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**DIETARY SATISFACTION AND ITS ASSOCIATION WITH WEIGHT LOSS: AN
EXPLORATORY ANALYSIS**

A Thesis in
Nutritional Sciences
by
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ABSTRACT

Weight loss and weight-loss maintenance are undertakings that require physical and mental stamina. Short-term weight loss success has been observed among diverse populations and within a variety of interventions; however, long-term weight-loss maintenance has not been widely evident, likely due to minimal continued adherence and satisfaction with the prescribed intervention. In an attempt to improve long-term adherence to weight-loss interventions, it is critical to realize the facilitators and barriers that may prevent or promote an individual's compliance. A review of literature was conducted to establish the influences related to satisfaction or adherence to a diet or dietary intervention. The most prominent influences included time, cost, motivation, self-control, family and friend support, like/dislike of foods, and availability or accessibility of foods. From this review, it was established that dietary satisfaction can be defined, at least partially, through the facilitators and barriers to adherence.

A 45-item dietary satisfaction questionnaire (D-SAT) was created in 2004 that was consistent with the factors revealed through the aforementioned literature search. The D-SAT was completed in two weight-loss interventions in premenopausal women aged 20-45y with overweight or obesity ($n=180$; mean \pm SD age= 34.5 ± 6.9 y; BMI= 30.3 ± 3.6 kg/m²). There were no differences between baseline D-SAT scores, thus the results were combined for analysis. A secondary data analysis was completed to evaluate the internal validity of the D-SAT through exploratory factor analysis of the baseline D-SAT scores. This analysis resulted in two versions of the D-SAT suggesting 6-factors (36 items) and 7-factors (38 items). The constructs were labeled: "Benefits of diet," "Preoccupation with diet," "Eating away from home," "Diet planning," "Family impact," and "Financial cost," (6-factor D-SAT) and "Personal cost" (7-factor D-SAT).

The 6-factor D-SAT and the 7-factor D-SAT were employed in a subsequent secondary analysis to explore the relationship between a prompt change in D-SAT score from baseline to

week 2 (jumpstart phase of the intervention) and weight outcomes (body weight [BW] and body mass index [BMI]) during a 12 week intervention phase and 12 week weight-maintenance phase of a study in premenopausal women aged 20-45y that were overweight/obese. Sixty-eight women were included in the analysis whose D-SAT change scores from baseline to week 2 were stratified into 3 groups based on a decrease in score (negative group), no change (neutral group), and increase in score (positive group). A repeated measures ANOVA (4Time x 3Group) and Pearson's correlation were explored using the 3 groups. Results of the 6-factor D-SAT showed a significant main effect of time on BW [$F(1.262, 82.02) = 125.722, p < 0.001$] and BMI [$F(1.305, 123.95) = 127.808, p < 0.001$]. A significant main effect of D-SAT group and time x D-SAT group interaction were not found for BW or BMI. The 7-factor D-SAT results also revealed a significant main effect of time on BW [$F(1.243, 82.82) = 124.949, p < 0.001$] and BMI [$F(1.284, 83.43) = 127.463, p < 0.001$]; however, there was not a significant main effect of D-SAT group or time x D-SAT group for BW or BMI. Further, there was not a significant bivariate correlation between D-SAT group and BW and BMI change over the 24-week intervention for the 6-factor D-SAT or the 7-factor D-SAT.

Due to the risks associated with overweight and obesity, it is critical to address the factors that influence satisfaction with a diet or dietary intervention, in order to personalize a regimen to the point of satisfaction, adherence, and subsequent improvement in weight, and long-term weight-loss maintenance. Continued analysis of the D-SAT in various populations and interventions is important for refining the questionnaire to confirm that satisfaction is addressed in its entirety and establish its use as a tool for gauging dietary satisfaction and maximizing weight-loss.

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Chapter 1

Introduction

Although the pervasiveness of obesity has tapered¹ in the past few years, the proportion of individuals living with overweight and obesity in the United States remains alarming. Coinciding with a high prevalence of overweight/obesity, weight-loss programs and weight-loss attempts are ubiquitous. In fact, approximately 40 percent of women currently claim to be attempting to lose weight.² Despite initial interest, motivation for long-term participation in weight-loss interventions is lacking, with the average duration around six months.² Furthermore, attrition is common, with rates of up to 80 percent, contingent upon the specific intervention.³

Deviations from a customary routine, whether dietary or otherwise, are challenging, especially as a prolonged endeavor. The goal of an effective weight-loss intervention is to modify dietary intake in a way that is relatable to an habitual routine so as to ensure individual contentment and capability of incorporating dietary changes as a long-term lifestyle modification. Studies have shown that lasting adherence to a weight-loss intervention is more critical than the composition of the diet in terms of maximizing weight loss.^{4,5} Overall satisfaction with modifications made to the habitual diet may be the primary agent for a manageable transition and long-term adherence.⁶

Dietary satisfaction is a multifaceted dimension of internal and external determinants that aid successful weight loss. Dietary satisfaction may also be effective as a weight-loss indicator in that a person who believes a particular intervention to be

satisfying and feasible will likely adhere with the adjustments made to their typical diet and subsequently will lose weight.^{6,7} Individuals who are able to recognize personal facilitators and barriers to following a prescribed weight-loss intervention may be inclined to make the necessary adjustments in order to maximize their satisfaction with the diet, and subsequent compliance.^{8,9,10} Moreover, when satisfied with a diet, temporary behavior change may transition toward a permanent lifestyle-adaptation which may aid in the maintenance or furtherance of weight loss.¹¹

While dietary satisfaction is regarded as a determinant of success with weight loss, the concept of dietary satisfaction has been inadequately defined. Several constructs have been established as components of perceived dietary satisfaction, which characterize satisfaction by their influence over changes in dietary patterns. These components include, but may not be limited to, social influences,^{8,9,12,13, 14} time constraints,^{8,12,13,15,16} meal preparation,^{8,12,13,16} financial restrictions and affordability,^{8,12,13,17} food preferences, feelings of deprivation and accessibility,^{8,9,12,13} and family support.¹³ In order to maximize satisfaction with a weight-loss intervention and adequately operationalize dietary satisfaction, a precise characterization of dietary satisfaction is necessary.

In order to observe the factors that impacted compliance with prescribed dietary interventions, Ello-Martin and colleagues¹⁸ created the Dietary Satisfaction Questionnaire (D-SAT). In 2006, a study investigating the effect of incorporating water-rich, low-calorie foods (defined as low energy-dense foods) on diet composition, dietary satisfaction and hunger was published.¹⁹ Participants in this study were required to complete the D-SAT at various time points during the intervention. Prior to this study, a tool for evaluating dietary satisfaction, which may be essential to the success of a weight-

loss intervention, did not exist for weight-loss interventions that were not population-specific.

This 45-item D-SAT¹⁹ (Figure 3-1) prompted participants to respond to questions, in a Likert-scale fashion, that related to seven proposed fundamental elements of dietary satisfaction including Healthy Lifestyle, Convenience, Family Dynamics, Preoccupation with Food, Negative Aspects, Cost, and Preparation.¹⁹ Although this tool was used in a particular study and found to be valid,¹⁹ the questionnaire was not further tested in other populations.

Specific Aims

Individuals living with overweight and obesity frequently attempt weight-loss interventions, but long-term adherence is rare likely due, in part, to dissatisfaction with the imposed dietary recommendations. The purpose of the present analysis was to explore the factors of the original D-SAT and to provide a validated measure of dietary satisfaction for use in weight-loss interventions specific to healthy premenopausal women living with overweight and obesity. In this exploratory analysis, it was expected that at least six factors would be confirmed for defining and measuring dietary satisfaction (Chapter 3). Further, it was hypothesized that D-SAT score would be significantly and positively associated with body weight loss in premenopausal overweight/obese women who participated in a weight-loss intervention (Chapter 4).

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Chapter 2

Review of Literature

ABSTRACT

Satisfaction with a dietary intervention or diet modification may be a critical aspect to short- and long-term adherence and weight loss success; however, the concept of dietary satisfaction is multifaceted and difficult to measure. This review was conducted to evaluate the current scientific literature to determine various internal and external influences regarding satisfaction with a weight-loss intervention. Twenty-eight studies (5 qualitative, 9 cross-sectional, 3 longitudinal, 11 randomized trials) were identified that either observed facilitators or barriers to adherence or specifically mentioned dietary satisfaction. Facilitators or barriers salient in the literature included cost, time, social and family support, social influences, motivation, self-control, deprivation, and availability or accessibility of healthy or prescribed foods. Five randomized trials explicitly mentioned dietary satisfaction; however, only 1 study observed participant satisfaction using a tool created specifically for measuring dietary satisfaction. From this review, it was concluded with limited confidence that dietary satisfaction can be delineated through the various influences on adhering to dietary interventions. Further testing and publication of a validated measurement tool is

necessary to address dietary satisfaction in its entirety in order to impact short- and long-term weight loss outcomes.

INTRODUCTION

Due to the overwhelming rates of overweight and obesity in the United States, attempts at weight loss are prevalent. Regardless of the type of intervention, men and women alike have a difficult time adhering to a weight-loss regimen in the short-term (≤ 6 months), and especially over long-term intervals (≥ 12 months). Eating less overall, consuming less fat, engaging in physical activity, increasing water consumption, consuming lower energy-dense foods, skipping meals, or beginning a commercial weight-loss diet are the top weight-loss strategies reported by adults with obesity, according to 2001-2006 National Health and Nutrition Examination Survey (NHANES) data.¹ Although adhering to a weight-loss strategy may be challenging, weight loss could be sustained long-term, if individuals were to continue an intervention using some of the aforementioned strategies. Del Corral and colleagues² found that men and women who were considered high-adherers to an energy-restriction intervention had greater rates of weight loss during the intervention and gained half as much weight at the 1- and 2-year weight-maintenance follow-up phases compared to low-adherers or non-adherers. Studies that have evaluated single factors contributing to weight loss also have identified spousal and social support,³⁻⁵ and food provisioning⁶ (i.e., providing of prepared and portioned foods) as effective means to short-term weight loss. While short-term weight loss can often be achieved by many weight-loss approaches, approximately 50% of weight lost is typically regained within 1 year, and most individuals return to their original weight

within 3 to 5 years.⁷ When characteristics of weight-loss maintainers were compared to weight regainers, Byrne and colleagues⁷ found that cognitive and affective factors contributed to the ability to maintain weight loss. It can be posited that when a person does not adhere to a weight-loss regimen, this non-adherence is related to dissatisfaction with 1 or more aspects of the weight-loss approach.⁷ Successful weight loss requires that individuals replace their habitual routines with unfamiliar behaviors.⁶ Adoption of new behaviors forces active engagement over the short-term, typically resulting in positive physical and psychological effects such as reduced body weight and improved mobility, physical appearance, mood, and self-efficacy. Once individuals achieve contentment with their efforts, however, active engagement typically wanes and cognitive focus on maintaining physical and mental modifications that supported weight loss diminishes or ceases.^{6,8}

Ultimately, satisfaction with a dietary intervention is fundamental for adherence, successful weight-loss, and weight-loss maintenance. A study evaluating weight-loss outcomes among men and women after 2 years found that those who were assigned to their preferred treatment group lost more weight than those who were assigned to a less-preferred diet regimen.⁹ This illustrates the notion that individuals who are overall more satisfied with their diet or intervention type are more likely to adhere and to achieve long-term overall health outcomes such as weight loss and weight-loss maintenance.

Overall dietary satisfaction is not simply a function of foods that comprise a diet. Rather, several internal and external factors are involved in food choice or health behaviors.¹⁰ Satisfaction, or the notion of “being satisfied,” has been defined as, “to be adequate; to make true by fulfilling a condition; or to gratify to the full.”¹¹ Further, a

synonym to satisfaction is contentment.¹¹ When a weight-loss diet reaches an individual's subjective standard of satisfaction or contentment, he/she may be more likely to continue to follow the diet, considering that it would likely meet expectations and that reasons to return to the previous, habitual diet would be minimal. Conversely, if a weight-loss diet does not fulfill an individual's expectations of adequacy, or does not provide contentment, it is unlikely that the individual will continue the diet over the short- or long-term.

Several variables may contribute to satisfaction with a weight-loss diet, and conversely, similar or different factors may influence an individual's decision to continue following a weight-loss diet. The Academy of Nutrition and Dietetics proposes several variables that may impact food intake behaviors, including individual factors, environmental factors, various sectors of influence such as the government, food industry, and the media, and social and cultural values.¹² Because weight loss is recommended for individuals with overweight and obesity, determining facilitators of dietary satisfaction within these realms of influence is pivotal for improving weight-loss outcomes and health of the majority of individuals in the United States. Presently, a valid and reliable instrument that has been widely tested for its ability to measure dietary satisfaction is not available. However, several approaches have been taken to determine key influences on weight-loss outcomes by identifying facilitators and barriers to adherence with weight-loss diets and dietary interventions.

The purpose of this review was to evaluate the current literature in adults on the various factors associated with dietary satisfaction to identify facilitators and barriers to positive weight-loss outcomes, both short- and long-term. An underlying assumption was

that if individuals were willing to adhere to a weight-loss diet or dietary intervention, this would have indicated satisfaction with that weight-loss regimen.

METHODS

An extensive literature search for articles examining dietary satisfaction and adherence or non-adherence to weight-loss interventions was conducted using 3 databases, including PubMed/MEDLINE, PsycINFO, and CAB Abstracts. All published studies from November 1980, through March 2013, on this topic were considered for review.

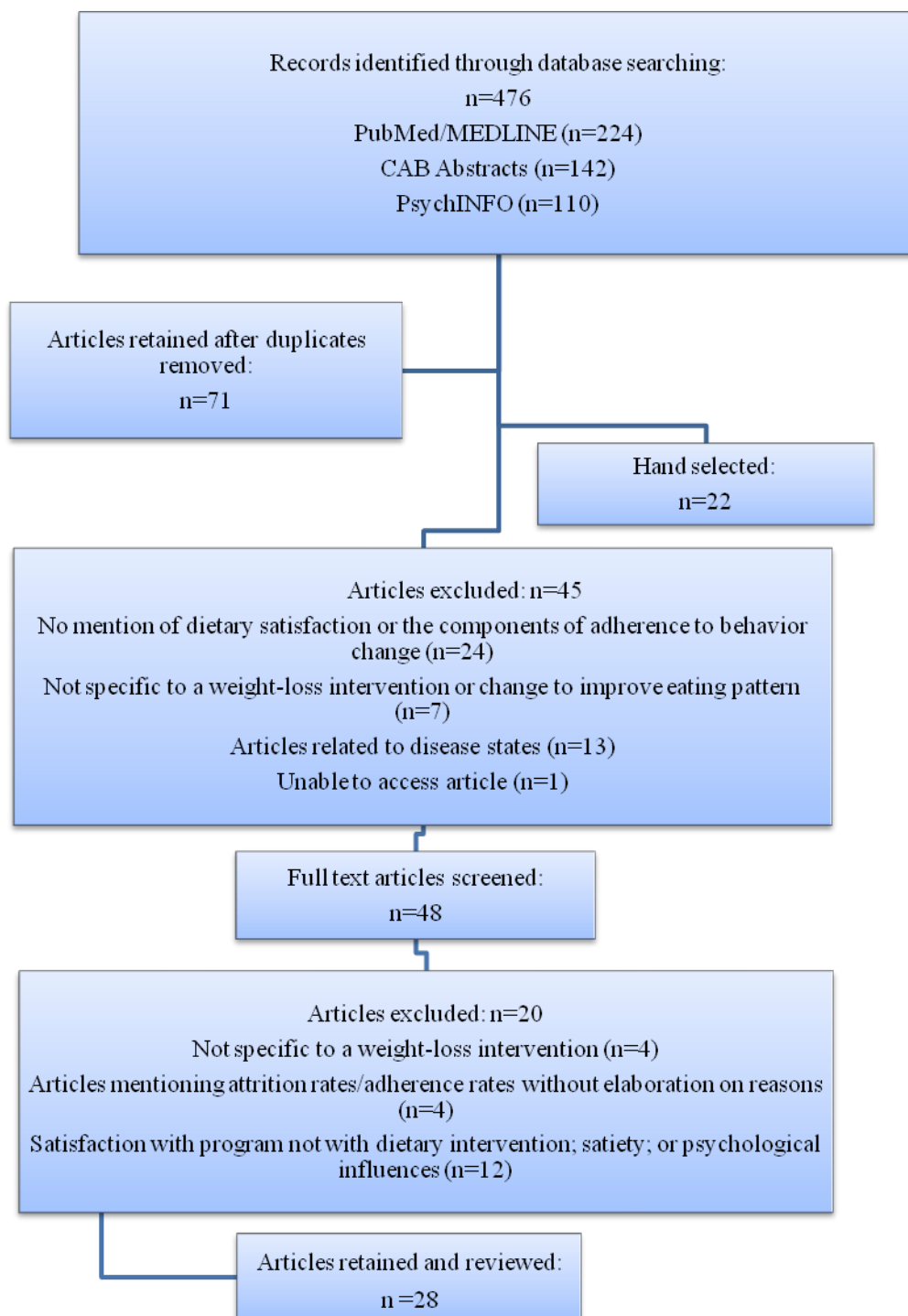
Key search terms included: “diet” OR “dietary” AND “satisfaction,” “adherence,” “compliance,” “weight-loss,” “weight-loss maintenance,” “weight-regain,” “success,” “liking,” “completion,” “follow-through,” “barriers,” “unsatisfied,” “dislike,” OR “inadequate” (Figure 2-1). Combinations of these terms were iteratively entered into databases until all reasonable combinations were considered. Article abstracts with any of the aforementioned key words in the title were considered. “Dissatisfaction” was not included as a search term, due to the overwhelming combination of “dissatisfaction” with “body” or “weight” (i.e.: “body dissatisfaction” or “body weight dissatisfaction”) and “disordered eating.” Studies were included, if they were conducted in men and women ≥ 15 years and the mean age of participants was within ages 20-60 years. Children, adolescents, and elderly individuals (i.e., >65 years) have specific dietary needs, living situations, and/or physical limitations not typical of the mid-life stage of the lifespan. Weight-loss interventions conducted either in the United States or abroad, and published in English were included in the current review.

This literature review focused on individuals engaging in dietary interventions for weight loss and/or healthy eating to identify perceived or actual facilitators and barriers to adhering to dietary recommendations. Therefore, articles were excluded if participants were diagnosed with chronic disease states, with the exception of uncomplicated overweight and obesity, weight-related co-morbidities, or were undergoing medical nutrition therapy. Individuals with acute and chronic weight-related co-morbidities may have weight-loss requirements and dietary intervention requirements that are not comparable to an otherwise healthy but overweight/obese population. Further, facilitators or barriers to adhering to a weight-loss intervention may differ for groups attempting to alleviate existing diseases. Studies that were non-specific as to reasons for adherence or non-adherence to intervention also were excluded. Articles that simply mentioned a rate of adherence or attrition were excluded, because they did not contribute to determining factors related to dietary satisfaction. Studies focusing on the method of weight-loss, specifically the type of diet without mention of dietary satisfaction or adherence also were excluded. Reports of satisfaction related to satiety were excluded due to the association of satiety with hunger, liking, and palatability of the diet. The current review focused on dietary satisfaction of overall diet and not specific foods consumed. Additionally, studies regarding satisfaction with the amount of weight lost also were excluded, as these related to quality of life, self-image, and other psychological characteristics influencing weight outcomes and were not reflective of dietary satisfaction. Articles reporting satisfaction with procedural rather than substantive aspects of the program were excluded (e.g., support from the program leader, ease of navigation or use of an internet-based intervention) as were studies that reported satisfaction with a

particular product used (e.g., meal replacement food or beverage) rather than the overall dietary approach or intervention.

Based on search and selection criteria, 28 articles were included for review (Figure 2-1). Twenty-two articles were hand-selected from references of fully-reviewed articles and of subsequent articles. Thirteen of these hand-selected articles were retained and along with the 15 papers identified through the search and selection process, contributed to the final 28 articles reviewed. The quality of this literature was determined, using the Academy of Nutrition and Dietetics Process Quality Criteria Checklist.¹³

Figure 2-1. Search and selection process for diet/dietary satisfaction in adults engaging in weight-loss dietary regimens and interventions



RESULTS AND DISCUSSION

Of the 28 articles retained and reviewed, 23 discussed various influences on adherence to weight-loss interventions or change to an habitual diet to include healthier foods.¹⁴⁻³⁶ The remaining 5 studies were weight-loss interventions that specifically assessed dietary satisfaction,³⁷⁻⁴¹ although this variable was a primary outcome of only 1 of these studies.⁴¹

Five studies were qualitative interviews.¹⁴⁻¹⁸ Cross-sectional designs were used in 9 studies conducted in the United States and European countries.¹⁹⁻²⁷ Three studies were longitudinal interventions.²⁸⁻³⁰ Eleven³¹⁻⁴¹ studies were randomized trials including 4 that were long-term follow-up studies to randomized trials.³³⁻³⁶ Studies included in the current review have been summarized in Table 2-1.

Common barriers to dietary satisfaction included: 1) perceived high cost; 2) time constraints; 3) required food preparation; 4) laziness; 5) lack of availability of healthy foods or diet, tasty foods, knowledge of healthy eating and food shopping, and discipline; 6) feelings of deprivation or sacrifice of enjoyed foods; 7) temptations; 8) negative social influences by family and friends; 9) picky eaters; 10) low motivation, and 11) desire to use food as a reward (Table 2-2). Facilitators to dietary satisfaction included the opposite conditions of reported barriers (e.g., perceived low cost; few time constraints; ease of food preparation, etc.) (Table 2-2). These barriers and/or facilitators were consistently reported across studies and existed both independently of and concurrently with weight-loss approaches or interventions.

Evidence from Qualitative Interviews

Although qualitative studies are rated as lower quality and findings should be interpreted with caution, such data provide anecdotal insight into an individual's experience with weight-loss attempts. These perspectives can be beneficial to gaining an understanding of reasons for successes and failures with weight-loss and satisfaction associated with weight-loss diets.

Men and women in 4 studies participated in interviews or focus groups designed to explore their dieting histories and personal explanations for successes or failures with weight-loss interventions or manipulations of diets toward healthy eating.¹⁴⁻¹⁷ When discussing weight-loss attempts, men and women characterized the state as unnatural and constantly on guard or in a mode of dieting.¹⁴ Adults recognized that changes in their dietary intakes were necessary to prevent weight-related diseases; however, adhering to changes were reported as very difficult.^{14,15} Individuals in such a frame of mind may perceive dietary changes to be a temporary solution to overcoming overweight or obesity. A long-term commitment to and contentment with making life-long modifications may be lacking. Many individuals oscillate between the desire to lose weight and the longing to revert back to their habitual diets.^{14,16,17} If changes to the habitual diet evoke perceived contentment and do not seem unrealistic,¹⁶ individuals may struggle less with following necessary changes. If individuals were to eliminate internal barriers such as feelings of guilt, deprivation or hunger^{14,16} that also prevent them from following a weight-loss dietary regimen, the result may be greater dietary satisfaction.

Adults who participated in focus groups reported a lack of personal time during which they could focus their efforts on behavior change as a barrier to short- and long-

term weight loss. Furthermore, a lack of time due to societal norms was perceived as a significant barrier among women. Women felt that household responsibilities, such as cooking, cleaning and taking care of children, were difficult to juggle with paid work; moreover, they considered healthy cooking inconvenient.¹⁴⁻¹⁷ Male participants in 1 study¹⁴ placed the responsibility of healthy cooking largely on their female counterparts.

The spousal relationship was a prevalent topic among qualitative study participants in that motivation and accountability were greater when the significant other was involved in behavioral changes.¹⁴ Similarly, support and accountability from friends, significant others, and children,^{17,18} specifically when preparing meals,¹⁵ were reported as factors that made dietary changes easier. Eating in the context of social settings with diet-sabotaging friends and spouses was a difficult area to overcome for several men and women. Female participants described their husbands as discouraging to their eating less or exercising,¹⁸ and adults perceived their friends as making them feel guilty about losing weight and eating less which they perceived as undermining their self-efficacy.^{15,16,18}

Finally, cost of healthy foods was discussed as a barrier, with dieting overall considered too expensive.^{15,16} Particularly, mothers mentioned that the cost of healthy eating was especially challenging when making changes to their diets, because they were required to buy twice as many foods, if their family did not want to eat the healthier choices, or the healthier foods were more expensive than their habitual food purchases.¹⁵

Overall, the compilation of qualitative studies included in the current review addressed cost, time, support, motivation, and accountability as barriers or facilitators to adhering to a behavior change and attaining satisfaction with a weight-loss diet or dietary

intervention. Again, these findings should be regarded with prudence, due to the qualitative and somewhat subjective nature of these studies.

Evidence from Cross-Sectional Studies

Capturing experiences related to weight-loss diets and facilitators and barriers to adhering to recommended diets may be conveniently conducted via cross-sectional surveys. Although causal inferences cannot be made about dietary adherence, satisfaction and weight loss when using this study design, cross-sectional studies provide objective examinations of relationships among variables of interest. Study samples within cross-sectional investigations included in the current review ranged in age, income status, and education level. Likewise, weight-loss approaches reported by study participants varied widely across studies.¹⁹⁻²⁷

Weight-loss attempts occur frequently and in several fashions. Commercial weight-loss programs, personal attempts, and research interventions were reported as the 3 most commonly used techniques for weight loss.¹⁹ Burke and colleagues¹⁹ found that among 98 men and women, roughly 30% reported self-initiation of lifestyle changes as their favorite method for weight loss.

In the context of weight loss, age, income status, and education level can influence the importance or prevalence of various factors associated with dietary adherence. Individuals often find that changing an habitual diet requires effort,^{20,21} motivation,^{19,20} time,¹⁹⁻²² money,^{19,20,22} knowledge and understanding.^{19,20,22} Depending on individual circumstances, these factors also may encourage or inhibit an adult from adhering to and reporting satisfaction with a diet.

Self-administered questionnaires with proposed barriers to healthy eating or hindrances to successful weight-loss attempts were used in 4 studies.¹⁹⁻²² Depending on situational circumstances, these barriers varied. For example, lack of time and high cost were reported as barriers to weight loss by a convenience sample of middle-aged men and women.²⁰ More specifically, high cost and financial constraints were reported significantly more frequently as barriers in individuals of low income, while lack of time, lack of discipline, and laziness were reported significantly more often in adults of higher income and education levels.^{19,20}

Lack of access to healthy food options was a barrier to healthy eating among mothers of low income.²¹ Conversely, overabundance or the omnipresence of food made it difficult to successfully avoid desired foods and lose weight for adults who were employed and of higher socioeconomic status.¹⁹ Feelings of deprivation and lack of discipline were mentioned as barriers for men and women of both low and high incomes, while the need for more education was mentioned less frequently in adults of higher income compared to adults of lower income.¹⁹ Participants of higher income reported that availability of healthy foods, such as from a personal or friend's garden, education, accountability, flexibility, and upbringing were motivators to healthy eating,^{19,20} while adults of lower income perceived that assistance programs, such as food stamps, were facilitators of following a recommended dietary pattern.²⁰ The need for more knowledge or education was not a significant deterrent for following a healthy diet in 2 studies,^{19,20} and high nutrition knowledge decreased the likelihood of consuming unhealthy foods in another study.²²

General time constraints¹⁹ and specific lack of time for grocery shopping^{21,22} and food preparing,^{21,22} along with family commitments^{19,21} were repeatedly reported across cross-sectional studies as barriers. Women who were recipients of a food assistance program for low-income families reported that they did not have time for themselves throughout the day, because they focused their efforts on their children's needs.²¹ Therefore, these women opted for unhealthy food options that were quick and easy.²¹ When faced with the vulnerable state that a weight-loss diet or healthy dietary intervention may provoke, lack of self-control and self-efficacy and low outcome expectations may present challenges for women, particularly when circumstantial limitations, such as low income, are existent.^{20,21} Positive and negative emotional eating, meal skipping, and snacking are a result of limited personal time for meals and are associated with perceived inability to adhere to healthy eating.²¹ Further, when confronted with time constraints, the availability of convenience and pre-packaged foods or fast foods are often deterrents to healthy eating.²¹

Support from family, friends, co-workers, and health professionals has been reported in 4 cross-sectional studies included in the current review as a strong determinant of healthy eating, dietary adherence, or long-term success with weight-loss maintenance.¹⁹⁻²² Eikenberry and colleagues²⁰ reported that 34% of adults designated family as the top promoter of healthy eating.²⁰ Women who perceived support from family and friends, especially family support, were more likely to consume fruit and vegetables and less likely to consume energy-dense foods or fast foods.²² In a separate study, women reported that encouragement from others assisted in long-term weight-loss efforts.²¹ Conversely, lack of support from family and friends has been identified as a

barrier to dietary change and adherence to dietary modifications.²⁰⁻²² Among a group of men and women with low-income, 20% identified living alone as a barrier to healthy eating.²⁰ In a study sample of highly educated, married men and women, 18% reported lack of support as a barrier to dietary adherence.¹⁹ Even when behavior change may be critical to improving health, if an individual's support network discourages or complains about dietary changes, the individual may be unable to improve dietary habits.^{20,21} Family, friends and individuals in the social network may influence dietary satisfaction.

Finally, emotional eating was reported as a common barrier to maintaining dietary changes, regardless of sex or socioeconomic status.²¹ Moreover, taste and dislike of foods also were mentioned as barriers to adopting healthy eating habits in 3 of the cross-sectional studies included in this review.^{19,20,22}

Regardless of the approach to weight loss (i.e., commercial weight-loss program or plan, self-imposed and personal attempt, or research-based intervention or recommendation for a healthier diet), individual factors, whether inter- or intra-personal, require consideration to produce sustainable changes that promote dietary satisfaction, adherence, and weight-loss success. Although some of these barriers may not be generalizable to middle- or upper-income target populations, lack of time, support and self-discipline, feelings of deprivation, food and taste preferences, and emotional eating have been consistently reported across the 9 cross-sectional studies included in the current review.¹⁹⁻²⁷ These barriers were reported as current factors preventing healthy eating over the short-term.

Like the United States, countries around the world deal with overweight and obesity. Reasons for minimal adherence to dietary interventions for weight loss have

been reported in 5 studies conducted outside of the United States. In these cross-sectional studies,²³⁻²⁷ a 22-item questionnaire (The Institute of European Food Studies Pan-European Union Survey of Consumer Attitudes to Food, Nutrition and Health) containing 9 subscales, regarding barriers that influenced weight-loss experiences was administered to participants during in-person interviews. Table 2-2 presents these barriers (i.e., subscales); they include: 1) cost of food; 2) time; 3) self-control; 4) selection influences; 5) knowledge; 6) unpleasant foods; 7) resistance to change; 8) food preparation, and 9) influence of others.⁴² Questions included in the 22-item instrument were revised from an original study conducted in individuals with cardiovascular disease so that the questionnaire would be relatable to a general, healthy population.²³ Variations of this questionnaire, or questions extracted from research papers utilizing this questionnaire were included in 2 of the 5 studies.^{25,27}

Parallel with cross-sectional studies conducted with adults in the United States, time, cost, and self-control were reported most frequently in these international studies.²³⁻²⁷ Lack of time, which included irregular work hours and busy lifestyle, was the most salient barrier in these 5 European studies.²³⁻²⁷ Lack of time and willpower were most commonly reported by younger, employed men with at least a secondary education.^{23,24,26} Compared to men, women more frequently reported influences of others as a barrier to dietary adherence.²³ Yet, another study reported that men also found influences of others as a barrier that was difficult to overcome.²⁷ Surprisingly, 1 study of primarily college-aged students in addition to other adults did not report influences of others as a major hindrance to eating healthier foods.²⁴ In this particular study, only 1.7% of all participants reported not having a difficult time eating healthily,²⁴ compared to 20% and 18% in 2

other studies.^{26,27} In a study that included only adult females, mothers identified influences of others, specifically support from their children, friends, or partner, as a more important barrier to following and maintaining prescribed weight-loss strategies when compared to single women.²⁵

Self-control, represented as giving up foods, willpower and motivation, was reported as a top barrier in all 5 studies.²³⁻²⁷ Cost was reported frequently and consistently in 4 of the international studies,²⁴⁻²⁷ and while the 5th study reported cost as a significant barrier, the regularity with which cost was identified by participants was less²³ than in the other 4 studies. Depending on the country, the average response for unappealing foods, lack of knowledge, experts changing their opinions, food preparation, and selection influences (e.g., limited choices when eating out, limited healthy choices in stores, not enough food to satisfy hunger, and awkward to transport home) varied greatly. For example, 2 studies reported unpleasant foods as a top barrier,^{24,26} while 2 studies reported that this barrier was chosen infrequently,^{23,27} and another study did not find this as a barrier.²⁵ In general, lack of skills, knowledge, accessibility and availability of foods, and changes in expert advice were barriers that were least commonly mentioned across the studies.^{23,25-27} In addition to choosing from the list of 22 barriers, 1 study provided an open-ended response section for participants to name any barriers that were not included in the list.²⁵ Participants reiterated in this section that inconvenience, expense of healthy foods, taste preferences, and lack of time were barriers to implementing a weight-loss diet or maintaining weight loss.²⁵

These 5 international studies demonstrated wide variability in responses regarding barriers toward dietary adherence, likely reflecting differences in lifestyles and cultural

norms that may determine initiation and continuance of behavior changes toward healthy eating, whether within a weight-loss intervention or simply to improve overall health.²³⁻²⁷

When considering internal and external influences on eating behavior change, characteristics of the target population should be taken into account to aid in predicting an individual's ability and motivation to follow prescribed changes to a routine dietary pattern. In general, time constraints, perceived cost of foods, and self-control were the key barriers to adhering to healthy eating and likely dietary satisfaction. Perceived dissatisfaction with dietary modifications may also be represented by the aforementioned barriers.

When evaluated as a collection of cross-sectional studies, findings from 9 investigations support that lack of time, self-control, and motivation, perceived high cost of food, and lack of social support are related to low adherence with a weight-loss diet or healthy eating.¹⁹⁻²⁷ These barriers may correspond to low dietary satisfaction, although this specific construct was not evaluated in these cross-sectional studies. In addition, due to the research design, these studies were not able to measure changes in dietary adherence with a concurrent dietary modification.

Evidence from Longitudinal Intervention Studies

Self-imposed interventions offer individuals the ability to alter eating patterns or habits, adapt their mentality, or improve planning skills in a manner consistent with personal needs.²⁸ Knauper and colleagues²⁸ observed that women who followed self-imposed dieting rules were able to lose a small amount of weight and women that reported the same rules consistently between baseline and week 8 were closer to reaching their goal weight at week 8 than women who did not adhere to the same rules. Overall,

the number of rules implemented at baseline declined and was significantly lower at week 8 compared to baseline. Nearly 75% of women reported a different barrier to weight loss at baseline compared to week 8,²⁸ possibly reflecting an inability to adhere to the multiple rules initially imposed or a need for changing rules as weight loss progressed. Interestingly, women who implemented only 1 dieting rule, specifically either increasing exercise or reducing calories, were more likely to lose weight than both strategies combined, suggesting that the implementation of 1 change may have been easier to adhere to than multiple manipulations of a habitual diet for short-term weight loss success.²⁸ Although weight loss results may not be optimal, individuals may be more apt to adhere to self-set dieting rules, because they implement changes under their own conditions, yielding dietary satisfaction. When making dietary changes that best fit internal and external expectations and allowing satisfactory modifications to the habitual diet, adults may be more likely to adhere, albeit only long enough for short-term weight loss.²⁸ The number of categories of rules representing aspects of a dieting mentality were reported frequently at baseline, but less consistently at week 8. Moreover, women who listed more categories for a dieting mentality at baseline were least likely to achieve their goal weight.²⁸

In comparison, an 8-week physical activity and weight-loss intervention conducted in low-income women found that women who successfully lost weight while participating in the weight-loss intervention had considerable improvements in attitude and perceived fewer barriers (specifically dislike of low-fat foods, lack of knowledge and family preferences) toward healthy eating and weight-loss post-intervention.²⁹ An individual's satisfaction with a weight-loss diet or dietary changes may improve once

weight-loss efforts are reinforced and anticipated results are evident. Subsequently, an individual may be more inclined to follow the diet recommendations and may perceive fewer barriers to following the diet. Of note is that 56% of participants withdrew from the study by Jordan and colleagues.²⁹ Illness, lack of child care, job conflicts, transportation difficulties, financial constraints, lack of time, family responsibilities, lack of support from family members, and stress were identified by women as hindrances to remaining in the study.²⁹ Although a few of these barriers did not pertain to the dietary intervention *per se*, several reasons for attrition illuminated the roadblocks to adherence to a prescribed dietary intervention, namely lack of time, personal and family commitments, high cost, and lack of family support.²⁹ It is imperative to determine the expectations and perceived or actual barriers when imposing a dietary intervention in adults. Utilizing preferences to make recommendations that meet personal weight-loss plan expectations may improve the likelihood that the modifications will be implemented as a habitual routine.

Other barriers, including laziness, lack of willpower, and food as a means to relieve stress and achieve relaxation, have been documented as obstacles to adhering to a weight-loss maintenance diet 3 years after a weight-loss intervention.³⁰ Several individuals who participated in this follow-up study also noted that external factors such as cost, food preferences, and influences of friends, family, and co-workers were still related to dietary adherence several years later. Interestingly, 17% of respondents reported that they were unable to find an appropriate response among the barriers listed,³⁰ suggesting that unknown variables related to weight-loss adherence and dietary satisfaction existed.

Evidence from Randomized Trials

Randomized trials are important for distinguishing factors that determine dietary adherence in a treatment group compared to a control or other treatment group. This study design is considered the highest quality; thus, findings from these investigations may provide the most salient information about dietary adherence to weight-loss interventions or changes in habitual dietary patterns.

Two studies that did not specifically have dietary satisfaction as an outcome utilized an experimental research design found social influences,^{31,32} emotional eating, and eating environment³¹ to be primary factors associated with low adherence to the weight-loss intervention. Tempting situations may be problematic for individuals trying an energy-restricted, non-habitual diet, if complying with the weight-loss diet takes great effort. Social situations, when desired foods are consumed by friends or family members, may be disruptive to participant adherence.³¹ Eating while in the car and comfort or emotional eating also were mentioned as barriers by adults in 1 study, despite the intervention including educational advice on handling circumstances where these barriers may be problematic.³¹ Individuals who perceive heightened positive or negative emotions, particularly individuals with overweight or obesity, may struggle with overeating or disinhibited eating.⁴³ These emotions may be escalated when attempting to try an energy-restricted or novel dietary pattern, due to the unfamiliar and vulnerable cognitive state that dieting often induces.

Food provisioning is a possible mechanism for improving motivation to adhere to an intervention. Eliminating time constraints, unavailability of foods and cost may improve the likelihood that an intervention will be perceived as feasible. Overweight men

and women were randomized to a calorie-restricted, calorie-restricted with exercise, low-calorie liquid diet or a control group, and meals were provided for 16 out of 24 weeks of intervention.³² During the weeks of meal provisioning, adult participants were more likely to adhere to the assigned treatment; however, deviation from the protocol still occurred, with reports of temptation for non-study foods and difficulties with avoiding food intake in social settings.³² Evidence demonstrating that participants are unable to adhere to a diet, even when foods are provided, indicates that unknown aspects about adherence remain. This is further supported by traditional weight-loss methods such as energy restriction or macronutrient modifications which also have been shown to result in low adherence and high attrition, due to various reasons.

A study that compared standard behavioral treatment to variation in intervention for weight loss and health behavior change also found adherence to be an issue.³³ Based on a factor analysis, Welsh and colleagues³³ found that lack of knowledge, self-control, and time were the 3 underlying explanations for why men and women did not successfully follow prescribed diets. Similarly, Urban and colleagues³⁴ conducted a follow-up study with women from the Women's Health Trial to determine if participants were continuing to follow a low-fat diet anywhere between 5 and 20 months post-intervention. A factor analysis was conducted, using qualitative responses from the initial trial, to identify 6 types of experiences that encouraged or discouraged maintenance of a low-fat diet. These 6 experiences included: 1) feelings of wellness (physical and emotional); 2) distaste (physical response to fat); 3) costs (meal preparation costs); 4) inconvenience (inconvenience outside of the home); 5) deprivation (food deprivation and dissatisfaction), and 6) family (inconvenience for family).³⁴ Women who were most

adherent during the trial were more likely to retrospectively report maintaining the diet during the randomly selected follow-up.³⁴ Deprivation, specifically cravings for high-fat foods, and costs of the diet (time and money for planning and preparation) were the most influential to low adherence to a low-fat diet over these short- and long-term intervals.³⁴

With the high prevalence of low adherence in short-term studies, it is not surprising that long-term weight-loss maintenance also yields low success rates. A 5-year follow-up to a randomized weight-loss intervention found that all treatment groups from the original study regained weight after the termination of the intervention.³⁵ Social situations, including work and social gatherings, were negative influences on weight control efforts. Further, persuasion by others also was a major factor for participants, specifically family as both a positive and negative influence and spouses as a negative influence on weight control. Friends and co-workers, however, were mentioned as positive influences.³⁵ Various emotions were reported as negatively impacting weight-maintenance efforts, contributing to the barriers to adhering to an intervention.³⁵ In contrast, a 1-year study with a 1-year follow-up period in women (mean age of 58 years) found that participants who received tailored letters that included personal goals and reminders of their personal influences on weight loss, such as improved appearance, had fewer barriers (inconvenience, cost, time) and improved eating habits at each measurement interval compared to women who received standard, non-personalized letters.³⁶ Further, family support predicted a positive association with healthy eating after 1 year,³⁶ suggesting that individualized methods for improving eating habits may be beneficial. Continued family support may play a significant role in promoting long-term behavior changes.

Findings from randomized trials^{31,32} and long-term follow-up studies³³⁻³⁶ indicate that poor and/or negative social and family support, tempting situations that provoke feelings of deprivation from desired foods, and lack of time, knowledge, and self-control contribute to low adherence to weight-loss diets or dietary interventions. These situational circumstances may play significant roles in weight loss and should be considered when assessing an individual's level of satisfaction with a dietary regimen. Assuming that dietary satisfaction correlates strongly with adherence, high satisfaction with a weight-loss diet or dietary intervention would result in greater adherence than if the individual were dissatisfied. Table 2-2 presents a comprehensive list of barriers and facilitators identified across a variety of studies. Regardless of sex, socioeconomic status, race/ethnicity, and country of residence, the issue of dietary adherence is relevant and may contribute to dietary satisfaction, which ultimately relates to improved health. Although these aforementioned studies have depicted dietary satisfaction in terms of barriers and facilitators associated with dietary adherence, none of these studies have methodologically measured satisfaction or have included dietary satisfaction as a primary outcome.

Studies explicitly reporting dietary satisfaction

The current review of literature identified 5 randomized trials that mentioned dietary satisfaction as a method, result or within the discussion section of these published papers (Table 2-1).³⁷⁻⁴¹ All 5 studies were weight-loss interventions conducted in overweight or obese, but otherwise healthy, individuals that were randomly assigned to intervention groups. Interventions varied across studies. While all 5 studies mentioned dietary satisfaction, this was a primary outcome for only one of these studies.⁴¹

Moreover, methodology for measuring dietary satisfaction was reported only in the study by Rolls and colleagues.⁴¹ The 4 other randomized trials attempted to gauge a level of dietary satisfaction among participants in these interventions by characterizations of or testimonials regarding overall satisfaction.

Baron and colleagues³⁷ reported that men and women in 1 treatment group “appeared less satisfied with their diet experience”^{37, p.1295} compared to the other treatment group. This conclusion was drawn from participant reports of difficulties or barriers associated with following their assigned dietary regimen (for example, cost or emotional eating).³⁷ A standardized assessment tool or method for measuring dietary satisfaction was not described. Satisfaction is an abstract idea that involves numerous components. Thus, satisfaction may not be accurately assessed using 1 or 2 generalized questions.

In a separate study by Ebbeling and colleagues,³⁸ adults were asked to rate their overall satisfaction with the diet program by responding to the questions: 1) “How satisfied are you with this diet?”^{38, p.2100} 2) “How easy has this diet been?”^{38, p.2100} 3) “How tasty have the foods been?”^{38, p.2100} and 4) “How satisfied are you with your weight loss to date?”^{38, p.2100} Separate, 10 cm visual analogue scales, where 0 cm represented “not at all” and 10 cm represented “extremely” were used for responses. Satisfaction between the low-glycemic-index diet and low-fat diet groups did not differ in adults who completed this intervention.³⁸ Individuals may find it difficult to definitively respond to such questions, as there may be several factors confounding the ease by which dietary adoptions occur or levels to which various factors contribute to overall

satisfaction. In addition, visual analogue scales are specific to each respondent and not to a scoring system.

Two separate studies used a questionnaire³⁹ and a Likert-type scale⁴⁰ to measure dietary satisfaction. Sacks and colleagues³⁹ used a previously created questionnaire assessing experiences associated with following a low-fat diet³⁴ and reported that satisfaction was not different among intervention groups of adults.³⁹ Questions developed for this instrument were primarily based on anecdotal comments about experiences influencing maintenance of a low-fat diet by women in the Women's Health Trial study. A factor analysis was conducted to determine the accuracy of the constructs.³⁴ However, these experiences were specific to the influences on adhering to a low-fat diet prescription, not explicitly overall dietary satisfaction. Krieder and colleagues⁴⁰ conducted a randomized trial in men and women to determine if a meal replacement diet would be more effective than a standard, supervised meal plan, specifically 2 popular weight-loss programs.⁴⁰ To assess perceived diet quality, a 10-point Likert scale assessing hunger, appetite, fullness, energy levels, quality of diet, and diet satisfaction was used. A "0" on the scale indicated "no agreement" and "10" indicated "highest agreement."⁴⁰ Krieder and colleagues⁴⁰ found no significant differences between groups in any measure of appetite, hunger, fullness, diet quality or diet satisfaction. Other than explicitly asking participants to rate their level of diet satisfaction, a standardized, validated measurement tool for assessing satisfaction was not utilized. Satisfaction may be a difficult notion to capture, especially through 1 specific statement, as there are several dimensions that may define the term. Simply asking participants if they are satisfied may not capture components that individuals find difficult to concretely identify.

Rolls and colleagues⁴¹ administered a satisfaction questionnaire addressing participant satisfaction with foods in a diet treatment. This is the only study that reported dietary satisfaction as measured through a tool specific to the construct.⁴¹ Two-hundred overweight and obese men and women were randomized into 4 energy-restricted diet intervention groups. For 6 months, 3 of the 4 groups were provided with and consumed 1 serving of soup daily, 2 servings of soup daily, or 2 servings of dry snack foods such as crackers, baked chips and pretzels daily. A comparison group was included which was not provided with foods to consume.⁴¹ All study foods were similar in caloric content; however, energy density differed between dry snack foods and soup groups. Weight loss and change in diet composition was assessed after 6 months of intervention and after a 6-month weight maintenance phase.⁴¹ The questionnaire was completed by participants at baseline and 1, 3, 6, 9, and 12 months after baseline to assess satisfaction with their provisioned foods.⁴¹ Rolls and colleagues⁴¹ found that men and women in all intervention groups lost weight during the weight-loss intervention; at 12 months, the group consuming 2 servings of soup per day lost significantly more weight than the dry snack group.⁴¹ After examination of diet records, food energy density decreased significantly more in both soup groups than the comparison group and the dry snack food group.⁴¹ However, there were no group differences in response to the question, “How healthy do you feel on this plan?” Compared to the snack group, more participants in both soup groups responded “very full” or “extremely full” to the question, “How full do you feel after your meals while on this food plan?” and “not at all hungry” or “somewhat hungry” to the question, “How hungry do you feel while on this food plan?”⁴¹ Although hunger and overall health were the only 2 aspects reported from the questionnaire, Rolls

and colleagues⁴¹ were able to gauge a level of satisfaction with low energy-dense foods and the associated weight-loss outcomes in adults.⁴¹ The use of a similar questionnaire that is validated as a measurement tool for satisfaction may be useful for monitoring contentment or satisfaction with an aspect of a diet or dietary intervention.

Because most randomized trials included in the current review that specifically cited a finding or conclusion about dietary satisfaction were not designed to measure this paradigm, conclusions about dietary interventions that promote dietary satisfaction are tenuous. These studies were possibly unable to accurately or truly measure dietary satisfaction among adults. To date, the only randomized trial that has used an instrument specifically designed to measure and assess dietary satisfaction has shown that individuals who reported feeling more satisfied with the prescribed foods, in terms of fullness and lack of hunger, were more likely to eat less and lost more weight even 1 year post intervention.⁴¹ While many common constructs related to dietary adherence, such as cost, time, social support, motivation, and deprivation in terms of hunger or cravings, appear to overlap with the notion of dietary satisfaction, further testing of available dietary satisfaction questionnaires is necessary before strong conclusions may be made.

CONCLUSION

This review was conducted to determine the factors that contribute to dietary satisfaction, including motivators and barriers to adhering to a particular weight-loss intervention. The studies included were not specifically designed to measure dietary satisfaction; rather, they examined factors related to the facilitators or barriers to following a prescribed dietary pattern. Although several of the studies were not of optimal design,^{14-28,30,33-36} they were effective for elucidating factors that may prevent or

promote dietary satisfaction and continued adherence to behavior change. Based on articles included in this review, it was clear that dietary adherence served as a proxy for dietary satisfaction. Salient dimensions of satisfaction (or dissatisfaction) included cost of the diet, time constraints, social influences, social support, taste, and self-control (including feelings of deprivation and temptation). Studies, at best, included a few of these contributors to dietary satisfaction, yet very few studies encompassed all of these perceived facilitators and barriers, and further, only one study has determined a method for measuring dietary satisfaction. The original goal of this literature review was to capture dietary satisfaction in its entirety; however, the scope of literature was limited to adherence or non-adherence to a weight-loss intervention. Future research is needed to define and operationalize dietary satisfaction so that it may be further tested.

Based on quality criteria of studies, the small amount of evidence available, and limitations in the scope of available literature on facilitators and barriers to adhering to a weight-loss intervention, it can be concluded with limited confidence that the factors that promote or prevent an individual from adhering to a particular dietary regimen, are the defining characteristics of dietary satisfaction. Further testing of an instrument that measures dietary satisfaction is necessary in order to reflect fulfillment and adherence with a diet and ultimately weight-loss outcomes in adults.

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Table 2-1. Characteristics of studies on dietary satisfaction regarding barriers and facilitators of adherence to a weight-loss diet or dietary intervention in men and women, ages 20-60 years

Study	Population	Study Design	Assessment Method of Dietary Satisfaction	Primary Outcome/Top Barriers ^a
Qualitative Interviews				
Green et al., 2009 ¹⁴	Men and women (n=10; 2 men, 8 women) over age 18; Included if have made at least two significant attempts and failed at weight loss and currently unhappy with eating habits Mean age: 43.7 years	Open-ended interviews recorded; Questions based on themes from a literature review; Data were transcribed; analysis conducted based on Interpretative Phenomenological Analysis	Primary questions: “Tell me about your dieting history” “When would you have considered a diet to have failed/no longer trying to diet” “What is it like when a diet fails/end a diet” “Why have diets failed/ended?” “How do you feel about dieting now?” “How do you feel about your eating?”	Themes of diet failures: <u>Dieting mode</u> A frame of mind/heightened awareness and discipline required to follow a diet; <u>Multi-me:</u> Internal battle/ inner conflict or lack of self-control <u>Not me:</u> Biological factors (e.g. poor metabolism) <u>Modern life:</u> No time for self/food preparation Exposure to food marketing <u>Challenges of emotional and eating:</u> Emotional eating Influence of others
Tessaro et al., 2006 ¹⁵	Women (n=48) Rural, low-income counties in West Virginia Mean age: 54 years old	Focus groups designed to guide development of a tailored nutrition intervention using computer-based interaction for rural, low-income, low-	Open-ended interview script on perceptions, knowledge and concerns of heart disease, knowledge about risk factors for heart disease, benefits of healthy eating, barriers and motivators to	<u>Top barriers:</u> Support from family Culture/changing society: way they were raised prevented healthy dietary changes Convenience

		<p>literacy populations to prevent CVD; 4 groups held in local churches or senior citizen centers; Notes taken and sessions video-taped; data transcribed and analyzed through notation of themes within questions; Text analysis software Ethnograph used to sort and coded data into themes</p>	<p>making healthy dietary changes, social support for making dietary changes, knowledge and skills needed, and current dietary behaviors</p>	<p>Time Will power/Self-efficacy</p>
<p>Thomas et al., 2008¹⁶</p>	<p>Obese men and women in Victoria, Australia (n=76) BMI ≥ 30 Mean age 47; Mean BMI 42.5 (No reports of weight-associated disease)</p>	<p>Qualitative interviews; recruited through newspapers, convenience sampling; Interviewed in person or via telephone; comparative methods to analyze and address emerging themes; inter-rater reliability conducted to confirm validity of interpretations</p>	<p>Open-ended questions on experiences with commercial diets, how engaged in dieting strategies, impact of dieting on physical and emotional health and well-being, attitude toward physical activity</p>	<p><u>Motivations to lose weight:</u> Improve health/well-being; increase mobility; prevent early death; professional advice to lose weight; desire to participate in social and children's activities; social acceptance; establish or maintain relationships <u>Weight-loss techniques:</u> Commercial programs, pharmaceuticals, meal replacements, fad diets, fasting <u>Top barriers:</u> Unrealistic Too Expensive Wanted to feel "normal" Wanted a "quick fix" not long-term commitment <u>Motivators:</u> Support system Accountability Accessibility</p>

				Individualized program
Herriot et al., 2008 ¹⁷	Individuals from the Diet Trials (Truby et al. 2006) (N=32; 7 males, 25 females) Mean age: 42.3 Mean BMI: 32 kg/m ²	Six 1-hour focus groups conducted as an addition to the “Diet Trials” study. Four focus groups held at 6 months with 14 of the 32 individuals	Semi-structured focus groups audio taped and comprehensive notes were taken by moderators; open-ended questions provoked conversation regarding experiences, motivators, expectations, and opinions of the specific diet followed in the “Diet Trials” intervention; Qualitative analyses of the focus group data collected	<u>Psychological barriers:</u> Emotions, lack of will power, perceived lack of support “Wrong frame of mind” <u>Lifestyle barriers:</u> Family commitments, social life, work (time/odd hours) <u>Motivators:</u> Improve appearance Social support from other participants and family and friends 6-month post- study focus group: <u>Motivators</u> Support to continue to follow a diet plan Evident physical results
Hardcastle & Hagger, 2011 ¹⁸	Overweight and obese men and women (n=14; 9 females 5 males)	Follow-up study to a counseling intervention in obese men and women; Of 37 participants, 14 agreed to participate in interviews sessions; successful and unsuccessful weight-loss maintainers for 1 year were questioned to explore reasons, experiences, and perceptions of the 12 months post- (initial) intervention on weight-loss,	Interviews conducted with open-ended questions regarding physical activity and eating habits, facilitators and barriers to change; Participants were audio-recorded and important or common emerging themes during interviews were recorded and analyzed post-interview	<u>4 Major themes:</u> Monitoring/Accountability and Support (deemed necessary by both successful and unsuccessful participants) Listening support (encouragement from significant others, friends and doctors) Motivation and Self-regulation and commitment (main contributor for successful participants) <u>Barriers</u>

		exercise, and CVD risk prevention		(Lack of social support, specifically as weight-loss sabotage by spouse or friends)
Cross-Sectional Studies				
Burke et al., 2008 ¹⁹	N=110 men and women aged 18-55; BMI 25-42 kg/m ²	Cross-sectional descriptive study; participants mailed questionnaire packets; descriptive analyses of responses to weight-loss intervention experiences; questionnaires included past weight-loss treatments and preference, self-efficacy, Perceived Therapeutic Efficacy, Barriers to healthy eating, barriers to adherence to weight-loss treatment, experiences with low-fat diets	Participants identified 3 reasons why they had difficulty being successful with weight-loss interventions	Difficulty making and maintaining changes Time Lack of support
			22-item questionnaire; 5-point scale (1=no problem; 5=very important problem) situations related to weight reducing eating plan (i.e.: cost of the regimen) Original scale by Wing & Jeffery 1996 and expanded by Burke et al. 1998;	<u>Primary barriers:</u> Temptation (hard to control what I eat when hungry) Lack of motivation Use food as a reward
			25-item scale developed in the Women's Health Trial 5-point scale; responses 1=strongly disagree; 5=strongly agree) six factors total four of the factors discourage maintenance of the low-fat diet ³⁴	<u>Primary barriers:</u> Distaste Cost Inconvenience
Eikenberry & Smith, 2004 ²⁰	Convenience sample (n=796) of low-income Minnesota men and women	4 study locations in Minnesota completed self-administered survey completed at designated sites; 15 focus groups conducted Cronbach's alpha coefficients calculated for	Survey developed based on literature review and emerging themes from focus group ; pilot tested for internal consistency; 21 possible responses were developed with space for elaboration if needed; questions	<u>Top barriers:</u> Cost Time Discipline <u>Motivators:</u> Health Feel good

		closed-ended questions;	regarding definition of health foods, motivation and barriers to healthy eating, promoters of healthy eating	Live longer <u>Promoters:</u> Family Private gardens Education
Chang et al., 2008 ²¹	(N=80) Non-Hispanic black, non-Hispanic white women; BMI 25-39.9 kg/m ² Aged 18-35 years; at least 3 months post-partum;	Recruitment through waiting rooms in WIC in 6 Michigan counties; 8 semi-structured questions developed from Social Cognitive Theory; 8 focus groups conducted and moderated and significant emerging themes were identified; audiotapes transcribed and field notes incorporated into the study	80-90 minute focus groups; Questioned to identify personal and environmental factors influencing healthy food choices	<u>Personal motivators to healthy eating:</u> Improve/maintain appearance Fit into clothes Participate in children's lives Alleviate physical pain <u>Environmental motivators to healthy eating:</u> Social support from mothers, friends, coworkers, spouses <u>Barriers to healthy lifestyle:</u> Outcome expectancies Self-control Self-efficacy Emotional eating Social support Situational influences
Williams & Crawford, 2012 ²²	N=1013 Random sample of women in Melbourne, Australia women from the SESAW study (Ball et al., 2006) Aged 18-65; Mean age 40.05 years	Self-completion dietary questionnaire and physical activity survey; Measured consumption of fruits and vegetables, fast food, and energy-dense snacks; 5-point Likert-scale surveys on individual, social and	<u>Individual measures:</u> Nutrition knowledge, self-efficacy, taste, lack of time <u>Social measures:</u> social support for healthy eating <u>Environmental measures:</u> perceived cost, availability of healthy foods	Women who did not consider time a barrier were more likely to consume fruit/vegetable, less likely consume fast food and high energy dense snacks; Enjoyed taste of fruits/vegetables were more likely to consume more Perceived family support and did

		environmental factors to influencing healthy eating		not consider cost a barrier, more likely consumed fruit and vegetables, less likely consume fast food Perceived friend/social support consumed more fruits vegetables; High nutrition knowledge were less likely consume fast food
European Cross-sectional Studies				
Lappalainen et al., 1997 ²³	General population of men and women 15 years or older (n=14,261) in European Union (EU) member states	Questionnaire on perceived barriers to healthy eating administered; face-to face interviews of 1000 participants per European Union countries (member states); interviews conducted as a part of Omnibus research; Age, sex, age, and education effects on answers analyzed with χ^2 statistics; Combined EU mean weighted for population size	Subjects asked to complete the Pan-European survey on Attitudes to Food, Nutrition, and Health (Institute of European Food Studies) provided list of 22 barriers; asked to choose significant barriers to healthy eating (see Table 2-2 for comprehensive list of barriers included)	21% - No barriers reported 66-91% reported ≥ 1 barrier <u>Most common barriers:</u> Lack of time Self-control 14-15% reported cost of food, unpleasant foods, influence of others, knowledge/expert consensus and selection influences More women than men reported influences of others Equal men and women: perceived knowledge/expert consensus, food preparation, unpleasant foods, and selection influences Younger: lack of time, self-control, food preparation Lack of knowledge/expert consensus and resistance to change (not age specific)

				<p>Lower education, resistance to change</p> <p>Higher education and lack of time (irregular work hours), self-control, food preparation</p> <p>Cost, unpleasant foods, influences of others, knowledge and selection influences (not education specific)</p>
Biloukha & Utermohlen, 2001 ²⁴	<p>Convenience sample men and women in Ukraine; aged 18-55years (n=; 84 males, 212 women); n=162 participants students; n=41: highly educated, unemployed attending government-sponsored courses; n=87: recruited through social networking (varied in educational and occupational status)</p>	<p>All participants recruited through flyers or word of mouth; filled out questionnaires and returned upon completion; questions gathered from the Pan-European Survey of Consumer Attitudes to Food Nutrition and Health;</p>	<p>Participants answered questions on reasons for food choices, barriers to healthful eating, where they get their information about healthy food options; adopted from the 22-item Pan-European survey (See Table 2-2 for comprehensive list of barriers included)</p>	<p><u>Influences on eating healthy: (% participants reporting influence)</u></p> <p>52.4% quality/freshness 13.5% Taste 10.8% Price 9.8% Trying to eat healthy 4.7% Family preferences</p> <p><u>Top perceived barriers:</u></p> <p>64.5% Cost of food 54.7% Lack of time 53.7% Self-control</p>
Andajani-Sutjahjo et al., 2004 ²⁵	<p>Australian women aged 18-32 (n=445); 42% tertiary education; half women were married; one in three had at least one child;</p>	<p>Stratified random sampling of women from the Australian Electoral Roll; Questionnaire completed on socio-demographics, education, domestic situation, education level, body weight, and perceived barriers to weight maintenance</p>	<p>22-item questionnaire; participants asked to rate the importance of the barriers; items derived from literature related to weight maintenance behaviors in various populations; perceived barriers to physical activity and healthy eating; asked to list the single most important barrier through two open-ended</p>	<p><u>Top healthy eating barriers:</u></p> <p>66% Lack of motivation 43% Lack of time 40% Cost</p> <p><u>Physical Activity barriers:</u></p> <p>74% Lack of motivation 58% Lack of time 51% Cost</p> <p><u>Open ended responses to barriers</u></p>

			<p>questions: “What is the one thing that makes it hardest for you to be physically active/eat a healthy diet?”; (Responses for barriers ranged from Not a barrier to Very important barrier) (See Table 2-2 for comprehensive list of barriers included)</p>	<p><u>to healthy eating:</u> 24% Taste 21% Time 13% Lack of motivation 13% Inconvenient and expensive</p>
Lopez-Azpiazu et al., 1999 ²⁶	Spanish Men and women aged 15 years and older (n=1009)	Subjects selected through the European Society for Opinion and Marketing Research; 15 minute interviews conducted through Eurobus; completed between October 1995-February 1996; One person per household interviewed; Individuals asked to choose two barriers on the list of 22 barriers; Nutritionists and food behavior specialists analyzed responses; Socioeconomic status, employment, education, age, and sex analyzed Pearson’s X ² ; using SPSS	<p>22-item Pan-European Survey on Attitudes to Food, Nutrition and Health (Institute of European Food Studies) on the barriers to healthy eating (See Table 2-2 for comprehensive list of barriers included)</p>	<p>29.7% Irregular work hours 29.7% Willpower 21.3% Unappealing foods 17.8% Busy lifestyle 20%: No difficulties</p>
			<p>Two questions on perceived benefits of healthy eating: “Some people believe that healthy eating has specific benefits, some of which are shown on this card. (List of 9 items) Which, if any, would you personally believe can be achieved by healthy eating?” And: “Which one benefit would be the most personally significant for you?”</p>	<p>73.6% Prevent disease in general 69.4% Stay healthy 50.9% Better quality of life 47.0% Control weight 39.4% Be fit 28.7% Live longer 28.2% Have plenty of energy 15.8% Do better at a sport 10.7% Look attractive 6.6% Healthy options not available in shop or canteen or home 1.6% None of these 1.0% Don’t know</p>

Holgado et al., 2000 ²⁷	Men and women (n=14, 331) 15 years and older	Face-to-face interviews discussing the results of a 22-item questionnaire on barriers to healthy eating; Identify differences between Spain and other European countries; participants allowed to select two options out of the 22 barriers; percentages of frequency of barrier chosen distributed by gender, age, education, employment; chi-squared and Pearson's correlation compared proportion of selected barrier between Spain and other European Union (EU) states	22-item questionnaire: Pan-European survey on Attitudes to Food, Nutrition and Health (Institute of European Food Studies) 22 Barriers divided into 9 categories on healthy eating (See Table 2-2 for comprehensive list of barriers included)	29%: Irregular work hours 24.7% Willpower 20%: no difficulties with eating healthy 17.8% Busy lifestyle 15% Price 14.3% Giving up foods 12.6% I do not want to change my eating habits
Prospective Longitudinal				
Knauper et al., 2005 ²⁸	Women aged 18-30 (n=132) currently on a weight-loss diet; Mean BMI: 23 kg/m ² ;	Participants recruited by flyers filled out questionnaire on dieting success; 2 month follow-up period; self-reported height and weight were recorded to calculate BMI at time 1 and 2. Participants were asked how much weight they intended to lose at time 1 and reported their weight	Participants asked to write down 8 self-inflicted dieting rules at two time points. At the second time point participants recorded retrospective rules that were followed; Adherence measured by degree of reporting of a rule at time 1 compared to time 2;	6.78 rules were reported on average by each participant; Reducing calories and increasing exercise=most common rules 27.6% reported the same rules at time 1 and time 2; 59.7% lost weight; 24.8% gained weight; 15.5% remained the same; dieting success was 18.85% More reports of reducing calories and exercising the more

		at time 2; dieting success calculated by dividing amount of weight lost by intended loss x 100		likely they reached their weight loss goal; combination of both resulted in less weight lost than exercise or reduced calories alone; Greater consistency of reporting or rules (adherence to rules), the closer they came to weight-loss goal
Jordan et al., 2008 ²⁹	Convenience sample from WIC, community centers and churches; overweight and obese mothers (n=114) BMI ≥ 25 kg/m ² ; < 200% poverty level; not breast-feeding	Anthropometrics measured at baseline and week 8, and reassessed at week 24 (follow-up sample [93 of the 114 women]); divided into “responders” and “non-responders” based on weight lost at 8 weeks and a comparison/control group; Intervention group received nutrition education by Registered Dietitians; 24-hour recalls and food records at baseline, and week 8 and during 2-hour weekly group educational classes; week 24 follow-up reevaluation in women who could still be reached	21-item Nutrition Attitudes Scale: subscales sensory (taste, hunger, cravings); emotional eating (depression, anxiety, anger); barriers to healthy eating (dislike of foods, family preferences, lack of knowledge/confusion, difficult/ a lot of work, lack of motivation to change habits; employment); healthy eating (enjoyment and perceived significance of eating healthy)	Significant weight loss, decrease in body fat and waist circumference in responders compared to non-responders; 86% total participants lost weight 1% maintained weight 13% gained weight At follow-up: weight loss, body fat and waist circumference remained significantly lower than baseline in intervention groups; Baseline: sensory factors greater impact on eating Healthful attitudes had greatest influence at end of intervention; Fewer barriers reported: reduced emotional eating and improved attitudes toward healthy eating post-intervention; Increased dairy food intake resulted in fewer barriers to healthy eating reported

				56% Attrition from program: lack of childcare, lack of family support, stress, lack of time, lack of transportation, financial constraints, family commitments, job conflicts;
Ziebland et al., 1998 ³⁰	N= 1660 men and women in England; Age range 35-64; BMI ranged < 25 to >30 kg/m ²	Three year health follow-up to the OXCHECK study; subset of participants that completed a questionnaire and had their height and weight measured after 1 year of the initial study and returned after 3 years; Measures: baseline exercise, fat consumption, age, BMI, social class, attempts to change behavior in last 12 months	Self-reported exercise and dietary intake patterns; Exercise frequency recorded as 1-3 times per month, once a week, 2 or more times per week; fat consumption Dine questionnaire (Roe et al. 1994); Attempts at change (tried to increase exercise or lose weight or change eating habits); Asked if wished to change and reasons why and what would make it difficult (list of 10 positive and negative influences on behavior and internal/external barriers to behavior change)	73% of women and 59% men who mentioned they wanted to change diet habits had done so at the 3 year follow-up The younger the participants the more likely they were to increase exercise Participants who selected only internal barriers were less likely to report improvement in exercise Women more likely than men to improve fat intake or lose weight Highest intake of fat at baseline were more likely to reduce fat intake at 3 years; 61% selected only internal barriers to making changes change; 9.0% : external barriers; 29.9% mix <u>Most common internal barriers:</u> Lack of willpower Too lazy Too Busy Need for stress relief/relaxation <u>Most common external barriers:</u>

				<p>Lack of facilities Lack of money Friends' preferences/behaviors Family and coworkers influence</p>
Randomized Trials Monitoring Adherence				
Schlundt et al., 1993 ³¹	Men (avg. age 42 years old) and women (avg. age 46); at least 20% over their ideal body weight (n=49)	Participants randomized into 2 groups: low-fat group or low-calorie group; Both groups received behavior modification education (self-monitoring, exercise, self-esteem enhancement, Skill development); low-fat intake assigned <25g; Received electronic feedback of self-reported diaries on progress of intervention; 12 month follow up of weight data	Self-reported diary entries on eating behavior in a situational context; day, time, location, personal mood and company at meals recorded to determine the relationship between situations and behaviors; Behaviors analyzed from diaries: Overeating Impulsive/unplanned eating Macronutrient content of meals Cluster analysis to observe behavior-situation patterns; compared two-week baseline diaries to diaries during intervention	<p>Low-fat group: weight loss mean 4.6 kg (males: 8.0kg; females: 3.9 kg) Low-calorie group: weight loss mean: 8.8 kg (males: 11.8 kg, females: 8.2kg) Both groups: significant decreases in lean mass and fat mass Low-fat group: ~850kj/day more than low-calorie group 14% participants responding at follow-up did not gain weight 20% regained 1kg or less 40% <3kg; results did not differ as a function of intervention group During treatment- more low-calorie participants completed diary entries; compliance for both groups decreased with time</p> <p><u>Barriers reported for low compliance with healthy eating:</u> Eating in the car Social situations Emotional eating</p>

<p>Moreira et al., 2011³²</p>	<p>(N=46) 21 Men, 25 women; Mean age 37.7 Mean BMI: 27.7 kg/m²</p>	<p>Randomized into 4 groups: control calorie-restricted; calorie-restricted and exercise; low-calorie liquid diet; 6 months total: 5 weeks baseline, 24-week intervention; Baseline: food provisioned for two weeks (outpatient); 5 days inpatient stay where foods were provisioned; First 12 weeks: outpatient diet provisioned; 5 days inpatient stay diet provisioned; Received assignment and dietary training Weeks 13-21: self-selected diet (outpatient) Weeks 22-23: provisioned outpatient Week 24 (5 days) inpatient food provisioned</p>	<p>Self-report assessment form; recording of reason for non- compliance with the provisioned foods or self-selected foods based on prescribed dietary intervention; recorded missed study foods, non-study foods consumed; assigned calorie allotment within treatment group; adherence measured by amount of weight lost</p>	<p>59% consumed all of meals when provisioned Adherence to inpatient food consumption was low in participants who disliked foods Mean weight loss: Control: -0.2% Calorie-Restricted: -9.9% Calorie-restricted and exercise: - 9.0% Liquid diet: -13.4%</p> <p>Outpatient non-adherence: Baseline control diet: 6 participants consumed non-study foods 40% participants consumed non- study foods during the 11-weeks of intervention Calorie-restricted and calorie- restricted and exercise groups: lower adherence- larger number of missed study foods during weeks 5-11 Self-reported reasons: Illness (2.7%) Dislike for foods (2.1%) Spilled beverages (3.5%) Social settings (2.7%) Temptation (89%) Deviations from diet did not affect total energy intake Total overall energy intakes matched energy assignments for</p>
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				all groups
Welsh et al., 2012 ³³	Men and women (n=100men, 113 women total n=213); mean age 48.8 Females mean BMI: 34.8 kg/m ² ; Males mean BMI: 35.0 kg/m ² ; N=179 at 12 month follow-up	Secondary analysis of a LIFE study randomly assigned to standard behavior treatment group (assigned calorie/ expenditure amounts, self-monitoring, discussion of actions to meet goals) or maintenance tailored group (different strategies implemented overtime, focus on adapting to changes made); Exploratory Factor analysis to test factor structure and internal consistency of questionnaire administered to measure barriers related to healthy eating Observed association between changes in barriers and change in energy intake and body weight	Demographics questionnaire; 60-item Block Food Frequency Questionnaire 39-item 5-point scale questionnaire on the barriers to proper eating and exercising in the past 6 months	Exploratory factor analysis: 3 factors: Lack of knowledge Lack of time Lack of self-control Baseline to 12 month change in the three factors significantly associated with change in energy intake Baseline to 12 month change in lack of self-control and lack of time – significantly associated with change in weight status (1 unit decrease on lack of self-control from baseline to 12 months associated with significantly greater weight loss; mean 6.0kg lost by 12 months) (1 unit decrease on lack of time scale from baseline to 12 months associated with significantly greater weight loss; mean 2.5kg lost by 12 months)
	N=408 Women aged 45-69 years	Follow-up qualitative study: Women's Health Trial participants discussed experiences with following a low-fat diet; Responses were collected and compiled	35 experiences included 6 categories of indicators of adherence: Wellness; Distaste; Cost; Inconvenience; Deprivation; Family	Together- the 6 experiences had a significant effect on adherence to diet during trial and maintenance post-intervention Adherence during trial: developed distaste of fat-

Urban et al., 1992 ³⁴		during the study to create a questionnaire on the indicators of adherence; women were sent the questionnaire randomly 5-20 months after trial; retrospective self-report responses collected at follow-up ; Structural equation model to estimate experiential variables effect on attendance and adherence to initial treatment and long-term maintenance of low-fat diet	Women were asked if they had experienced the situational indicator; if yes, asked if it had motivated or prohibited adherence	<p>trending to significance ($p=0.06$)</p> <p>Feeling of wellness related to the diet and distaste for fat overtime associated with improved weight maintenance (not significant)</p> <p>Deprivation was a significant barrier to weight maintenance ($p=0.004$)</p> <p>Costs (time and money) was a significant barrier to weight maintenance ($p=0.02$)</p> <p>Inconvenience and family had no effect on long-term maintenance</p> <p>Education significantly associated with attendance and adherence during trial</p> <p>Adherence during trial significantly associated with long-term maintenance ($p<0.001$)</p>
Stalonas et al., 1984 ³⁵	(N=36)Men and women; mean age 30.5 years; 40.2% were overweight	Five-year follow-up to a randomized trial with four treatment groups: standard behavior self-control treatment; standard treatment plus exercise; additional contingency components to original treatment; additional exercise and contingency	Interview questions: perception of factors which influence weight	All groups regained weight since the end of the intervention 5 years prior; 86% who gained weight since treatment gained avg 16 pounds; 5 individuals continued to lose weight after intervention; 54% were lighter than pretreatment; 46% heavier than pretreatment;

		components to original treatment		<u>Influences on weight change:</u> Family or social situations Emotional eating
Yates et al. 2012 ³⁶	(N=225) Caucasian, married women aged 50-69 years; mean age 58 years;	12 month randomization to a tailored newsletter intervention or control, standard newsletter group; tailored newsletters were individualized to personal goals, current perceived benefits and barriers of the diet, self-efficacy, and interpersonal support, and biomarker information; Both groups emphasized increasing fruits, vegetables and whole grains, and decreasing total fat and saturated fat	Items selected from the Healthy Eating Benefits and Barriers Scale; Self-efficacy for Eating Habits Scale, Family Support for Healthy Eating Habits Scale	Significant increase over first year of intervention for family support; tailored newsletter group reported significantly more family support than standard letter group; Significant decrease in barriers during intervention; tailored letter group associated with significantly fewer perceived barriers; Tailored letter increased healthy eating more than standard letter In intervention and during maintenance phase; Decrease in barriers associated with significant increase in healthy eating during intervention; Effect of tailored letter group was moderated by family support and decreased barriers
Randomized Trials Specifically Mentioning Satisfaction				

Baron et al., 1986 ³⁷	Men and women Mean age 39 years Mean BMI	Randomly assigned to low-fat diet/high fiber or low carbohydrate diet; both interventions assigned values to food items, with individuals allotted 10 units of intake/day; diet instruction sheets and techniques; provided to both groups; weekly meetings during 3 month diet period; weight and height and blood samples measured at baseline 1 month and 3 months;	Dietary questionnaire completed at trial entry and 1 and 3 months post-intervention on frequency of eating; side effects and difficulties when dieting No methodology reported for measuring dietary satisfaction	At 3 months: low-carbohydrate group decreased fiber intake Low-fat group increased fiber Moderate weight loss by both groups; most regained by one year Low-carbohydrate lost more weight than low-fat group on average Individuals under 40 years old and low-carbohydrate diet more weight lost than low-fat diet <u>Low-fat group fewer complaints overall:</u> 3 months: low-carbohydrate dieters complained more about 6%: expense (0% in low-fat group) 23% GI distress (3% in low-fat group) Both groups: Fatigue (22% total) Emotional stress (31%) In discussion: “The low-carbohydrate/low-fiber dieters appeared less satisfied with their diet experience”
Ebbeling et al., 2007 ³⁸	Men and women (n=73) Mean age 28 years (Low-glycemic load group); 27 (low-fat group)	Randomized into low-fat/high glycemic load vs. low-glycemic/ high-fat groups for 18 months (6-month	Participant satisfaction with the program: Participants responded to questions on satisfaction using	Glycemic index and carbohydrate intake decreased in low-glycemic group; Total dietary fat increased;

	<p>Mean BMI: 41 (low-glycemic group); 40 (low-fat group)</p>	<p>intensive intervention, 12 month follow-up); nutrition education and dietary counseling provided to both groups; glucose tolerance test conducted prior to randomization; body weight, body composition, blood pressure, lipids profile, and insulin levels measured at 6, 12, and 18 months; 23 group workshops, private counseling, 1 motivational telephone call, and interviews provided throughout intervention; food choice lists provided to all participants; dietitians provided information, and cooking education during interactive activity sessions tailored to each treatment group for diet and exercise; ad libitum approach to eating to observe intrinsic control of intake and increased satiety;</p>	<p>10-cm visual scale: 0 = “not at all”; 10= “extremely” Questions prompted for overall satisfaction with the diet and weight loss, ease of following the diet and palatability of foods</p>	<p>Low fat group: total fat and saturated fat decreased;</p> <p>Low-glycemic group lost weight rapidly and lost more weight overall; no evidence of weight regain at 6 months</p> <p>“Satisfaction with the program also did not differ between groups” (Reference to Participant Satisfaction table with questions: “How satisfied are you with this diet?” Low-glycemic load diet: mean 7.0 ;Low-fat diet: mean 6.9 ($p=.80$) “How easy has this diet been?” Low-glycemic load diet: mean=5.3; Low-fat diet: mean5.1 ($p=.68$) “How tasty have the foods been?” Low-glycemic load diet: mean= 6.9; Low-fat diet: mean= 6.8 ($p=.92$) “How satisfied are you with your weight loss to date?” Low-glycemic load diet mean=4.1; Low-fat diet: mean=4.7 ($p=.37$)</p>
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Sacks et al., 2009 ³⁹	Men (n=296; 36%) and women (n=515; 64%) Mean age: 51years Mean BMI:33 kg/m ²	Randomized into 4 groups: 1.20% fat, 15% protein, 65% carbohydrates (low-fat avg. protein) 2.20% fat, 25% protein, 55% carbohydrate (low-fat, high protein) 3.40% fat, 15% protein, 45% carbohydrates (high-fat avg. protein) 4.40% fat, 25% protein, 35% carbohydrates (high-fat, high-protein) Group sessions weekly for 6 months; daily meal plans provided; daily records of food intake and physical activity required; behavioral counseling; body weight, waist circumference measured; Questionnaire with questions regarding satiety, food cravings, eating behaviors, and satisfaction with the diet at baseline, (except diet satisfaction) 6 months and 2 years	Questionnaire assessed extent that the 4 diets affected diet satisfaction at 6, 12, and 24 months: 6 scores for factors wellness, distaste, costs, inconvenience, deprivation, inconvenience for family- total score not computed	Average weight lost: 6 kg Regain of weight began after 12 months Weight loss was similar in 15% protein group vs. 25% protein group All diets reduced risk factors for cardiovascular disease Changes between groups, <0.5 kg body weight “Cravings fullness, hunger and satisfaction similar at 6 months and 2 years among the diets”
Kreider et al., 2011 ⁴⁰	N=90 overweight women Mean age 42 years Mean BMI: 33 kg/m ²	(10 week weight-loss; 24-week maintenance phase)	SF-36 Health-related Quality of Life Scale	Standard diet and exercise group lost significantly more weight, fat mass and waist circumference

		<p>Randomized into two common weight loss interventions: Meal replacement group (special K Challenge: Replaced two meals per day; 8 weeks dietitian education on portion sizes intake and exercise; reduce intake - 500/d</p> <p>Standard diet and exercise group: Curves diet program- 1 week structured plan (1200 kcal; 9 weeks 1600kcal/d; 24 weeks: follow 2100kcal/d with intermittent dieting of 1200-1300 kcal if gain >3 lbs.;</p> <p>Both groups exercise intervention; anthropometrics measured; psychosocial assessments</p>	<p>Likert-scale of appetite, hunger, diet satisfaction, feeling of fullness, energy levels, and quality of life (0=no agreement to highest agreement)</p>	<p>than meal replacement group</p> <p>Standard diet and exercise group had significantly greater increase in aerobic capacity</p> <p>Maintenance: No significant interaction between groups energy intake, macronutrient intake, in total cholesterol, LDL, blood glucose or insulin</p> <p>SDE group trended toward significance for more energy than MRP group, however “No significant interaction observed between groups in appetite ($p=0.56$), hunger ($p=0.84$); fullness ($p=0.89$); diet quality ($p= 0.12$); or diet satisfaction($p=0.58$)”</p>
Rolls et al., 2005 ⁴¹	(N=200; 147 completers) Men (n=64) and women (n=154) Mean BMI	<p>Randomized to three energy-restricted groups) Instructed to consume specified amount of foods: One serving of soup (one-soup group) Two servings of soup (two-soup group) Two servings snacks (two-</p>	<p>Leisure-Time Exercise Questionnaire- assessed physical activity</p> <p>The Eating Inventory- assessed disinhibition, dietary restraint, hunger</p> <p>The Food Preference</p>	<p>All groups: mean weight loss 7.6 kg (8.7% initial weight) 1 year: mean weight loss with 50% greater in two-soup groups and control vs. two-snack group (7..2kg vs. 4.8 kg)</p> <p>Significantly lower energy density in soup-groups than</p>

		<p>snack group) Comparison group-no provisioned foods</p> <p>Registered dietitians counseled all participants on weight loss; blood pressure, weight, lipid profile, completed 3-day diet record recorded</p>	<p>questionnaire- preference for taste of low-fat and high-fat versions of foods</p> <p>The Diet Satisfaction Questionnaire: Assessed satisfaction with food plan on 7-point scale</p> <p>All questionnaires completed at baseline, 3, 6, 9, 12 months</p>	<p>snack-groups ($p<0.005$)</p> <p>All intervention groups had reduced blood pressure at 6 months, unchanged at 12 months</p> <p>2 strongest predictors weight loss at 1 and 2 months: decrease in food energy density from baseline and baseline disinhibition score (combined 18% variability in weight-loss at 1month; 15% at 2 months)</p> <p>6 and 12 months: 2 strongest predictors: decrease disinhibition and increased restraint</p> <p>All groups decreased disinhibition and tended toward hunger and increased dietary restraint from baseline to 1 year</p> <p>High-fat choices were reported to taste better for 63% food items at baseline; decreased to 56% at 3 months; no significant differences between groups</p> <p>Diet Satisfaction Questionnaire: No differences among groups in answers “How healthy you feel on food plan” (83% responded “very healthy” or “extremely</p>
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				<p>healthy”</p> <p>Two-soup group participants reported feeling “extremely full” and “very full” (55%) > one-soup group (47%) > snack group (40%) > control group (36%)</p> <p>“How hungry do you feel while on this food plan?” “not at all hungry” or “somewhat hungry” responses: Soup groups and comparison group: 70%; snack group: 59%</p>
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Table 2-2. Listing of the barriers and facilitators to adherence to a weight-loss diet or dietary recommendation as identified in studies included in the current review. Barriers denoted as: √*** ; √** ; √* ; √; barriers ranked by significance in the study with more asterisks indicating more significant. Facilitators to following a weight-loss diet or dietary recommendation denoted as +.

	Cost	Time-no specification	Time (Shopping)	Time (Meal preparation)	Inconvenience	Family commitments	Work hours /career interference	Availability	Accessibility	Feelings of deprivation	Emotional eating	Family/friend support	Social situations	Preferences/influences of friends and family	Self- control /discipline	Willpower/ Self- Efficacy	Not willing to change/ too great of a change from current diet	Knowledge/Education	Laziness	Temptation	perishable/ Lack of storage or cooking	Physiological Discomfort	Perceived benefits
Green et al.2009 ¹⁴		√*		√***	√**		√***				√***		√***		√**								
Tessaro et al. 2006 ¹⁵	√***	√***			√***											√***		√**					
Thomas et al. 2008 ¹⁶	√***						√	+				+			√	√***			√**				
Herriot et al. 2008 ¹⁷						√**	√**				√***	+/ √***	√**										
Hardcastle & Hagger 2011 ¹⁸												√***			√***								
Burke et al. 2008 ¹⁹	√		√***			√				√**	√*	√**	√*					√		√			
Eikenberry & Smith 2004 ²⁰	√***	√***		√**	√*										√***			√	√***				
Chang et al. 2008 ²¹	√**		√***	√***	√***	√**					√***	+/ √***	√**	√***	√***	√**		√		√**			
Williams et al. 2012 ²²	√		√	√						√		√				√							
Lappalainen et al. 1997 ²³	√***			√*			√***	√**	√**	√**				√**	√***	√**	√**	√***			√		
Biloukha & Utermohlen 2001 ²⁴	√***	√***		√*			√***	√**	√*					√*	√***	√*		√**					

Table 2-2 (Continued). Listing of the barriers and facilitators to adherence to a weight-loss diet or dietary recommendation as identified in studies included in the current review. Barriers denoted as: √*** ; √** ; √* ; √; barriers ranked by significance

	Resistant to change/ Lack of motivation to change	Omnipresence of foods	Psychological or psychosocial factors	No noticeable results	Taste/Distaste	Picky/ Limited Selection when eating out	Maintaining focus	Inflexibility or Restrictive intervention requirements	Lack of accountability (or Live Alone)	Energy/Lack of Energy	Lack of structure	Metabolism, hormones, genetics	Transportation	How I was raised	Unable to Choose Foods/ Unappealing foods	Lack of Skills	Wrong frame of mind	Constant thoughts about food	Expert opinion constantly changing	Not enough food to satisfy hunger
Green et al. 2009 ¹⁴			√***							√*		√*					√**			
Tessaro et al. 2006 ¹⁵	√***													√*			√***			
Thomas et al. 2008 ¹⁶									√***								√***	√***		
Herriot et al. 2008 ¹⁷	√***																√***			
Hardcastle & Hagger, 2011 ¹⁸									√***											
Burke et al. 2008 ¹⁹	√***	√*	√*	√*			√	√	√	√	√	√								
Eikenberry & Smith 2004 ²⁰					√***	√**			√**				√*	√*	√					
Chang et al. 2008 ²¹				√*								√*			√*					
Williams et al. 2012 ²²					√															
Lappalainen, et al. 1997 ²³	√**					√***									√**	√**			√**	√
Biloukha & Utermohlen	√**														√**					√

Chapter 3

Dietary Satisfaction: Exploring Constructs with Factor Analysis

ABSTRACT

Dietary satisfaction with a weight-loss intervention is critical for weight-loss and weight-loss maintenance. In order to assess the internal validity and confirm the underlying dimensions of dietary satisfaction proposed in a previously created, 45-item dietary satisfaction questionnaire (D-SAT), a contemporary factor analysis was conducted. Data from two weight-loss interventions including premenopausal women with overweight/obesity were utilized for the current factor analysis ($n = 180$; mean \pm SD age = 34.5 ± 6.9 y; BMI = 30.3 ± 3.6 kg/m²). After standard preliminary factor analysis, a rotated Varimax factor analysis was conducted. Eigenvalues and a scree plot suggested that a 6-factor or 7-factor solution was adequate for characterizing dietary satisfaction. Further objective and subjective measures were considered to compare the 6-factor and 7-factor solutions. Factors were labeled: “Benefits of diet,” “Preoccupation with diet,” “Eating away from home,” “Diet planning,” “Family impact,” and “Financial cost” (6-factor D-SAT), along with “Personal cost” (7-factor D-SAT). The 36-item (6-factor) and 38-item (7-factor) versions of the D-SAT should be further tested to identify the most salient version of the questionnaire. At present, the 36-item or 38-item D-SAT offers a measurement tool to gauge dietary satisfaction and adherence to a weight-loss intervention.

INTRODUCTION

Dietary satisfaction is a complex notion comprised of internal and external dimensions leading to adherence or compliance with a dietary pattern. Dietary satisfaction has been implicated in the ability or inability to comply with weight loss interventions, as evidenced by research on the barriers or facilitators to adherence.¹⁻²⁵ However, the definition of dietary satisfaction has not been well characterized. Moreover, measurement of dietary satisfaction, specifically related to weight-loss diets, remains elusive. Constructs proposed to define dietary satisfaction include food preferences,^{9,12,13,16-21,26} feelings of hunger or deprivation,^{4,5,9,11,13,16-21} food accessibility,^{9,13,17-21} economic cost,^{9,11-14,17-23} self-control,^{6,8,9,11,13,15-23,25} time constraints,^{8,9,12-23} social and family support^{4-7,9,11-25} and knowledge and self-efficacy.^{7-9,12,13,15-23}

A follow-up study to a randomized trial for weight loss in overweight and obese individuals was conducted to determine the primary barriers to adherence to the original weight-loss intervention.⁸ Factor analysis was conducted to determine underlying themes of the variables preventing participants from following the particular diet. Welsh and colleagues⁸ proposed that lack of knowledge, self-control and time were the three factors associated with low adherence. Further, change in energy intake was significantly associated with change in factor score. Specifically, participants who had decreases in scores for these three factors also had reductions in their energy intakes.⁸ Although several studies have characterized dietary satisfaction through factors related to adherence,¹⁻²⁶ only one has attempted to measure dietary satisfaction as reflective of

contentment and compliance.²⁷ A Dietary Satisfaction Questionnaire (D-SAT) was developed by Ello-Martin and colleagues; this D-SAT demonstrated that dietary satisfaction was characterized by cost, lifestyle, convenience, family dynamics, food preoccupation and barriers to dieting and meal planning/preparation.²⁸ The D-SAT was also shown to change during the course of compliance with a weight-loss intervention.²⁷ To date, this instrument has not been peer-reviewed for publication. Yet, a critical need exists for a questionnaire that measures dietary satisfaction. The purpose of this study was, therefore, to further explore the D-SAT in a current sample of women. It was expected that dietary satisfaction would be comprised of at least six factors.

PARTICIPANTS AND METHODS

Study Design

The current study was a secondary analysis of D-SAT quantitative data which were collected at baseline for two independent weight-loss interventions that included a total of 180 premenopausal women (mean \pm SD age = 34.5 \pm 6.9 y). Both primary interventions were designed to produce body weight loss of 1-2 pounds per week in participants. The first intervention compared the incorporation of dark chocolate sweet snacks and a cocoa beverage into an energy-restricted dietary pattern to non-chocolate sweet snacks and a non-cocoa/chocolate beverage on weight loss over 18 weeks.²⁹ The second intervention compared the inclusion of low-fat yogurt as a meal replacement versus a standard calorie-controlled dietary pattern on weight loss over 12 weeks of weight loss, followed by 12 weeks of weight-loss maintenance.³⁰ Rationale and complete details of methods for each study have been published elsewhere.^{29,30}

Participants

Participants in the first intervention included premenopausal women, ages 25-45 y who were overweight or obese [body mass index (BMI) ≥ 25 to ≤ 43 kg/m²]. Women were included if eumenorrheic, weight stable for six months prior to the study and were engaging in less than five hours of physical activity per week (n=60).²⁹ Individuals enrolled in the second intervention were eumenorrheic women, ages 25-45 y, who were overweight or obese (BMI ≥ 25 to ≤ 43 kg/m²). Women were included if they participated in physical activity for less than 2 hours per week, were of stable weight for the previous six months and lacked a yogurt allergy, intolerance, or aversion (n=120).³⁰ Women in the primary studies were without chronic disease (except for overweight/obesity) and were not taking any prescription medications for acute or chronic conditions.

Each primary study, including collection of D-SAT data, was approved by the Institutional Review Board for Research Involving Human Subjects at The Pennsylvania State University (University Park, PA, USA). Each participant provided written informed consent before completing any primary study procedure.

Dietary Satisfaction Questionnaire (D-SAT)

Women completed paper-and-pencil versions of the 45-item D-SAT. The D-SAT was completed at baseline or before random assignment to dietary intervention in each primary study. Women were asked to respond to every item on the questionnaire by circling the number that best corresponded to their current response to each statement. Possible responses included 1=disagree strongly; 2=disagree somewhat; 3=neither disagree nor agree; 4= agree somewhat; 5=agree strongly. Twenty-nine of 45 D-SAT

items were reverse coded before entry into the database. These 29 questions were negatively worded to minimize social desirability in responses.

Statistical Analyses

Responses to the D-SAT between comparative groups by primary study (i.e., chocolate vs. non-chocolate; yogurt vs. non-yogurt) and between studies (i.e., chocolate vs. yogurt) were examined. No significant differences in responses to D-SAT items were found between groups within each study or between the two primary studies. Therefore, data were pooled and further examined.

Pooled, baseline D-SAT data from both aforementioned weight-loss interventions were analyzed using factor analysis (IBM SPSS Statistics Software version 19.0, 2010, IBM Corp., Armonk, NY, USA), a statistical technique used to group variables that correlate highly with one another and that together create a factor. Specifically, factor analysis was used to explore the ability of the D-SAT to capture elements of dietary satisfaction. A composite D-SAT score also was explored.

A preliminary, non-rotated analysis was conducted with data from 180 participants. Data were excluded list-wise; therefore, participants' data were only included if data were available for all questions. Data from two participants were removed, due to random missing data, for a final sample size of 178 women. To ensure adequate sample size, a Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was calculated. As the KMO value approaches 1.0, variables are likely adequately clustered and representative of a specific factor.³¹

A correlation matrix output was conducted to evaluate the correlation values of the 45 items of the D-SAT. Any question with few or no correlation values of 0.3 or

greater indicates that the question is unrelated to any other question in the instrument and should be considered for removal from the final solution. A correlation anti-image matrix was analyzed for values of 0.5 or less. This matrix helps to determine which questions should be removed from any instrument.³¹ In order to dismiss multicollinearity, or the situation of correlated independent variables and, thus, an erroneously high standard error,³¹ the determinant value of the correlation matrix was tested.

Pearson's correlation and correlation matrix analyses were conducted to define the relationship between variables. A correlation value of less than 0.01 identifies that variables are not related and, therefore, data should be considered for a rotated factor analysis.

Eigenvalues and a Scree plot determined the number of factors to retain from the dataset in a rotated analysis. Factors with eigenvalues of 1.0 are typically retained.³¹ Data were analyzed for the number of non-redundant residuals with an absolute value greater than 0.5. Less than 50% of data as such would verify that an adequate number of factors were retained.³¹ Cronbach's α was computed to address the reliability of the questionnaire as a whole as well as each individual factor. A Cronbach's α value of 0.7 to 0.8 has been deemed an acceptable indicator of a reliable tool.³¹

The composite score was calculated by averaging the scores from questions on the 45-item D-SAT. This composite score also was determined for the 6-factor and 7-factor questionnaires. Correlation analyses between questionnaire Item 7 ("I am satisfied with my current diet") and the composite score for the entire D-SAT (45 items), the composite score for the 6-factor solution (36-item D-SAT) and the composite score for the 7-factor solution (38-item D-SAT) were completed. A correlation between the composite score

and Item 7 tested the bivariate relationship between the simple statement, “I am satisfied with my current diet” and additional components captured in constructs potentially comprising dietary satisfaction.

RESULTS

At baseline, there were no significant differences in age, BMI and outcome variables between the two weight-loss intervention studies; therefore, D-SAT data from the two primary studies were combined for analysis. After list-wise removal of missing data, 178 complete questionnaires were included in subsequent analyses. As displayed in Table 3-1, the KMO value was 0.752, verifying that the sample size was “good.”³¹ Four questions of the D-SAT had correlation values of less than 0.3, and the anti-image matrices confirmed the removal of these four items (Table 3-1 and Figure 3-1, Items 13, 25, 26 and 38). The determinant value of these data was 0.00014, eliminating the notion of multicollinearity and singularity and demonstrating that none of the D-SAT items were related. A Pearson’s correlation value of 0.000 also suggested that none of the factor scores were related; therefore, the factors themselves were unrelated, indicating that a varimax rotation (orthogonal) was necessary. Eigenvalues from preliminary analysis proposed a 13-factor solution as the number necessary to observe the underlying dimensions of the D-SAT. Further analysis and observation of a Scree plot revealed the possibility of a 3-factor, 6-factor or 7-factor solution as representative of the D-SAT. A 9% non-residual value verified the three different solutions to be acceptable for the D-SAT.^{31,32} Results of the correlation analysis between D-SAT Item 7 and the composite score of the 45-item D-SAT was $r = 0.30$ ($p < 0.0001$). The 6-factor solution (36-item D-

SAT) correlated with Item 7 at $r = 0.38$ ($p < 0.0001$), while the 7-factor solution (38-item D-SAT) correlated with Item 7 at a value of $r = 0.35$ ($p < 0.0001$).

A maximum likelihood factor analysis with varimax rotation was used to allow for a small number of items to correlate highly with only one factor.³¹ Rotated factor analysis was completed without the four questions (Items 13, 25, 26 and 38) that were established to be independent from all others in the questionnaire. Items with factor loadings of 0.3 or greater were considered acceptable and were retained, since a loading greater than 0.3 represented a 9% overlap in variance between that variable and the corresponding factor. This is an adequate value for interpretation, although as overlap percentage increases, there is a higher likelihood that the variable is a true representation of that factor.³² For items that had a loading of 0.3 or greater for more than one factor, the higher loading value was retained.

The 3-factor solution retained 23 of 41 D-SAT questions, while the 6- and 7-factor solutions retained 36 and 38 items, respectively. Further, the 3-factor solution only explained roughly 26% of the variance of the questionnaire. Removing 18 questions from the D-SAT (3-factor solution) generated a version that inadequately operationalized dietary satisfaction, due to an insufficient remaining number of questions to define this multifaceted construct. The 3-factor solution, therefore, was not further considered.

Consideration of the 6-Factor and 7-Factor Solutions

A summarization of the differences between the 6-factor and 7-factor solution is depicted in Table 3-2. From the total variance explained, 40.3% of the information from the original 41 items was explained by the 6-factor solution. The 7-factor option explained 43.8% of the variability in the 41 questions. The Cronbach's α value for the 6-

factor solution was 0.817, while the 7-factor solution resulted in a Cronbach's α of 0.808. In addition, the 6-factor solution removed two questions that the 7-factor solution preserved ("I spend a lot of time looking for new ideas for food and meals that fit into my current diet" and "I have to prepare most of my foods from 'scratch'"). Overall the 6- and 7-factor solutions incorporated questions and allocated them into six and seven constructs with factor loadings ranging from 0.316 to 0.933 and 0.340 to 0.911, respectively (Tables 3-3 and 3-4). The Cronbach's α value for each factor of the two questionnaires is also depicted in Tables 3-3 and 3-4. All values were above the recommended value of 0.7, with values ranging from 0.712 to 0.832 and 0.712 to 0.937 for the 6-factor solution and 7-factor solution, respectively.

DISCUSSION

This secondary analysis was conducted to further explore a previously created D-SAT to define constructs associated with dietary satisfaction. Preliminary analysis removed four items, and after a rotated factor analysis was conducted, 6-factor and 7-factor solutions were proposed and considered. Factors for each solution were labeled: (1) Benefits of diet; (2) Preoccupation with diet; (3) Eating away from home; (4) Diet planning; (5) Family impact; and (6) Financial cost (6-factor solution), along with (7) Personal cost (7-factor solution).

Both the 6-factor and 7-factor solutions removed three common questions from the preliminary 41-item questionnaire. Item 16 ("I limit my choice of restaurants") may be dispensable, due to the fact that individuals are not likely to limit their choice of restaurant, rather, their choices within a restaurant. Conversely, though, an individual may be advised by a health professional to avoid particular restaurants, which would

make this question relevant to assessing a barrier to adhering to dietary advice. Item 16 did not receive a factor loading value higher than 0.284 and 0.250 on the 6-factor and 7-factor solutions, respectively. Therefore, Item 16 was determined to not represent a significant portion of any factor and was not retained. The second item removed was Item 37 (“I feel embarrassed if I order specially prepared foods in a restaurant”). In contemporary society, specially prepared foods in restaurants are commonplace. Individuals frequently make special requests, ranging from food substitutions to preparation methods, especially if medically necessary. Item 37 may not be relevant to the characterization of dietary satisfaction, because of the commonness of such requests. The factor loading values were not equal to or greater than 0.3, the minimum value for retention on a factor; thus, Item 37 was removed. For this analysis, baseline data were analyzed; therefore, individuals were not yet assigned to a dietary intervention. Item 40 (“I have to prepare separate meals for my family and myself”) may not have been relevant at baseline, and therefore did not result in a loading of equal to or greater than 0.3 for any factor in the 6-factor or 7-factor solutions. While it may be beneficial to analyze loading values for this item during a treatment phase of an intervention, Item 40 was not retained.

In addition to the four questions removed from the 45-item D-SAT and the three questions removed from the 41-item D-SAT, the 6-factor solution removed two more questions, resulting in a 36-item D-SAT. The 7-factor solution did not remove any additional questions, resulting in a 38-item D-SAT. These two proposed versions are illustrated in Figures 3-2 and 3-3, respectively. A comparison of the original D-SAT and the contemporary 6-factor and 7-factor versions are presented in Tables 3-5 and 3-6,

respectively. Although the 7-factor solution included more items from the original D-SAT than the 6-factor solution, the two additional questions that the 6-factor solution removed (and 7-factor solution retained) may be considered irrelevant for the framework of dietary satisfaction.

In the context of a weight-loss intervention, participants are primed to understand that the intervention includes a pre-planned, prescribed diet. The D-SAT is intended for an audience that is partaking in a weight-loss intervention which does not require participants to self-reliantly choose appropriate, healthy food options. The notion of creativity in meal selection is not necessarily instrumental in the ability to follow an established weight-loss regimen, and thus is not essential to the D-SAT. Item 45 of the original D-SAT (“I spend a lot of time looking for new ideas for food and meals that fit into my current diet”) therefore is not applicable in the evaluation of factors that influence dietary satisfaction. The other item removed (Item 12, “I have to prepare most of my foods from ‘scratch’”) is expendable due to the debatable fact of whether participants following a prescribed weight loss routine prepare meals from scratch. In a recent study, approximately 44% of women admitted to spending 20 minutes or less on dinner preparation,³³ demonstrating the obsolescence of cooking meals from scratch. A question on the D-SAT which may no longer pertain to individuals currently engaged in a weight-loss intervention should not be included as an integral characterization of dietary satisfaction. Furthermore, the purpose of a questionnaire in a weight-loss intervention is to gauge participants’ progress and gather information in a quick, simple manner. The 6-factor solution results in a shorter questionnaire which may prevent inaccuracies in

answers from participants, while also providing questions that are relevant to the participants' experiences.

Although the 38 items in the 7-factor solution explained a higher percentage of variance than the 36 items in the 6-factor solution, the 6-factor solution correlated higher with Item 7 ("I am satisfied with my current diet"), a simple external measure of validity, than did the 7-factor solution. Further, the distribution of questions into the various factors was similar for the 6-factor and 7-factor solutions, with the exception of four questions. The two questions that were removed from the 6-factor solution were retained in factor 5 of the 7-factor solution. Items 43 and 44, that were retained in factor 4 ("Diet Planning" factor) were the only two items included in factor 7 of the 7-factor solution. The Cronbach's α value of this factor was 0.937 (Table 3-4). This objective measure of reliability was conducted to determine the homogeneity of the items within a scale, as well as the questionnaire as a whole.³⁴ In the case of a questionnaire that measures one construct through multiple underlying dimensions, such as the D-SAT, Streiner³⁴ suggests that, while each underlying dimension will have a higher level of homogeneity than the questionnaire as a whole, a Cronbach's α value greater than 0.9 on one dimension (as with factor 7) may indicate redundancy of items rather than homogeneity of the factor.³⁴

Behavioral and cognitive-behavior changes are essential initial steps in the pursuance of weight loss and weight-loss maintenance. Any action that provokes pleasure or fulfillment will lead to a continuation of that behavior.³⁵⁻³⁸ Individuals assume and manage behaviors based on personal standards that must be fulfilled; individuals do the things that maximize satisfaction, and minimally satisfying tasks are avoided,³⁸

suggesting that satisfaction is an integral component to all persisting situational behaviors. Studies have been conducted in which satisfaction or dissatisfaction with the diet has been nominally reported by participants. Whether a modification to macronutrient distributions,³⁹⁻⁴¹ or incorporating healthier foods into an habitual diet,^{42,43} studies continue to provide anecdotal feedback on dietary satisfaction, most frequently in terms of one or two of the underlying dimensions of the construct.

Few studies have focused primarily on dietary satisfaction as a weight-loss indicator, principally because of the lack of a validated tool for measuring this paradigm.^{8,27} One recent study conducted a factor analysis to determine the perceived barriers to adhering to a particular weight-loss intervention and found that lack of knowledge, self-control and time were the three primary influences on adherence, energy intake and weight loss.⁸ Although labeled differently, the three themes of knowledge, self-control and time also were confirmed in the current factor analysis, with the addition of other underlying factors. In 2006, the D-SAT items loaded into 7 factors and represented knowledge via preparation and planning, self-control via healthy lifestyle and preoccupation with food and time via cost, convenience and negative aspects, along with family dynamics.²⁸ The 45-item D-SAT was found to be reliable ($p < 0.0001$),²⁸ and the overall D-SAT score increased from baseline to end of intervention in women with obesity who were randomized to either a reduced fat or reduced fat plus increased fruits and vegetables diet group.²⁷

The D-SAT is a compilation of the proposed components characterizing dietary satisfaction, which could arguably be distributed into 6 or 7 dimensions. Whether there are six or seven factors, these components may be generalizable to any weight-loss

intervention for gauging satisfaction through the duration of changes in dietary patterns. Operationalizing dietary satisfaction may facilitate individualized counseling by identifying personal facilitators and barriers to adherence, thereby increasing the possibility of maximized weight loss and weight-loss maintenance.

This study contributes to the scientific literature by refining a tool for use that may measure and promote positive health changes, specifically adherence to weight-loss interventions. Future studies are required to confirm the applicability of the D-SAT, as well as the legitimacy and appropriate number of factors to adequately characterize dietary satisfaction. Additional work is necessary to confirm that this questionnaire is generalizable to any weight-loss intervention. This analysis was conducted on data collected only from premenopausal women who were overweight/obese; therefore, other facilitators and barriers may be encountered by men or other age groups not captured in this current analysis. Premenopausal women, especially mothers in mid-life, may be presented with specific motivators to following a weight-loss intervention, while conversely, encountering barriers that a younger or older population of males and females may not face.

In conclusion, a factor analysis was conducted on the 45-item D-SAT, resulting in a 36-item questionnaire and a 38-item questionnaire that incorporated six and seven fundamental dimensions of dietary satisfaction, respectively. The two proposed revised versions of the D-SAT should be tested in other populations to confirm the most valid and reliable D-SAT for use. Irrespective of the version, this questionnaire has the potential to improve weight-loss outcomes by determining the factors that motivate or prevent an individual from following prescribed recommendations. Ultimately, when an

individual perceives an intervention to fulfill internal and external expectations, that individual will be more inclined to adopt the prescribed regimen as a long-term lifestyle modification, rather than a temporary solution. Using dietary satisfaction as a guide, weight-loss interventions may be individually tailored to increase motivators and decrease the barriers to dietary adherence; such individualized programs may attenuate overweight/obesity and lead to prevention of weight-associated co-morbidities.

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Table 3-1. Non-rotated preliminary factor analysis of the Dietary Satisfaction Questionnaire to test for normality and to determine the necessity of rotated analysis

Test Statistic	Result
KMO ^a	0.752
Pearson's Correlation ^b	<i>p</i> -value: 0.000
Correlation Matrix ^c	Questions 13, 25, 26, 38: No correlation values > 0.3
	Question 12: Two correlations > 0.3 Question 45: Two correlations > 0.3
Anti-image Correlation Matrix ^d	Question 13: 0.543 Question 25: 0.496 Question 26: 0.578 Question 38: 0.532
Eigenvalues	13 Factors >1.0
Determinant ^e	0.00014

^a KMO=Kaiser-Meyer-Olkin; Measure of sample size adequacy; 0.5-0.7=Mediocre, 0.7-0.8=Good, 0.8-0.9=Great, and >0.9=Superb.

^b If significance $p < 0.05$, reject the hypothesis that variables are related.

^c A correlation of <0.3 between D-SAT variables indicates no relationship and that these items should be removed. Variables with a small number of correlations >0.3 also should be considered for removal.

^d Off-diagonal values of the anti-image matrices should present values of >0.5. Variables with correlations close to 0.5 or <0.5 should be excluded.

^e Determinant >0.00001 confirms that multicollinearity is not present in data.

Table 3-2. Comparison of the 6-factor solution and 7-factor solution of the Dietary Satisfaction Questionnaire (D-SAT) from a rotated factor analysis with varimax rotation

	6-Factor Solution	7-Factor Solution
Total variance explained	40.3%	43.8%
Composite score vs. Item 7	$r=0.38$ ($p<0.0001$)	$r=0.35$ ($p<0.0001$)
Questions (Q) removed from 45-item D-SAT	<p>Q 16: I limit my choice of restaurants.</p> <p>Q 37: I feel embarrassed if I order specially prepared foods in a restaurant.</p> <p>Q 40: I have to prepare separate meals for my family and myself.</p> <p>Q 12: I have to prepare most of my foods “from scratch”.</p> <p>Q45: I spend a lot of time looking for new ideas for food and meals that fit into my diet.</p>	<p>Q 16: I limit my choice of restaurants.</p> <p>Q 37: I feel embarrassed if I order specially prepared foods in a restaurant.</p> <p>Q 40: I have to prepare separate meals for my family and myself.</p>
Cronbach’s α	0.817	0.808

Table 3-3. Rotated factor matrix correlation analysis for the 6-factor solution

Factors						
	Benefits of Diet	Preoccupation with Diet	Eating Away from Home	Diet Planning	Family Impact	Financial Cost
Question 1	0.339					
Question 2	0.386					
Question 3	0.745					
Question 4	0.812					
Question 5	0.605					
Question 6	0.737					
Question 7	0.574					
Question 8	0.403					
Question 9		0.378				
Question 10		0.787				
Question 11		0.887				
Question 12		0.353				
Question 13		0.684				
Question 14		0.575				
Question 15		0.610				
Question 16		0.343				
Question 17			0.438			
Question 18			0.524			
Question 19			0.448			
Question 20			0.590			
Question 21			0.457			
Question 22			0.565			
Question 23			0.434			
Question 24			0.316			
Question 25				0.368		
Question 26				0.393		
Question 27				0.933		
Question 28				0.872		
Question 29					0.643	
Question 30					0.667	
Question 31					0.765	
Question 32						0.625
Question 33						0.416
Question 34						0.729
Question 35						0.735
Question 36						0.433
Cronbach's α	0.826	0.832	0.712	0.802	0.766	0.719

Factor loadings >0.3 were retained as components of specific factors of dietary satisfaction.

Table 3-4. Rotated factor matrix correlation analysis for the 7-factor solution

Factors							
	Benefits of Diet	Preoccupation with Diet	Eating Away from Home	Diet Planning	Family Impact	Financial Cost	Personal Cost
Question 1	0.340						
Question 2	0.402						
Question 3	0.743						
Question 4	0.805						
Question 5	0.634						
Question 6	0.737						
Question 7	0.577						
Question 8	0.419						
Question 9		0.368					
Question 10		0.796					
Question 11		0.883					
Question 12		0.356					
Question 13		0.677					
Question 14		0.575					
Question 15		0.618					
Question 16		0.356					
Question 17			0.440				
Question 18			0.553				
Question 19			0.474				
Question 20			0.527				
Question 21			0.464				
Question 22			0.579				
Question 23			0.443				
Question 24			0.364				
Question 25				0.632			
Question 26				0.417			
Question 27				0.729			
Question 28				0.743			
Question 29				0.427			
Question 30					0.394		
Question 31					0.744		
Question 32					0.779		
Question 33					0.564		
Question 34						0.615	
Question 35						0.697	
Question 36						0.775	
Question 37							0.911
Question 38							0.755
Cronbach's α	0.826	0.832	0.712	0.719	0.719	0.766	0.937

Factor loadings >0.3 were retained as components of specific factors of dietary satisfaction.

Table 3-5. Comparison of the original 45-item Dietary Satisfaction Questionnaire and the allocated constructs versus the revised 36-item questionnaire (6-factor solution)*

Revised	Original
Benefits of Diet	Healthy Lifestyle
1. I have a lot of energy.	1. I have a lot of energy.
2. I feel good about myself.	2. I feel good about myself.
3. I think that I eat a healthy diet.	3. I think that I eat a healthy diet.
4. I believe that I am reducing my risk for disease by the way that I eat.	4. I believe that I am reducing my risk for disease by the way that I eat.
5. I believe that I am reducing my risk for disease by the way that I exercise.	5. I believe that I am reducing my risk for disease by the way that I exercise.
6. I think that I have a healthy lifestyle.	6. I think that I have a healthy lifestyle.
7. I am satisfied with my current diet.	7. I am satisfied with my current diet.
8. My family encourages me to keep eating the way I am eating now.	8. The way that I currently eat makes me feel guilty.
Preoccupation with Diet	Preoccupation with Food
9. Thoughts of food are always on my mind.	29: Thoughts of food are always on my mind.
10. I think about food between almost every meal.	30: I think about food between almost every meal.
11. I have cravings for some of my favorite foods.	31: I have cravings for some of my favorite foods.
12. I always feel like I want to snack between meals.	32: I always feel like I want to snack between meals.
13. I often feel hungry.	33: I often feel hungry.
14. I feel that my diet controls my life.	34: I feel that my diet controls my life.
15. I feel deprived when I choose to avoid some of my favorite foods.	
16. The way that I currently eat makes me feel guilty.	
Eating Away From Home	Convenience
17. The way that I currently eat prevents me from eating in restaurants frequently.	9: The way I currently eat prevents me from eating in restaurants frequently.
18. When dining out, I can easily choose foods from the menu that fit into my current diet.	10: When dining out, I can easily choose foods from the menu that fit into my current diet.
19. Finding appropriate food choices at restaurants is difficult.	11: Finding appropriate food choices at restaurants is difficult.
20. I have difficulty finding the foods I want when eating out.	12: I have to prepare most of my foods “from scratch”.
21. I find it easy to shop at my grocery store for the kinds of foods I eat.	13: I find eating satisfying.
22. I have plenty of different types of foods to choose from with my current diet.	14: I have difficulty finding the foods I want when eating out.
23. I feel deprived based on what I order when eating in a restaurant.	15: I find it easy to shop at my grocery store for the kinds of foods I eat.
24. I feel self-conscious trying to eat my current diet at social events.	16: I limit my choice of restaurants.
	17: I have plenty of different types of foods to choose from with my current diet.
Diet Planning	Preparation and Planning
25. I spend a lot of time planning my meals.	41: I spend a lot of time planning my meals.

26. I spend a lot of time shopping for food.	42: I spend a lot of time shopping for food.
27. I think preparing food and meals for the way I eat now is time-consuming.	43: I think preparing food and meals for the way I eat now is time-consuming.
28. I think preparing food and meals for the way I eat now requires a lot of effort.	44: I think preparing food and meals for the way I eat now requires a lot of effort.
	45: I spend a lot of time looking for new ideas for food and meals that fit into my current diet.
Family Impact	Family Dynamics
29. I feel that the way I eat now bothers my family.	23: I feel that the way I eat now bothers my family.
30. My family discourages me from eating the way I am eating now.	24: My family encourages me to keep eating the way I am eating now.
31. The way I currently eat causes stress within my family.	25: My family supports my efforts to eat a healthy diet.
	26: I enjoy getting together for holiday meals with family.
	27: My family discourages me from eating the way I am eating now.
	28: The way I currently eat causes stress within my family.
Financial Cost	Cost
32. I feel that I spend a large amount of my budget on the foods that I eat.	18: I feel that I spend a large amount of my budget on the foods that I eat.
33. I think that preparing food and makes for the way I eat now is economical.	19: I think that preparing food and meals for the way I eat now is economical.
34. I think that preparing food and meals for the way I eat now costs a lot of money.	20: I think that preparing food and meals for the way I eat now costs a lot of money.
35. I spend a lot of money on food.	21: I spend a lot of money on food.
36. It is hard for me to afford the kinds of foods that I eat.	22: It is hard for me to afford the kind of foods that I eat.
	Negative Aspects
	35: I feel deprived based on what I order when eating in a restaurant.
	36: I feel self-conscious trying to eat my current diet at social events.
	37: I feel embarrassed if I order specially prepared foods in a restaurant.
	38: My family eats the same foods that I currently eat.
	39: I feel deprived when I choose to avoid some of my favorite foods.
	40: I have to prepare separate meals for my family and myself.

*Original Dietary Satisfaction Questionnaire from Ello-Martin, J. A. (2006). *Reducing Dietary Energy Density for the Treatment of Obesity: the Long-term Effects on Weight Loss, Hunger, and Diet Satisfaction*. (Doctoral dissertation). The Pennsylvania State University, University Park, PA. Revised version based on Ello-Martin (2006) source.

Table 3-6. Comparison of the original 45-item Dietary Satisfaction Questionnaire and the allocated constructs versus the revised 38-item questionnaire (7-factor solution)*

Revised	Original
Benefits of Diet	Healthy Lifestyle
1. I have a lot of energy.	9. I have a lot of energy.
2. I feel good about myself.	10. I feel good about myself.
3. I think that I eat a healthy diet.	11. I think that I eat a healthy diet.
4. I believe that I am reducing my risk for disease by the way that I eat.	12. I believe that I am reducing my risk for disease by the way that I eat.
5. I believe that I am reducing my risk for disease by the way that I exercise.	13. I believe that I am reducing my risk for disease by the way that I exercise.
6. I think that I have a healthy lifestyle.	14. I think that I have a healthy lifestyle.
7. I am satisfied with my current diet.	15. I am satisfied with my current diet.
8. My family encourages me to keep eating the way I am eating now.	16. The way that I currently eat makes me feel guilty.
Preoccupation with Diet	Preoccupation with Food
9. Thoughts of food are always on my mind.	29: Thoughts of food are always on my mind.
10. I think about food between almost every meal.	30: I think about food between almost every meal.
11. I have cravings for some of my favorite foods.	31: I have cravings for some of my favorite foods.
12. I always feel like I want to snack between meals.	32: I always feel like I want to snack between meals.
13. I often feel hungry.	33: I often feel hungry.
14. I feel that my diet controls my life.	34: I feel that my diet controls my life.
15. I feel deprived when I choose to avoid some of my favorite foods.	
16. The way that I currently eat makes me feel guilty.	
Eating Away From Home	Convenience
17. The way that I currently eat prevents me from eating in restaurants frequently.	9: The way I currently eat prevents me from eating in restaurants frequently.
18. When dining out, I can easily choose foods from the menu that fit into my current diet.	10: When dining out, I can easily choose foods from the menu that fit into my current diet.
19. Finding appropriate food choices at restaurants is difficult.	11: Finding appropriate food choices at restaurants is difficult.
20. I have difficulty finding the foods I want when eating out.	12: I have to prepare most of my foods “from scratch”.
21. I find it easy to shop at my grocery store for the kinds of foods I eat.	13: I find eating satisfying.
22. I have plenty of different types of foods to choose from with my current diet.	14: I have difficulty finding the foods I want when eating out.
23. I feel deprived based on what I order when eating in a restaurant.	15: I find it easy to shop at my grocery store for the kinds of foods I eat.
24. I feel self-conscious trying to eat my current diet at social events.	16: I limit my choice of restaurants.
	17: I have plenty of different types of foods to choose from with my current diet.
Financial Cost	Preparation and Planning
25. I feel that I spend a large amount of my budget on the foods that I eat.	41: I spend a lot of time planning my meals.
26. I think that preparing food and meals for the way I	42: I spend a lot of time shopping for food.

eat now is economical.	
27. I think that preparing food and meals for the way I eat not costs a lot of money.	43: I think preparing food and meals for the way I eat now is time-consuming.
28. I spend a lot of money on food.	44: I think preparing food and meals for the way I eat now requires a lot of effort.
29. It is hard for me to afford the kind of foods that I eat.	45: I spend a lot of time looking for new ideas for food and meals that fit into my current diet.
Diet Planning	Family Dynamics
30. I have to prepare most of my foods “from scratch”.	23: I feel that the way I eat now bothers my family.
31. I spend a lot of time planning my meals.	24: My family encourages me to keep eating the way I am eating now.
32. I spend a lot of time shopping for food.	25: My family supports my efforts to eat a healthy diet.
33. I spend a lot of time looking for new ideas for food and meals that fit into my current diet.	26: I enjoy getting together for holiday meals with family.
	27: My family discourages me from eating the way I am eating now.
	28: The way I currently eat causes stress within my family.
Family Impact	Cost
34. I feel that the way I eat now bothers my family.	18: I feel that I spend a large amount of my budget on the foods that I eat.
35. My family discourages me from eating the way I am eating now.	19: I think that preparing food and meals for the way I eat now is economical.
36. The way I currently eat causes stress within my family.	20: I think that preparing food and meals for the way I eat now costs a lot of money.
	21: I spend a lot of money on food.
	22: It is hard for me to afford the kind of foods that I eat.
Personal Cost	Negative Aspects
37. I think preparing food and meals for the way I eat now is time-consuming.	35: I feel deprived based on what I order when eating in a restaurant.
38. I think preparing food and meals for the way I eat now requires a lot of effort.	36: I feel self-conscious trying to eat my current diet at social events.
	37: I feel embarrassed if I order specially prepared foods in a restaurant.
	38: My family eats the same foods that I currently eat.
	39: I feel deprived when I choose to avoid some of my favorite foods.
	40: I have to prepare separate meals for my family and myself.

*Original Dietary Satisfaction Questionnaire from Ello-Martin, J. A. (2006). *Reducing Dietary Energy Density for the Treatment of Obesity: the Long-term Effects on Weight Loss, Hunger, and Diet Satisfaction*. (Doctoral dissertation). The Pennsylvania State University, University Park, PA. Revised version based on Ello-Martin (2006) source.

Figure 3-1. Original 45-item Dietary Satisfaction Questionnaire (D-SAT)*

D-SAT Questionnaire	ID Number _____ Date _____
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EXAMPLE	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
I think that I exercise a lot.	1	2	3	4	5

QUESTIONNAIRE	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
1. I have a lot of energy.	1	2	3	4	5
2. I feel good about myself.	1	2	3	4	5
3. I think that I eat a healthy diet.	1	2	3	4	5
4. I believe that I am reducing my risk for disease by the way that I eat.	1	2	3	4	5
5. I believe that I am reducing my risk for disease by the way that I exercise.	1	2	3	4	5
6. I think that I have a healthy lifestyle.	1	2	3	4	5
7. I am satisfied with my current diet.	1	2	3	4	5
8. The way that I currently eat makes me feel guilty.	1	2	3	4	5
	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
9. The way I currently eat prevents me from eating in restaurants frequently.	1	2	3	4	5
10. When dining out, I can easily choose foods from the menu that fit into my current diet.	1	2	3	4	5

11. Finding appropriate food choices at restaurants is difficult.	1	2	3	4	5
12. I have to prepare most of my foods "from scratch".	1	2	3	4	5
13. I find eating satisfying.	1	2	3	4	5
14. I have difficulty finding the foods I want when eating out.	1	2	3	4	5
15. I find it easy to shop at my grocery store for the kinds of foods I eat.	1	2	3	4	5
16. I limit my choice of restaurants.	1	2	3	4	5
17. I have plenty of different types of foods to choose from with my current diet.	1	2	3	4	5
	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
18. I feel that I spend a large amount of my budget on the foods that I eat.	1	2	3	4	5
19. I think that preparing food and meals for the way I eat now is economical.	1	2	3	4	5
20. I think that preparing food and meals for the way I eat now costs a lot of money.	1	2	3	4	5
21. I spend a lot of money on food.	1	2	3	4	5
22. It is hard for me to afford the kind of foods that I eat.	1	2	3	4	5
	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
23. I feel that the way I eat now bothers my family.	1	2	3	4	5
24. My family encourages me to keep eating the way I am eating now.	1	2	3	4	5

25. My family supports my efforts to eat a healthy diet.	1	2	3	4	5
26. I enjoy getting together for holiday meals with family.	1	2	3	4	5
27. My family discourages me from eating the way I am eating now.	1	2	3	4	5
28. The way I currently eat causes stress within my family.	1	2	3	4	5
	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
29. Thoughts of food are always on my mind.	1	2	3	4	5
30. I think about food between almost every meal.	1	2	3	4	5
31. I have cravings for some of my favorite foods.	1	2	3	4	5
32. I always feel like I want to snack between meals.	1	2	3	4	5
33. I often feel hungry.	1	2	3	4	5
34. I feel that my diet controls my life.	1	2	3	4	5
	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
35. I feel deprived based on what I order when eating in a restaurant.	1	2	3	4	5
36. I feel self-conscious trying to eat my current diet at social events.	1	2	3	4	5
37. I feel embarrassed if I order specially prepared foods in a restaurant.	1	2	3	4	5

38. My family eats the same foods that I currently eat.	1	2	3	4	5
39. I feel deprived when I choose to avoid some of my favorite foods.	1	2	3	4	5
40. I have to prepare separate meals for my family and myself.	1	2	3	4	5
	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
41. I spend a lot of time planning my meals.	1	2	3	4	5
42. I spend a lot of time shopping for food.	1	2	3	4	5
43. I think preparing food and meals for the way I eat now is time-consuming.	1	2	3	4	5
44. I think preparing food and meals for the way I eat now requires a lot of effort.	1	2	3	4	5
45. I spend a lot of time looking for new ideas for food and meals that fit into my current diet.	1	2	3	4	5

Thank you for completing this questionnaire.

*Original Dietary Satisfaction Questionnaire from Ello-Martin, J. A. (2006). *Reducing Dietary Energy Density for the Treatment of Obesity: the Long-term Effects on Weight Loss, Hunger, and Diet Satisfaction*. (Doctoral dissertation). The Pennsylvania State University, University Park, PA.

Figure 3-2. Revised 36-item version of the Dietary Satisfaction Questionnaire (D-SAT)*

D-SAT Questionnaire	ID Number _____ Date _____
----------------------------	-------------------------------

EXAMPLE	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
I think that I exercise a lot.	1	2	3	4	5

QUESTIONNAIRE	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
1. I have a lot of energy.	1	2	3	4	5
2. I feel good about myself.	1	2	3	4	5
3. I think that I eat a healthy diet.	1	2	3	4	5
4. I believe that I am reducing my risk for disease by the way that I eat.	1	2	3	4	5
5. I believe that I am reducing my risk for disease by the way that I exercise.	1	2	3	4	5
6. I think that I have a healthy lifestyle.	1	2	3	4	5
7. I am satisfied with my current diet.	1	2	3	4	5
8. My family encourages me to keep eating the way I am eating now.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
9. Thoughts of food are always on my mind.	1	2	3	4	5
10. I think about food between almost every meal.	1	2	3	4	5
11. I have cravings for some of my favorite foods.	1	2	3	4	5
12. I always feel like I want to snack between meals.	1	2	3	4	5
13. I often feel hungry.	1	2	3	4	5
14. I feel that my diet controls my life.	1	2	3	4	5

15. I feel deprived when I choose to avoid some of my favorite foods.	1	2	3	4	5
16. The way that I currently eat makes me feel guilty.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
17. The way that I currently eat prevents me from eating in restaurants frequently.	1	2	3	4	5
18. When dining out, I can easily choose foods from the menu that fit into my current diet.	1	2	3	4	5
19. Finding appropriate food choices at restaurants is difficult.	1	2	3	4	5
20. I have difficulty finding the foods I want when eating out.	1	2	3	4	5
21. I find it easy to shop at my grocery store for the kinds of foods I eat.	1	2	3	4	5
22. I have plenty of different types of foods to choose from with my current diet.	1	2	3	4	5
23. I feel deprived based on what I order when eating in a restaurant.	1	2	3	4	5
24. I feel self-conscious trying to eat my current diet at social events.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
25. I spend a lot of time planning my meals.	1	2	3	4	5
26. I spend a lot of time shopping for food.	1	2	3	4	5
27. I think preparing food and meals for the way I eat now is time-consuming.	1	2	3	4	5
28. I think preparing food and meals for the way I eat now requires a lot of effort.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
29. I feel that the way I eat now bothers my family.	1	2	3	4	5

30. My family discourages me from eating the way I am eating now.	1	2	3	4	5
31. The way I currently eat causes stress within my family.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
32. I feel that I spend a large amount of my budget on the foods that I eat.	1	2	3	4	5
33. I think that preparing food and meals for the way I eat now is economical.	1	2	3	4	5
34. I think that preparing food and meals for the way I eat now costs a lot of money.	1	2	3	4	5
35. I spend a lot of money on food.	1	2	3	4	5
36. It is hard for me to afford the kinds of foods that I eat.	1	2	3	4	5

*Original Dietary Satisfaction Questionnaire from Ello-Martin, J. A. (2006). *Reducing Dietary Energy Density for the Treatment of Obesity: the Long-term Effects on Weight Loss, Hunger, and Diet Satisfaction*. (Doctoral dissertation). The Pennsylvania State University, University Park, PA. Revised version based on Ello-Martin (2006) source.

Figure 3-3. Revised 38-item version of the Dietary Satisfaction Questionnaire (D-SAT)*

D-SAT Questionnaire	ID Number _____ Date _____
----------------------------	-------------------------------

EXAMPLE	Disagree strongly	Disagree somewhat	Neither disagree nor agree	Agree somewhat	Agree strongly
I think that I exercise a lot.	1	2	3	4	5

Questionnaire	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
1. I have a lot of energy.	1	2	3	4	5
2. I feel good about myself.	1	2	3	4	5
3. I think that I eat a healthy diet.	1	2	3	4	5
4. I believe that I am reducing my risk for disease by the way that I eat.	1	2	3	4	5
5. I believe that I am reducing my risk for disease by the way that I exercise.	1	2	3	4	5
6. I think that I have a healthy lifestyle.	1	2	3	4	5
7. I am satisfied with my current diet.	1	2	3	4	5
8. My family encourages me to keep eating the way I am eating now.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
9. Thoughts of food are always on my mind.	1	2	3	4	5
10. I think about food between almost every meal.	1	2	3	4	5
11. I have cravings for some of my favorite foods.	1	2	3	4	5
12. I always feel like I want to snack between meals.	1	2	3	4	5

13. I often feel hungry.	1	2	3	4	5
14. I feel that my diet controls my life.	1	2	3	4	5
15. I feel deprived when I choose to avoid some of my favorite foods.	1	2	3	4	5
16. The way that I currently eat makes me feel guilty.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
17. The way that I currently eat prevents me from eating in restaurants frequently.	1	2	3	4	5
18. When dining out, I can easily choose foods from the menu that fit into my current diet.	1	2	3	4	5
19. Finding appropriate food choices at restaurants is difficult.	1	2	3	4	5
20. I have difficulty finding the foods I want when eating out.	1	2	3	4	5
21. I find it easy to shop at my grocery store for the kinds of foods I eat.	1	2	3	4	5
22. I have plenty of different types of foods to choose from with my current diet.	1	2	3	4	5
23. I feel deprived based on what I order when eating in a restaurant.	1	2	3	4	5
24. I feel self-conscious trying to eat my current diet at social events.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
25. I feel that I spend a large amount of my budget on the foods that I eat.	1	2	3	4	5
26. I think that preparing food and meals for the way I eat now is economical.	1	2	3	4	5
27. I think that preparing food and meals for the way I eat now costs a lot of money.	1	2	3	4	5
28. I spend a lot of money on food.	1	2	3	4	5
29. It is hard for me to afford the kinds of foods that I eat.	1	2	3	4	5

	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
30. I have to prepare most of my foods “from scratch”.	1	2	3	4	5
31. I spend a lot of time planning my meals.	1	2	3	4	5
32. I spend a lot of time shopping for food.	1	2	3	4	5
33. I spend a lot of time looking for new ideas for food and meals that fit into my current diet.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
34. I feel that the way I eat now bothers my family.	1	2	3	4	5
35. My family discourages me from eating the way I am eating now.	1	2	3	4	5
36. The way I currently eat causes stress within my family.	1	2	3	4	5
	Strongly Disagree	Disagree Somewhat	Neither disagree nor agree	Agree somewhat	Strongly Agree
37. I think preparing food and meals for the way I eat now is time-consuming.	1	2	3	4	5
38. I think preparing food and meals for the way I eat now requires a lot of effort.	1	2	3	4	5

*Original Dietary Satisfaction Questionnaire from Ello-Martin, J. A. (2006). *Reducing Dietary Energy Density for the Treatment of Obesity: the Long-term Effects on Weight Loss, Hunger, and Diet Satisfaction*. (Doctoral dissertation). The Pennsylvania State University, University Park, PA. Revised version based on Ello-Martin (2006) source.

Chapter 4

Dietary Satisfaction as a Predictor of Weight Loss: An Exploratory Analysis

ABSTRACT

Internal and external factors play meaningful roles in weight-loss success. Overall satisfaction with a dietary intervention for weight loss represents these internal and external factors, and responses may be positive, neutral or negative. To explore the relationship between dietary satisfaction and body mass, two versions of a dietary satisfaction questionnaire (D-SAT; 6-factor and 7-factor) were evaluated in a secondary data analysis of 68 premenopausal women with overweight/obesity who engaged in 12 weeks of weight loss followed by 12 weeks of weight-loss maintenance. D-SAT score significantly decreased, remained unchanged or significantly increased from baseline to week 2, representing negative, neutral and positive responses to dietary intervention, respectively. Based on these 3 groups, relationships between D-SAT and body weight (BW) and body mass index (BMI) changes were explored, using Pearson's correlation and 4 x 3 (time x group) ANOVA with repeated measures on the time factor. A significant bivariate relationship between D-SAT (6-factor or 7-factor) and BW and BMI change was not found at any time interval. For the 6-factor D-SAT, there was a main effect of time on BW [$F(1.262,82.02)=125.722, p<0.001$] and BMI [$F(1.305,123.95)=127.808, p<0.001$], but there was not a significant main effect of group or time x group interaction for BW or BMI. For the 7-factor D-SAT, there was a main

effect of time on BW [$F(1.243, 82.82) = 124.949, p < 0.001$] and BMI [$F(1.284, 83.43) = 127.463, p < 0.001$], but there was not a significant main effect of group or time x group interaction for BW or BMI. Based on this secondary analysis of data, negative, neutral or positive change in the 6-factor or 7-factor D-SAT was not related to change in BW or BMI. Exploration should continue to refine the D-SAT and its relationship to body mass outcomes due to dietary interventions.

INTRODUCTION

Although short-term weight loss can be achieved, long-term weight-loss success in individuals has been minimal due to low adherence to dietary modifications.¹ With high attrition rates in weight-loss interventions, analyses of facilitators and barriers to adherence have been conducted.²⁻²² An individual's level of adherence to a dietary intervention may reflect a similar level of satisfaction with the particular dietary changes. In the case of high adherence, an individual may be more willing to follow the intervention, and therefore must be satisfied, to some extent, with the prescribed modifications. Had that individual not been satisfied, adherence would not have been maintained for an extended period of time, which would have likely resulted in minimal weight loss. A literature review was conducted (Chapter 2) to determine common facilitators and barriers to dietary adherence. Time,²⁻¹⁵ cost,^{3-6,9-16} self-control,^{2,3,5,7-11,13-18} family and friend support⁴⁻²² and accessibility or availability of foods,^{3,5,9-13} among other variables, have been identified as factors influencing long-term dietary compliance. Although not explicitly stated, studies that aimed to determine factors influencing adherence may have defined underlying dimensions of dietary satisfaction.

Fundamentally, dietary satisfaction may be comprised of such factors, many of which may be manipulated to improve adherence and maximize weight loss.

Until 2004²³ a measurement tool for dietary satisfaction specific to dietary interventions for weight loss did not exist. The dietary satisfaction questionnaire (D-SAT) was created and tested;²⁴ however, its use has been limited. The 45-item D-SAT²⁴ was recently analyzed, using factor analysis to confirm its internal validity. Two versions of the questionnaire were found acceptable: 6-factor D-SAT (36 items) and 7-factor D-SAT (38 items). Factors of dietary satisfaction included “Benefits of diet,” “Preoccupation with diet,” “Eating away from home,” “Diet planning,” “Family Impact,” and “Financial cost” (6-factor D-SAT) as well as “Personal cost” (7-factor D-SAT) (Chapter 3). Using the D-SAT tool, dietary satisfaction can be operationalized which may be useful for improving adherence and weight loss over short- and long-term intervals.

The aim of the current secondary analysis of data was to utilize the 6-factor and 7-factor D-SAT to explore the relationship between immediate change in D-SAT (i.e., baseline to week 2) and body mass changes during a 24-week study. It was hypothesized that there would be a significant positive association between D-SAT score and body mass change, specifically for body weight (BW) and body mass index (BMI).

PARTICIPANTS AND METHODS

Study Design and Participants

This study was an exploratory analysis of data previously collected during a 24-week weight-loss intervention conducted in premenopausal women with overweight/obesity. The original intervention aimed to induce 1-2 pounds of BW loss per week in participants through the utilization of a meal replacement strategy compared to a

standard energy-restricted diet. Twelve weeks of weight loss were followed by 12 weeks of weight-loss maintenance. A complete description of methods included in the primary study is published elsewhere.²⁵

Briefly, the primary study was conducted in women, ages 20-45 y, who were overweight or obese ($\text{BMI} \geq 25$ to $\leq 43 \text{ kg/m}^2$) and without other chronic disease. These women were not taking any prescription medications. Women were included if reporting normal menstrual cycles, less than 2 hours of physical activity per week, stable BW over the past 6 months, interest in losing BW, intake of <24 oz of yogurt, <16 oz of caffeinated beverages and <1 alcoholic beverage per day, and absence of an allergy, aversion, or intolerance to yogurt.²⁵

The primary study including data evaluated in the current study was approved by the Institutional Review Board for Research Involving Human Subjects at the Pennsylvania State University (University Park, PA, USA). All participants provided written informed consent before completing any primary study procedure.

Dietary Satisfaction Questionnaire (D-SAT)

Women completed paper-and-pencil versions of the 45-item D-SAT at baseline and at weeks 2, 12 and 24 of the intervention. Based on factor analysis (Chapter 3), the 6-factor (36 item) and 7-factor (38 item) D-SAT versions were used in the current study.

Body Mass Measurements

Standing height was measured to the nearest 0.1 cm, using a stadiometer (Seca 700, Seca North America East, Hanover, MD), and BW was measured to the nearest 0.1 kg, using a calibrated balance-beam scale (Seca 700). Height and BW were used to calculate BMI (kg/m^2).

Statistical Analyses

Data were removed from analyses, if participants did not have responses for all items of the D-SAT or if they were missing BW or BMI values at any interval. Data from 68 participants were retained in the current analyses. Data were evaluated for normality. A histogram and Q-Q plot were used to evaluate the frequency distribution of baseline BW, BMI and D-SAT. Independent *t*-tests were conducted to test differences between comparative groups (meal replacement vs. standard energy-restricted diet groups) as established by the primary study.

The goal of this study was to observe whether an immediate change in D-SAT score (baseline to week 2) would be related to BW loss over the 24-week intervention. Therefore, a variable (GroupD-SAT) was created by computing the difference between D-SAT score at week 2 minus D-SAT score at baseline for each participant. The frequency distribution of change values was used to group scores based on negative, neutral and positive D-SAT score change from week 2 to baseline. The negative group was defined as a change of 0.0 points or more in a negative direction, neutral was defined as a change of +0.1 to +10.0 points and positive was defined as a change of 10.1 or more points in a positive direction. Groups were chosen to represent a decrease (negative), no change (neutral) or increase (positive) in dietary satisfaction. These groups were applied to the 6-factor and 7-factor D-SAT.

Pearson's correlation analyses were conducted to observe the relationship between D-SAT group (negative, neutral, positive) and BW change from baseline to week 2, baseline to week 12, baseline to week 24 and week 12 to 24. The same analyses

were conducted between D-SAT group and BMI. Separate analyses were conducted for the 6-factor and 7-factor D-SAT.

A 4 x 3 (time x group) repeated measures ANOVA with repeated measures on the time factor was used to evaluate the relationship of D-SAT group with BW and separately with BMI changes over time. Separate ANOVA analyses were conducted with the 6-factor and 7-factor D-SAT. Mauchly's test of sphericity was completed,²⁶ and Greenhouse-Geisser correction values were used as needed. Prior to observation of the output, residual values of the dependent variable (BW, BMI) were saved in the model and computed in a scatterplot, histogram and Q-Q plot to confirm the validity of the model and to confirm that the assumptions of homoscedasticity, symmetry of the error terms and normality of the error terms had been met.

RESULTS

Analysis of a histogram and Q-Q plot on baseline BW, BMI and D-SAT score confirmed that data were normally distributed. Independent *t*-tests conducted on comparative groups, established in the primary study, showed no significant differences between groups; therefore, data from participants were combined for the current analysis. Participants (n=68) were separated into groups based on D-SAT change score from week 2 to baseline.

6-Factor D-SAT Results

Baseline age, height, BW, BMI and D-SAT score and week 2 BW, BMI and D-SAT score of all participants and by D-SAT group are displayed in Table 4-1. Separation of participants into groups based on D-SAT change score from week 2 to baseline

resulted in 3 groups: negative (n=24), neutral (n=21) and positive (n=23). At baseline, there were no significant differences in BW, BMI and D-SAT among these 3 groups.

D-SAT score significantly differed between baseline and week 2 [$F(1,65)=45.74$, $p<0.001$] for the total sample. When stratified by D-SAT group, the negative and positive D-SAT groups were significantly different (mean difference=-9.715, $p<0.05$). Results of one-tailed bivariate correlations are presented in Table 4-2. There were no significant associations between D-SAT group and BW or BMI at any interval.

Mauchly's test of sphericity was violated [$\chi^2(5)$, $p<0.05$]. Therefore, Greenhouse-Geisser ($\epsilon=0.421$) values were observed for the within-subjects effects. Using this correction factor, there was a main effect of time [$F(1.262,82.02)=125.722$, $p<0.001$] on BW change. Approximately 66% of the variability in BW change was explained by the time effect. A significant difference in BW was found between baseline and week 2 [$F(1,65)=444.837$, $p<0.001$] and week 2 and week 12 [$F(1,65)=126.151$, $p<0.001$] but not between week 12 and week 24 [$F(1,65)=1.940$, $p=0.17$]. The significant main effect of time was confirmed with Pillai's trace value of the multivariate test [$V=0.873$, $F(3,63)=144.805$, $p<0.001$]. Levene's test of equality of error variance indicated that all repeated measure values were homogeneous; therefore, between-subjects effects were evaluated.²⁶ A main effect of group on BW was not found. Moreover, a significant time x group interaction was not observed for BW.

Mauchly's test of sphericity was violated [$\chi^2(5)$, $p<0.05$]; therefore, Greenhouse-Geisser ($\epsilon=0.435$) values were observed for within-subjects effects. There was a main effect of time [$F(1.305,123.95)=127.808$, $p<0.001$] on BMI change. Approximately 66%

of the variability in BMI change was explained by the time effect. A significant difference in BMI was found between baseline and week 2 [$F(1,65)=443.391, p<0.001$] and week 2 and week 12 [$F(1,65)=126.823, p<0.001$] but not between week 12 and week 24 [$F(1,65)=2.666, p=0.11$]. The significant main effect of time was confirmed with Pillai's trace value [$V=0.874, F(3,63)=145.296, p<0.001$]. Levene's test of equality of error variance indicated that variances for each level of repeated measures were homogenous; therefore, between-subjects effects were evaluated. A main effect of group on BMI was not found. Moreover, a significant time x group interaction was not found for BMI.

7-Factor D-SAT Results

Baseline age, height, BW, BMI and D-SAT score and week 2 BW, BMI and D-SAT score of all participants and by D-SAT group are displayed in Table 4-3. Separation of participants into groups based on D-SAT change score from week 2 to baseline resulted in 3 groups: negative ($n=26$), neutral ($n=22$) and positive ($n=20$). At baseline, there were no significant differences in BW, BMI and D-SAT among these 3 groups.

D-SAT score significantly differed between baseline and week 2 [$F(1,65)=35.092, p<0.001$] for the total sample. When stratified by D-SAT group, the negative and positive D-SAT groups were significantly different (mean difference= $-11.925, p<0.01$). Results of one-tailed bivariate correlations are found in Table 4-4. There were no significant correlations between D-SAT group and BW or BMI at any interval.

Mauchly's test of sphericity was violated [$\chi^2(5), p<0.05$]. Therefore, Greenhouse-Geisser ($\epsilon=0.414$) values were observed for the within-subjects effects. With correction,

there was a main effect of time [$F(1.243,80.82)=124.949, p<0.001$] on BW change.

Nearly 66% of the variance in BW was explained by the time effect. A significant difference in BW was found between baseline and week 2 [$F(1,65)=447.231, p<0.001$] and week 2 and week 12 [$F(1,65)=124.179, p<0.001$] but not between week 12 and week 24 [$F(1,65)=2.508, p=0.12$]. The significant main effect of time was confirmed with Pillai's trace value [$V=0.874, F(3,63)=145.753, p<0.001$]. Levene's test of equality of error variance indicated that repeated measure values were homogeneous; therefore, between-subjects effects were evaluated. A main effect of group on BW was not found, and a significant time x group interaction was not found for BW.

Mauchly's test of sphericity was violated [$\chi^2(5), p<0.05$]; therefore, Greenhouse-Geisser values were evaluated ($\epsilon=0.428$). There was a significant main effect of time [$F(1.284,83.43)=127.463, p<0.001$] on BMI change. Sixty-six percent of the variability in BMI change was explained by the time effect. A significant difference in BMI was found between baseline and week 2 [$F(1,65)=447.028, p<0.001$] and week 2 and week 12 [$F(1,65)=125.450, p<0.001$] but not between week 12 and week 24 [$F(1,65)=3.387, p=0.07$]. Pillai's trace value confirmed the significant main effect of time on BMI [$V=0.874, F(3,63)=145.990, p<0.001$]. Levene's test of equality of error variance was not significant for any time point; therefore, between-subjects effects were evaluated. A main effect of group on BMI was not found. Moreover, a significant time x group interaction was not found for BMI.

DISCUSSION

An exploratory secondary data analysis was conducted to observe if an immediate change in D-SAT score, whether negative, neutral or positive, was related to BW loss and BMI reduction over a 24-week intervention that included 12 weeks of weight loss followed by 12 weeks of weight-loss maintenance. A negative, neutral or positive change in the 6-factor D-SAT or 7-factor D-SAT was not related to change in BW or BMI. While there was a significant main effect of time on BW and BMI for both the 6-factor D-SAT and 7-factor D-SAT, immediate change in D-SAT score from week 2 to baseline was not related to BW or BMI change at any interval in premenopausal women, ages 20-45 y, who were overweight or obese. The interval between week 2 and baseline in the primary intervention was a jumpstart phase, designed to induce rapid weight loss through significant energy restriction. For both the 6-factor and 7-factor D-SAT, composite score significantly changed for all 68 women and between those women reporting a negative and positive change in D-SAT. Yet, this change did not relate to BW or BMI change over time.

Individuals who have agreed to participate in a weight-loss intervention have already made the commitment to modify their habitual diets.²⁷ It is possible, that women in the current analysis were dedicated to BW loss and that dietary satisfaction was unrelated to the decision to adhere to the intervention. When individuals enter a dieting frame of mind, various factors that may contribute to dietary satisfaction may not be particularly influential as weight-loss is achieved.⁶ D-SAT score decreased, did not change, or increased from baseline to week 2 in women, suggesting that dietary

satisfaction is broader than perceived improvement in health, preoccupation with diet (i.e., excessive thoughts about food or cravings), financial and personal costs (i.e., time and effort), eating away from home and social and family support. Although these dimensions are critical to adherence to a diet and can be considered pieces of the dietary satisfaction definition, these factors may not fully capture gratification, contentment or liking of a diet. Moreover, self-perceived and self-rated response to dietary satisfaction is subjective.

Results of the current study are inconsistent with previous findings.^{24,28} When using the original 45-item D-SAT, women enrolled in an intervention that included reduced fat or reduced fat plus fruits and vegetables increased D-SAT score from baseline to the end of study. There were no differences in D-SAT score between intervention groups at baseline and 3, 6, and 12 months of the intervention.²⁴ Rolls and colleagues,²⁸ found that increase in satisfaction was associated with weight loss in men and women. While all participants lost weight, individuals that were in the low-energy density soup groups compared to a higher energy density dry snack food group reported greater fullness and lesser hunger and lost more weight.²⁸ Dietary satisfaction may be moderated by eating behaviors and/or hunger cues.

As a secondary analysis of data, the scope of this evaluation was limited. This analysis was conducted to observe a short, specific time frame over which dietary satisfaction changed. This study focused on a very narrow portion of the population, and therefore, results of this study may not be generalizable to other populations. Specifically, an analysis conducted in men, more diversity in race/ethnicity or wider age ranges would be beneficial for observing the external validity of the D-SAT and its association with

weight loss. Individual factors of the D-SAT were not further explored, since findings by D-SAT group were not significant. Future studies should consider expanding the time frame over which dietary satisfaction is observed and how individual factors of the D-SAT relate to BW and BMI changes. Further, change in D-SAT score as a continuous variable should be evaluated in future studies.²⁹

In conclusion, an exploratory repeated measures ANOVA with repeated measures on the time factor was conducted to determine if an immediate change in dietary satisfaction within the first 2 weeks of a weight-loss intervention would be related to BW and BMI change during 12 weeks of weight loss followed by 12 weeks of weight-loss maintenance. In this very specific population of premenopausal women, it is concluded that dietary satisfaction within this timeframe is not related to weight loss. Although the null hypothesis was not rejected in this study, other studies have been conducted that confirmed that a change in dietary satisfaction can predict weight-loss in men and women. It is imperative that the D-SAT be analyzed in a more diverse population in order to determine its use as a predictor of maximal weight-loss.

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Table 4-1. Age, height, body weight, body mass index, and dietary satisfaction score (6-factor) at baseline and week 2 in premenopausal women with overweight/obesity

Variable	D-SAT Group	Baseline (Mean \pm SD)	Week 2 (Mean \pm SD)	<i>p</i> -value
Age (y)	(-)	32.9 \pm 7.3	–	NA
	(ϕ)	35.4 \pm 7.6	–	NA
	(+)	37.2 \pm 6.6	–	NA
	Total	35.1 \pm 7.3	–	NA
Height (cm)	(-)	165.5 \pm 5.5	–	NA
	(ϕ)	165.3 \pm 6.2	–	NA
	(+)	165.7 \pm 5.5	–	NA
	Total	165.5 \pm 5.7	–	NA
BW (kg)	(-)	80.6 \pm 8.2	78.2 \pm 8.2	NS (group)
	(ϕ)	83.0 \pm 11.9	80.6 \pm 11.7	NS (group)
	(+)	83.3 \pm 10.4	80.9 \pm 10.3	NS (group)
	Total	82.2 \pm 10.1	79.9 \pm 10.00	<0.001 (time)
BMI (kg/m ²)	(-)	29.4 \pm 2.6	28.5 \pm 2.6	NS (group)
	(ϕ)	30.3 \pm 3.2	29.4 \pm 3.2	NS (group)
	(+)	30.3 \pm 3.3	29.5 \pm 3.0	NS (group)
	Total	30.0 \pm 3.0	29.1 \pm 3.0	<0.001 (time)
D-SAT (score)	(-)	117.4 \pm 11.0	108.0 \pm 11.2	NS (group)
	(ϕ)	110.6 \pm 12.7	116.0 \pm 14.2	NS (group)
	(+)	109.0 \pm 11.9	131.4 \pm 12.1	NS (group)
	Total	112.5 \pm 12.3	118.4 \pm 15.8	<0.001 (time)

D-SAT=dietary satisfaction questionnaire (6-factor); NA=not applicable; BW=body weight; NS=not significant; BMI=body mass index.

D-SAT group based on negative (-) (0.0 or -), neutral (ϕ) (+0.1 to +10.0 points) or positive (+) (+10.1 or higher) change in D-SAT score from baseline to week 2; (-), n=24; (ϕ), n=21; (+), n=23; Total, n=68.

Table 4-2. Pearson's correlation between dietary satisfaction (6-factor) group and body weight and body mass index over time in premenopausal women with overweight/obesity

D-SAT Group	Baseline to Week 2	Baseline to Week 12	Baseline to Week 24	Week 12 to Week 24
	Body Weight Change			
(-), n=24	0.12	0.25	0.20	-0.02
(ϕ), n=21	0.13	-0.21	-0.13	0.01
(+), n=23	0.01	-0.08	0.01	0.11
	Body Mass Index Change			
(-), n=24	0.08	0.21	0.15	-0.03
(ϕ), n=21	0.16	-0.23	-0.15	-0.01
(+), n=23	0.02	-0.08	0.08	0.23

D-SAT=dietary satisfaction questionnaire (6-factor); D-SAT group based on negative (-) (0.0 or lower), neutral (ϕ) (+0.1 to +10.0 points) or positive (+) (+10.1 or higher) change in D-SAT score from baseline to week 2. D-SAT group was not significantly related to any body weight or body mass index change variable.

Table 4-3. Age, height, body weight, body mass index, and dietary satisfaction score (7-factor) at baseline and week 2 in premenopausal women with overweight/obesity

Variable	D-SAT Group	Baseline (Mean \pm SD)	Week 2 (Mean \pm SD)	<i>p</i> -value
Age (y)	(-)	33.5 \pm 6.6	–	NA
	(ϕ)	35.7 \pm 8.4	–	NA
	(+)	36.6 \pm 6.8	–	NA
	Total	35.1 \pm 7.3	–	NA
Height (cm)	(-)	165.6 \pm 5.7	–	NA
	(ϕ)	165.5 \pm 6.6	–	NA
	(+)	165.5 \pm 4.7	–	NA
	Total	165.5 \pm 5.7	–	NA
BW (kg)	(-)	81.2 \pm 8.9	78.7 \pm 8.9	NS (group)
	(ϕ)	81.7 \pm 11.2	79.5 \pm 10.9	NS (group)
	(+)	84.1 \pm 10.6	81.8 \pm 10.5	NS (group)
	Total	82.2 \pm 10.1	79.9 \pm 10.0	<0.001 (time)
BMI (kg/m ²)	(-)	29.6 \pm 2.6	28.7 \pm 2.7	NS (group)
	(ϕ)	29.8 \pm 3.1	29.0 \pm 3.1	NS (group)
	(+)	30.7 \pm 3.4	29.8 \pm 3.4	NS (group)
	Total	30.0 \pm 3.0	29.1 \pm 3.0	<0.001 (time)
D-SAT (score)	(-)	122.8 \pm 12.6	111.9 \pm 11.8	NS (group)
	(ϕ)	119.1 \pm 12.4	123.9 \pm 12.9	NS (group)
	(+)	115.3 \pm 12.3	138.1 \pm 12.4	NS (group)
	Total	119.4 \pm 12.7	123.5 \pm 16.2	<0.001 (time)

D-SAT=dietary satisfaction questionnaire (7-factor); NA=not applicable; BW=body weight; NS=not significant; BMI=body mass index.

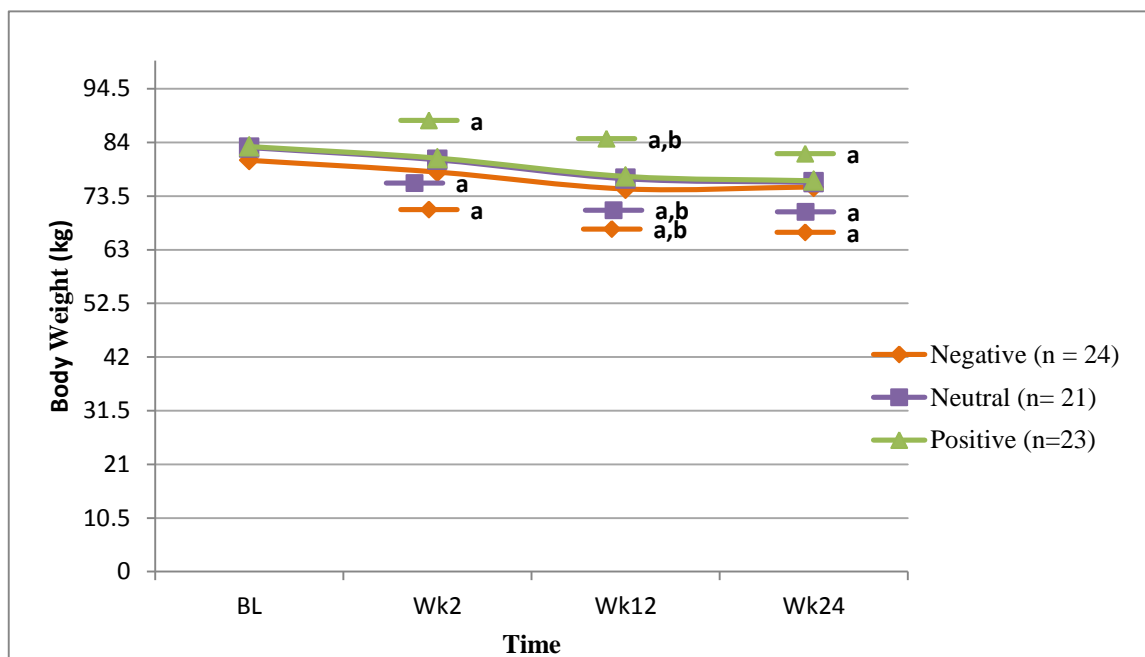
D-SAT group based on negative (-) (0.0 or -), neutral (ϕ) (+0.1 to +10.0 points) or positive (+) (+10.1 or higher) change in D-SAT score from baseline to week 2; (-), n=26; (ϕ), n=22; (+), n=20; Total, n=68.

Table 4-4. Pearson's correlation between dietary satisfaction (7-factor) group and body weight and body mass index over time in premenopausal women with overweight/obesity

D-SAT Group	Baseline to Week 2	Baseline to Week 12	Baseline to Week 24	Week 12 to Week 24
Body Weight Change				
(-), n=26	-0.13	0.11	0.11	0.04
(ϕ), n=22	0.01	-0.12	0.01	0.21
(+), n=20	0.06	-0.02	0.06	0.14
Body Mass Index Change				
(-), n=26	-0.15	0.09	0.08	0.04
(ϕ), n=22	0.02	-0.12	0.11	0.36
(+), n=20	0.07	-0.01	0.06	0.12

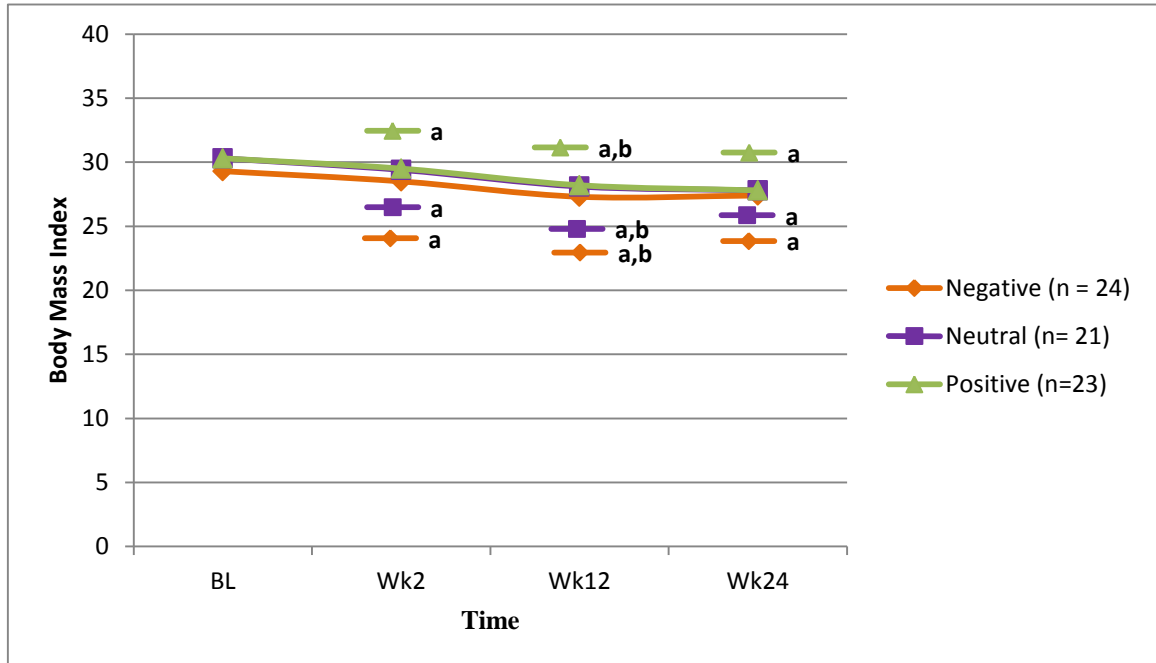
D-SAT=dietary satisfaction questionnaire (7-factor); D-SAT group based on negative (-) (0.0 or lower), neutral (ϕ) (+0.1 to +10.0 points) or positive (+) (+10.1 or higher) change in D-SAT score from baseline to week 2. D-SAT group was not significantly related to any body weight or body mass index change variable.

Figure 4-1. Change in body weight over time and by dietary satisfaction (6-factor) group in premenopausal women with overweight/obesity



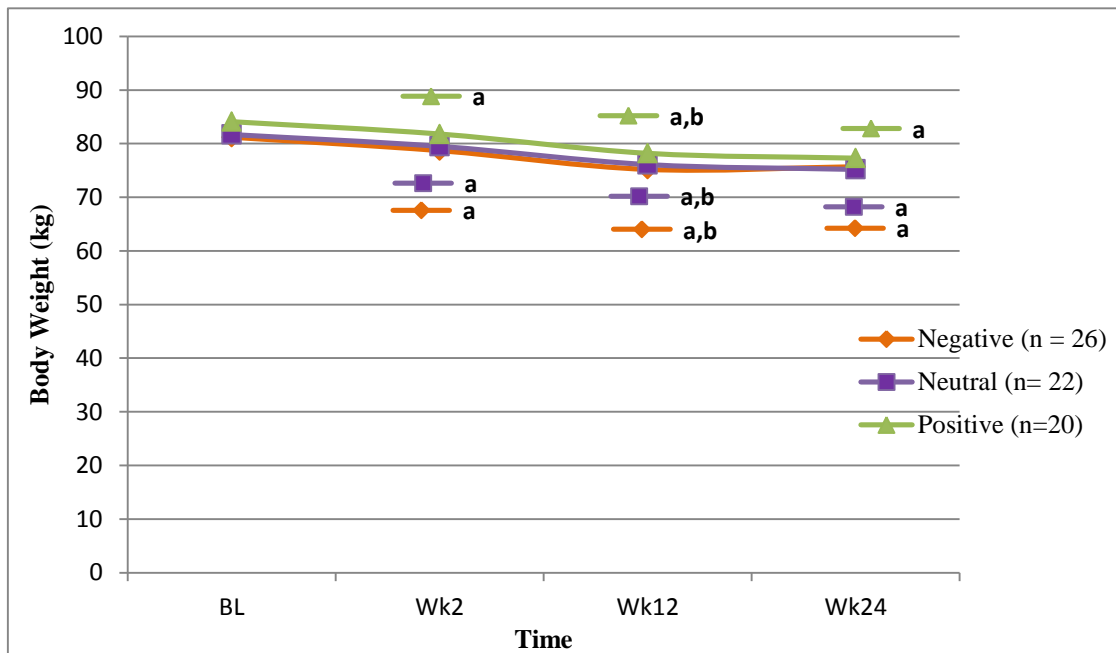
^a $p < 0.001$ for time effect from baseline; ^b $p < 0.001$ for time effect from week 2; group effect and time x group interaction were not significantly different, based on repeated measures ANOVA with repeated measures on the time factor.

Figure 4-2. Change in body mass index over time and by dietary satisfaction (6-factor) group in premenopausal women with overweight/obesity



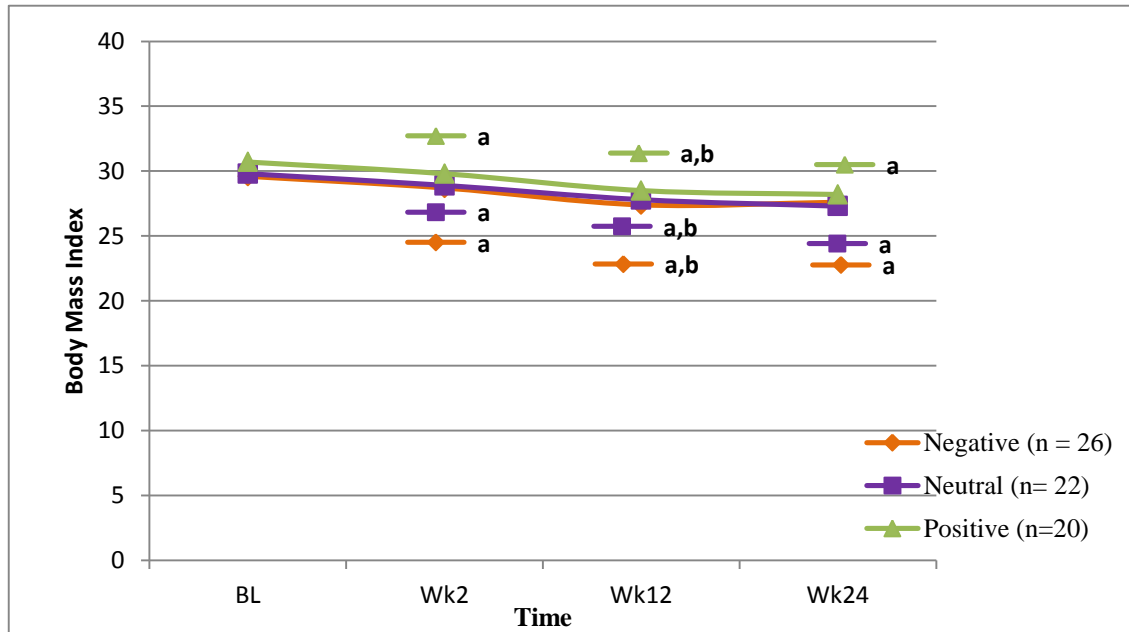
^a $p < 0.001$ for time effect from baseline; ^b $p < 0.001$ for time effect from week 2; group effect and time x group interaction were not significantly different, based on repeated measures ANOVA with repeated measures on the time factor.

Figure 4-3. Change in body weight over time and by dietary satisfaction (7-factor) group in premenopausal women with overweight/obesity



^a $p < 0.001$ for time effect from baseline; ^b $p < 0.001$ for time effect from week 2; group effect and time x group interaction were not significantly different, based on repeated measures ANOVA with repeated measures on the time factor

Figure 4-4. Change in body mass index over time and by dietary satisfaction (7-factor) group in premenopausal women with overweight/obesity



^a $p < 0.001$ for time effect from baseline; ^b $p < 0.001$ for time effect from week 2; group effect and time x group interaction were not significantly different, based on repeated measures ANOVA with repeated measures on the time factor.

Chapter 5

Conclusion

When considering the factors that influence adherence to a weight-loss intervention or to adopting a healthier lifestyle, it seems intuitive that satisfaction with the modifications would lead to short- and long-term adherence. However, the notion of satisfaction is complex and not easily defined. Through a literature review, it was concluded with limited confidence, based on quality criteria and the limited number of studies with optimal study designs, that dietary satisfaction can be defined in terms of the barriers and facilitators to adherence. Individuals frequently identified financial costs, time, social situations, family, friend and children support, motivation, self-control or willpower, availability and accessibility to foods and self-discipline as barriers to following a dietary pattern that was modified from their habitual routines. Not only can the aforementioned external factors play a significant role but individual psychological parameters should be considered when implementing an intervention. A 45-item dietary satisfaction questionnaire (D-SAT) was created in 2004 as a means of gauging both internal and external factors of satisfaction within a dietary intervention in overweight or obese, yet otherwise healthy adults.^{1,2} Two modified versions of this questionnaire were proposed after a factor analysis was conducted — a 36-item (6-factor) and 38-item (7-factor) questionnaire. The underlying dimensions of the 6-factor and 7-factor D-SAT were labeled: “Benefits of diet,” “Preoccupation with diet,” “Eating away from home,”

“Diet planning,” “Family impact,” and “Financial cost” (6-factor D-SAT) along with “Personal cost” (7-factor D-SAT).

Both the 6-factor D-SAT and 7-factor D-SAT were then utilized in an exploratory analysis to evaluate the relationship between body weight (BW) and body mass index (BMI) and change in D-SAT score within the first 2 weeks of a weight-loss intervention in premenopausal women living with overweight or obesity. Within this particular population, an immediate change in D-SAT score did not have a significant main effect on BW or BMI. Time, however, was shown to have a significant main effect on BW and BMI. Further, there were no significant correlations between D-SAT score and BW change at any point in the intervention. Results indicate that the BW loss observed in women specific to this intervention was not associated with D-SAT.

Individuals may partake in weight-loss interventions for numerous reasons which may impact their desire to adhere to that diet. Recently the notion of “readiness to change” was deemed a myth.³ More specifically, it was suggested that individuals who enroll in a dietary intervention are minimally ready to modify their lifestyles to lose weight.³ While individuals who join a weight-loss intervention may initially believe that they are prepared to follow the regimen, personal internal or external influences may be presented throughout the dietary intervention that were not initially expected, resulting in a change in satisfaction with that diet. The majority of these factors may be captured in the D-SAT; however, perceived enjoyment or gratification from the diet may be one aspect of satisfaction that may not be represented. This dimension of satisfaction with a diet may be a critical predictor of long-term weight-loss success, and therefore, questions regarding this notion should be considered as additions to the D-SAT.

The D-SAT has not been widely used in weight-loss interventions. Additional studies should be conducted which utilize this tool in order to refine the D-SAT. Specific factors may best capture dietary satisfaction as a whole, which may better predict individual weight-loss outcomes. Studies also should consider using a diverse population such as high or low socioeconomic status, race, ethnicity, sex, and age to evaluate the generalizability of the D-SAT. Literature has revealed that individual differences play a substantial role in the perceived and actual facilitators and barriers to weight-loss success.⁴⁻²² Further, the questionnaire should be utilized in various weight-loss interventions in order to confirm the external validity of the tool in all intervention types.

Satisfaction is not a construct that can be easily defined, interpreted, or observed, particularly within a dietary intervention. Numerous personal factors can contribute to determining a level of satisfaction with a dietary regimen and resulting adherence. It appears, however, that internal factors, such as feelings of contentment, or pleasure with a diet may be a critical piece to dietary satisfaction as a whole, although this should be confirmed with additional testing of the D-SAT. Reporting of successful long-term weight-loss and weight-loss maintenance is minimal, and has been contributed to low-adherence to dietary interventions. Although satisfaction with a diet may intuitively be an explanation for adherence or non-adherence as a predictor of weight loss, results have not been conclusive. Therefore, dietary satisfaction and its underlying constructs should be further explored to determine its role in short- and long-term weight-loss outcomes.

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