), 247-254. doi: 10.1177/153303460700600312

Sartorius, K., Sartorius, B., Madiba, T. E., & Stefan, C. (2018). Does high-carbohydrate intake lead to increased risk of obesity? A systematic review and meta-analysis. *BMJ Open*, *8*(2). doi:10.1136/bmjopne-2017-018449

Seagle, H. M., Strain, G. W., Makris, A., Reeves, R. S., & American Dietetic Association. (2009). Position of the American Dietetic Association: Weight management. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/19244669

Simple vs Complex Carbs. (n.d.) Retrieved from https://www.diabetes.co.uk/nutrition/simple-carbs-vs-complex-carbs.html

Slavin, J. L., & Lloyd, B. (2012). Health Benefits of Fruits and Vegetables. *Advances of Nutrition*, *3*(4), 506-516. doi: 10.3945/an.112.002154

Spalding, K. (2015). Adipose tissue turnover in humans. *Endocrine Abstracts*. doi: 10.1530/endoabs.37.s14.1

State Briefs. (2019). Retrieved from https://www.stateofobesity.org/states/tn/

Staying Away from Fad Diets. (2019). Retrieved from https://www.eatright.org/health/weight-loss/fad-diets/staying-away-from-fad-diets

Steele, E. M., Baraldi, L. G., Louzada, M. L., J., Mozaffarian, D., & Monteiro, C. A. (2016). Ultra-processe foods and added sugars in the US diet: Evidence from a nationally representative cross-sectional study. *BMJ Open*, *6*(3). doi: 10.1136/bmjopen-2015-009892

Steele, E. M., Popkin, B. M. Swinburn, B., & Monteiro, C. A. (2017). The share of ultra-processed foods and the overall nutritional quality of diets in the US: Evidence from nationally representative cross-sectional study. *Population Health Metrics*, *15*(1). doi: 10.1186/s12963-017-0119-3

Stein, K. (2014). Severely Restricted Diets in the Absence of Medical Necessity: The Unintended Consequences. *Journal of the Academy of Nutrition and Dietetics*, *114*(7), 986-994. doi: 10.1016/j.jand.2014.03.008

Steinberg, D. M., Bennett, G. G., Askew, S., & Tate, D. F. (2015). Weighing Every Day Matters: Daily Weighing Improves Weight Loss and Adoption of Weight Control Behaviors. *Journal of the Academy of Nutrition and Dietetics*, *115*(4), 511-518. doi: 10.1016/j.jand.2014.12.011

Stender, S., Dyerberg, J., & Astrup, A. (2006). High Levels of Industrially Produced Trans Fat in Popular Fast Foods. *New England Journal of Medicine*, *354*(15), 1650-1652. doi: 10.1056/nejmc052959

Supplement Business Report: Nutrition Business Journal. (2019). Retrieved from https://www.nutritionbusinessjournal.com/reports/2019-nbj-supplements-business-report/

The 80/10/10 Diet: Healthy Diet or Dangerous Fad? (2017). Retrieved from https://www.healthline.com/nutrition/80-10-10-diet#section4

The National Weight Control Registry. (n.d.) Retrieved from https://www.nwcr.ws/

Thomas, S., Hyde, J,. Karunaratne A., Kausman R., Komesaroff P. (2008). "They all work…when you stick to them": A qualitative investigation of dieting, weight loss, and physical exercise, in obese individuals. *Nutr J*, doi: 10.1186/1475-2891-7-34

Tsai, A. G., Wadden, T. A., Pillitteri, J. L., Sembower, M. A., Gerlach, K. K., Kyle, T. K., & Burroughs, V. J. (2009). Disparities by Ethnicity and Socioeconomic Status in the Use of Weight Loss Treatments. *Journal of the National Medical Association*, 101(1), 62-70. doi: 10.1016/s0027-9684(15)30813-0

U.S. household income distribution (n.d.) Retrieved from https://www.statista.com/statistics/203183/percentage-distribution-of-household-income-in-the-us/

Vannice, G., & Rasmussen, H. (2014). Position of the Academy of Nutrition and Dietetics: Dietary Fatty Acids for Healthy Adults. *Journal of the Academy of Nutrition and Dietetics*, 114(1), *136-153*. doi: 10.1016/j.jad.2013.11.001

Veech, R. L. (2004). The therapeutic implications of ketone bodies: the effects of ketone bodies in pathological conditions: ketosis, ketogenic diet, redox states, insulin resistance, and mitochondrial metabolism. *Prostaglandins, Leukotrienes and Essential Fatty Acids, 70* (3), 309-319. doi: 10.1016/j.plefa.2003.09.007

Vis, H. L. (1969). Protein deficiency disorders. *Postgraduate Medical Journal*, *45*(520), 107-115. doi: 10.1136/pgmj.45.520.107

Weiss, E. C., Galuska, D. A., Khan, L. K. & Serdula, M. K. (2006). Weight-Control Practices Among U.S. Adults, 2001-2002. *American Journal Of Preventative Medicine*, 31(1), 18-24. doi: 10.1016.j.amepre.2006.03.016

Wheless, J. W. (2004). History and Origin of the Ketogenic Diet. *Epilepsy and the Ketogenic Diet*, 31-50. doi: 10.1007/978-1-59259-808-3_2

Willett, W., Manson, J., & Liu, S. (2002). Glycemic index, glycemic load, and risk of type 2 diabetes. *The American Journal of Clinical Nutrition*, *76*(1). doi: 10.1093/ajcn/76.1.274s

Wing, R. R., Lang, W., Wadden, T. A., Safford, M., Knowler, W. C., Bertoni, A. G., . . . Wagenknecht, L. (2011). Benefits of Modest Weight Loss in Improving Cardiovascular

Risk Factors in Overweight and Obese Individuals With Type 2 Diabetes. *Diabetes Care*, *34*(7), 1481-1486. doi: 10.2337/dc10-2415

Wing, R. R., & Phelen, S. (2005). Long-term weight loss maintenance. *The American Journal of Clinical Nutrition*, *82*(1). doi: 10.1093/ajcn/82.1.222s

Wirth, A., Wabitsch, M., & Hauner, H. (2014). The Prevention and Treatment of Obesity. *Deutsches Aerzteblatt Online.* doi: 10.3238/arztebl.2014.0705

World Health Organization, "Healthy Diet" (2018). Retrieved from https://www.who.int/news-room/facts-sheets/detail/healthy-diet

Wright, S.M., & Aronne, L. J. (2012). Causes of obesity. *Abdominal Radiology*, *37*(5), 730-732. doi: 10.1007/s00261-012-9862-x

Wu, H., Flint, A. J., Qi, Q., Dam, R. M. V., Sampson, L. A., Rimm, E. B., … Sun, Q. (2015). Association Between Dietary Whole Grain Intake and Risk of Mortality. *JAMA Internal Medicine, 175(3),* 373. doi: 10.1001/jamainternmed.2014.6283

Yang, W., Dall, T. M., Beranjia K., Lin, J., Semilla, A.P., Chakrabarti, R., … Petersen, M.P. (2018). Economic costs of diabetes in the U.S. in 2017. *Diabetes Care, 41*(5), 917-928. https://doi.org/10.2337/dci18-0007

Yudai N, Shin T (2015). Differential effects of rapid or slow body weight loss on muscle weight and protein degradation pathways in rat skeletal muscle. *J Int Soc Sports Nutr, 12*(1)

APPENDIX

Survey

1. **Age:** What is your age?
____18-29 years old
____30-39 years old
____40-49 years old
____50-59 years old
____60 or older

2. **Gender:** What is your sex?

____Male
____Female
____Other (please specify)_____

3. **Ethnic origin:** What is you race?
____White
____Hispanic or Latino
____Black or African American
____Native American or American Indian
____Asian / Pacific Islander
____Other (please specify) _____

4. **Education:** What is your highest level of education?
____Some high school, no diploma
____High school graduate, diploma or equivalent (GED)
____Some college credit, no degree
____Trade/technical/vocational training
____College degree

5. What is your current weight?

6. What is your current height?

7. Do you consider yourself to be…
____Obese
____Overweight
____Normal/Healthy weight
____Underweight

8. Household Income:
_____< $25,000
_____ $25,000-$50,000
_____ $51,000-$75,000

_____ >$75,000

9. In the last 12 months, how often have you looked for advice about how to lose weight or control your weight?
____Never
____1-2 times
____3-4 times
____5-6 times
____7 or more times

10. How many times in **your life** have you made an effort to lose weight?
____Never
____1-2 times
____3-4 times
____5-6 times
____7 or more times

11. Where do you look for advice about how to lose weight? (Check all that apply)
____Physician
____Registered Dietitian
____Registered Nurse
____Other professions (specify)_____
____Books
____Magazines
____Blogs
____YouTube
____Instagram
____Facebook
____Other online sources (specify)_____

12. If you were at your ideal weight, how would your life be different (check all that apply)?
____I would be happier
____I would have more energy
____I would get more approval from others
____I would fit into my favorite clothes
____I could pursue my dreams
____I would have an overall sense of well-being
____Other (please specify) _____

13. What would you be willing to pay for a weight loss plan or diet?
____I would not pay
____$1 - $50
____$50 - $100
____$100 - $200
____$200 - $300
____I would pay any amount if I could lose the weight

14. I consider myself well qualified to judge the reliability of weight loss advice.

____Strongly disagree
____Disagree
____Not sure
____Agree
____Strongly agree

15. Are you currently trying to lose weight, gain weight, stay about the same weight, or maintain your weight?

____Lose weight
____Gain weight
____Maintain weight

16. Are you currently doing any of the following to control your weight? (Check all that apply)

____Exercising more
____Eating less fat
____Skipping meals
____Taking diet pills
____Taking laxatives
____Taking water pills or diuretics
____Fasting
____Ketogenic diet
____Other (please specify) _____

17. How often have you changed your eating behaviors **during the last year**?

____Never
____1-2 attempts
____3-4 attempts
____5-6 attempts
____7 or more attempts
____I am always dieting

18. Have you attempted any of the following in the past year? (Check all that apply)

____Fasting
____Skipped meals
____Took diet pills
____Made myself vomit
____Used laxatives
____Used diuretics (pills that make you urinate)
____None
____Other (please specify) _____

19. If you are trying to lose weight, what are your primary reasons? (Check all that apply)

____Improved health
____Feel more attractive

____Please others (family, friends, spouse)
____Have more confidence
____Fit into my favorite clothes
____Ease joint pain
____Other (please specify) _____

20. What weight loss plans have you tried in the past? (Check all that apply)

____Weight Watchers
____Jenny Craig
____Nutrisystem
____Low Carbohydrate
____Low Fat
____Paleo
____South Beach
____Ketogenic
____Bariatric Surgery
____Healthy Eating & Physical Activity
____None
____Other (please specify) _____

21. When you have been successful in losing weight, what were the main reasons? (Check all that apply)

____I loved the food
____I had great support from others
____I had the right frame of mind
____I had a strong purpose for losing (like a wedding or other event)
____I never felt hungry
____I had great accountability
____Counted calories
____Counted fat intake (grams)
____Other (please specify) _____

22. If you are currently on a specific weight loss diet, do you consider it safe and effective?

____I consider it safe and effective
____I consider it not safe, but effective
____I am unsure, I just hope it works
____Not on a diet/program

23. Do you consider your specific weight loss diet plan as short-term, meaning the diet is temporary until I lose the weight; or long-term, meaning I plan to follow this diet as a permanent lifestyle?

____Short-term (the diet is temporary until I lose the weight)
____Long-term (the diet as a permanent lifestyle)
____Unsure/Neutral

24. Of the following, which are important to you in a diet? (Check all that apply)

____Healthy food plan
____Quick weight loss
____Eat foods I love
____Great support group
____Not feeling hungry
____Not feeling like I am dieting
____Losing weight at a slow, steady pace
____Learning how to maintain the weight
____No exercise required
____Just taking a diet pill/supplement for convenience
____Other (please specify) _____

25. What have been your greatest difficulties with dieting or losing weight (Check all that apply)?

____Keeping the weight off
____Not being able to stick with it
____Hating the food
____Missing my favorite foods
____Binging after I go off my diet
____Too expensive
____Gaining back all the weight or more
____Other (please specify) _____

26. What does eating "healthy" mean to you?

VITA

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