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Motivations to Eat as a Predictor of Weight Status and Dietary Intake in Low-income, Minority Women in Early Postpartum

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by

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Dedication

This dissertation is dedicated to all of those who granted me the patience and support necessary to complete this work, especially my husband, Rocky.

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The purpose of this research was to develop, validate, and test an instrument to evaluate motivations to eat in low-income women during the early postpartum period. The instrument was also used in a sample of young college women to further validate the measure and explore determinants of eating in this population. In study 1, the Eating Stimulus Index was validated in 179 low-income women in early postpartum. Validity and reliability were determined via principal components analysis, internal consistency reliability, and test-retest reliability using a subgroup of 31 low-income new mothers. The factor analysis produced an eight factor structure with reliability coefficients ranging from 0.54-0.89. Convenience eating ($r=-0.25$, $P<0.01$), emotional eating ($r=-0.17$, $P<0.05$), and dietary restraint ($r=-0.21$, $P<0.01$) were significantly related to weight status. In study 2, the relationship between eating motivations and diet quality, determined via the Dietary Guidelines Adherence Index, was established in 115 low-

income women in early postpartum. High diet quality was related to fruit and vegetable availability ($r=0.25$, $P<0.01$), convenience eating resistance ($r=-0.36$, $P<0.001$), and vegetable taste preference ($r=0.23$, $P<0.05$). Motivations to eat differed between overweight and obese women with the primary motivation being convenience eating and taste, respectively. In study 3, determinants of weight loss were examined in 58 low-income women in early postpartum participating in an 8-week weight loss intervention. Participants were evaluated at pre- and post-study for all measures. Factors related to weight loss included increases in dietary restraint, weight management skills, and weight loss self-efficacy and decreases in fruit juice servings, total energy, and discretionary energy intakes. After hierarchical regression analysis, improvement in weight loss self-efficacy was the most significant determinant ($\beta=0.263$, $P<0.05$) followed by decreases in discretionary energy intake ($\beta=-0.241$, $P<0.05$). In study 4, determinants of diet quality were assessed in a sample of 88 young college women using the Eating Stimulus Index. Low diet quality was associated with poor fruit and vegetable availability, convenience eating resistance, vegetable taste preference, and weight management self-efficacy, while high diet quality was related to increased frequency of meals prepared at home and decreased frequency of meals consumed at fast food restaurants.

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Chapter 1: Review of Literature

In the United States, approximately 33.3% of men and 35.3% of women are obese (176). Since the 1960s, the incidence of overweight/obesity has risen almost 20% (177). This dramatic increase is of particular concern due to the high economic burden and cost of human life. Expenses attributable to obesity are estimated to exceed $100 billion annually (199). More significantly, obesity is the cause of over 100,000 excess deaths due to heart disease, diabetes, kidney disease, and cancers, such as colon, breast, esophageal, uterine, ovarian, kidney, and pancreatic (66). Those at highest risk for obesity include low-income minorities, particularly Mexican American (51%) and African American women (53%) (176). In minority women, the weight gain associated with pregnancy and retention after childbirth may contribute to this high incidence (244).

Pregnancy and the first year postpartum are critical periods that may influence weight status later in life. For example, the risk of becoming obese increases 60-110% with the delivery of one child. The increased risk for obesity is even greater in minority women (140). Weight gained during pregnancy and retention after childbirth may be responsible for this effect. In a long term study, Linne and colleagues (145) observed that women with the highest gestational weight gains retained the most weight at both 1- and 15-years. In addition, a study of women followed 8-10 years after pregnancy found that failure to return to prepregnancy weight by 6 months postpartum resulted in greater weight gains at follow up [8.3 kg vs. 2.2 kg ($P < 0.01$)] (195). Walker and colleagues (244) followed low income women through the first year postpartum and found that

minority women lost weight through the first 6 weeks, but then began to gain weight through the remainder of the first year. This finding is in contrast to White women who maintained a trajectory of weight loss after the 6 weeks time point.

Since the weight gained during pregnancy is related to obesity after childbirth, the Institute of Medicine has published guidelines based on prepregnancy BMI and optimal infant health (108). However, many women, especially those of low-income status, lack this knowledge or choose to ignore it (223), and gain more weight than recommended (205). Inadequate prenatal care may be one reason why women of low socio-economic status are unaware of the recommended guidelines for weight gain during pregnancy (75,138).

Early postpartum may represent an opportune time for interventions, since excess gestational weight gains have already occurred. However, significant barriers to achieving successful weight loss in low-income women exist. For example, the lack of social support (40), self-efficacy (171), outcome expectations (171), economic resources (59) and transportation (26) may all hinder the adoption of more positive health-related behaviors. Other significant hurdles to overcome are lack of time to perform weight loss behaviors, including healthy eating and physical activity, and the absence of a safe place to exercise (36). George and colleagues (78) examined factors related to healthy eating through the postpartum period and found that neglect of self care, weight-related distress, negative body image, stress, and depressive symptoms were related to poor diet quality.

Low-income women may be ready to lose weight, but less ready to perform the behaviors necessary to achieve their goals, such as high-fat food avoidance and exercise

(130). In addition, low-income women frequently use dysfunctional strategies, such as diet pills and purging (25), possibly due to a lack of knowledge, skills, and resources. Positive factors that have been related to weight status in low-income women include nutrition knowledge (124), attitudes (172), and satisfaction with appearance (40). Nuss and colleagues (173) followed low-income women through the first year postpartum and found that higher nutrition knowledge was related to lower weight retention. Nutrition knowledge in low-income women also has been associated with weight loss after an intervention (124). Clarke and colleagues (40) conducted an intervention in 114 low-income mothers of young children and found that women with healthier attitudes, more social support, less satisfaction with body appearance, and greater percentage of energy from protein lost more weight after 8 weeks.

An approach to increase the success of interventions proposed by the Action on Obesity Summit is the use of tailored messages, or personalized health related advice (212). Personalized health messages have the greatest success when used in populations with significant variability on key determinants. For example, in obesity, individuals vary in dietary intake, knowledge, weight loss skills, hunger sensations, and numerous other elements (128). This strategy is known to increase positive intervention outcomes (212) and studies that have applied this method have been successful (128,211), especially those in low-income women (112,116,119,152,196). For example, Martin and colleagues (152) conducted a weight loss intervention for low-income women using tailored messages provided by a team of health professionals including dietitians who provided nutritional recommendations based on current eating practices and preferences.

Individuals receiving personalized information lost 2.0 kg compared to a 0.2 kg gain in controls. Due to inadequate resources in health promotion, the capability to provide such intensive treatment on a large scale may not exist; therefore, tools to quickly and efficiently identify individual needs are warranted.

One method proposed in this dissertation to evaluate individual needs with regard to weight loss is the development of an instrument that will measure the primary motivations to eat. This questionnaire will focus on major factors that influence eating, including environmental (221), biological (235), and psychological stimuli (101). Determinants of food intake from the physical environment include the availability of healthful foods such as fruits and vegetables (21,127), eating in response to cues such as the sight or smell of food (61,234,240), and interactions between family, friends, and peers (221), such as modeling and social norms (64,92). Biological factors that motivate eating include taste and hunger, with taste being the most important determinant of food choice (54,80). Psychological factors that influence eating include self-efficacy (101) (the confidence in one's ability to perform a given activity) (9), emotional state (76,78,239), and dietary restraint (41,71). A scale that captures multiple determinants of food intake may help in the design of intervention programs to reduce postpartum weight retention.

It is clear that food intake and consumption patterns are influenced by a myriad of factors and that pregnancy and the postpartum period represent critical periods of weight gain. The overall goal of this dissertation is to evaluate the influence of motivations to eat on weight status, dietary intake, and weight loss in women.

SPECIFIC AIMS

1. **To develop and validate the Eating Stimulus Index in low-income minority women in early postpartum.**

   Hypothesis: A scale titled the Eating Stimulus Index can be developed to identify various motivations to eat and will reflect weight status in low-income women in early postpartum.

   Rationale: Information collected from such an instrument used at the individual level will be useful for the development of tailored weight loss information to help reduce retention after childbirth.

2. **To describe the relationship between motivations to eat and diet quality and nutrient intake in overweight and obese, low-income women in early postpartum.**

   Hypothesis: Motivations to eat, as measured by the Eating Stimulus Index, may relate to consumption of a more/less healthful diet and differ between overweight and obese women.

   Rationale: Associations between the Eating Stimulus Index and food intake further validate this instrument for use in low-income women. Additionally, once the primary motivations to eat are determined, this information could facilitate the development of behavior modification strategies specific to individual needs.

3. **To evaluate factors that influence weight loss in low-income, women in early postpartum**

   Hypothesis: Weight loss achieved after an intervention for low-income women will be influenced by theoretical constructs reflecting environmental, behavioral, and personal determinants.

   Rationale: The identification of modifiable factors that associate with successful weight loss will aid in the design of weight intervention programs for low-income populations and potentially increase the rate of success.

4. **To validate the Eating Stimulus Index in a different population and identify determinants of diet quality and intake in young college women**

   Hypothesis: The Eating Stimulus Index will identify determinants of overall diet quality and nutrient intake in young college women

   Rationale: Validation of the Eating Stimulus Index in a different population will broaden the utility of the scale to eventually characterize motivations to eat at the societal level. Additionally, the identification of determinants of healthful dietary behaviors in college students may be useful for the development of support programs to encourage better nutrition.

DEVELOPMENT AND VALIDATION OF THE EATING STIMULUS INDEX

Current Tools for Measurement

Factors that motivate eating in low-income women during the postpartum period must be assessed via a validated measurement tool. To date, an instrument for this purpose has not been designed for this population. Therefore, the first aim is to develop and validate the Eating Stimulus Index in low-income minority women in early postpartum. Current instruments that measure factors that influence food intake are summarized in Table 1.1.

The Eating Attitudes Test is a 26-item questionnaire that was designed to measure attitudes towards healthy behaviors. It is used frequently in the diagnosis of eating disorders (73,74). Psychometric analysis of this version was conducted in a sample of anorexia nervosa patients and resulted in the identification of three factors that accounted for 40.2% of the variance: dieting, bulimia and food preoccupation, and self control. Hoerr and colleagues (102) used the Eating Attitudes Test to identify the presence of eating disorders (n = 1,899) in 4.5% and 1.4% of college women and men, respectively. When used in a cohort of pregnant women, 4.9% were diagnosed with an eating disorder, which was associated with unemployment, poor housing, low education, and previous miscarriage (230). While this is a valid instrument, questionnaires developed to measure a single construct cannot provide a complete profile of motivations to eat, given that food intake is influenced by a myriad of factors.

Table 1.1. Measurement tools of food intake and eating behavior

Questionnaire	Scale Overview	Validation Sample	Items	Subscales	α[a]
The Eating Attitudes Test (74)	Identifies dysfunctional eating attitudes and is used in the diagnosis of eating disorders	160 female anorexia nervosa patients	26	Dieting Bulimia/food preoccupation Self control	0.90 0.84 0.83
The Emotional Eating Test (5)	Evaluates eating in response to negative emotions and has been shown to correlate to binge eating	47 obese females	25	Anger/Frustration Anxiety Depression	0.78 0.78 0.72
The Weight Loss Efficacy Lifestyle Questionnaire (38)	Measures self-efficacy with regards to weight loss	162 obese patients enrolled in a weight loss program	20	Negative Emotions Availability Social Pressure Physical Discomfort Positive Activities	0.87 0.76 0.90 0.82 0.70
Food Craving Inventory (252)	Assesses patterns in food cravings related to fats, sweets, carbohydrates, and fast food	379 subjects from a university and community setting	28	High-fat foods Sweets Starches Fast-food fats	0.86 0.86 0.84 0.76
The Motivation to Eat Scale (111)	Evaluates psychological motivations to eat and was able to predict restricted eating and binging and purging	812 college students	20	Coping Compliance Social Pleasure	0.88 0.85 0.84 0.89

Three-Factor Eating Questionnaire (225)	Classifies individual eating behaviors as a result of restrained eating, disinhibition, or hunger	220 subjects from a weight loss program and the community	51	Hunger Restraint Disinhibition	0.82 0.90 0.87
Dutch Eating Behavior Questionnaire (237)	Identifies patterns of restrained, emotional, and external eating and used in the diagnosis of eating disorders	1170 young adults	33	Restrained eating Emotional eating I Emotional eating II Emotional eating III External eating	0.95 0.94 0.93 0.86 0.80
The Food Choice Questionnaire (219)	Identifies determinants of food choice	358 adults from a university sample	36	Health Mood Convenience Sensory Appeal Natural content Price Weight Control Familiarity Ethical Concern	0.81 0.83 0.84 0.72 0.86 0.83 0.85 0.72 0.74
The Motivation for Eating Scale (96)	Measures the motivations for eating related to situational triggers and attempts to identify patterns of intuitive eating	298 subjects from a university and community setting	43	Emotional Environmental Physical Social	0.95 0.80 0.86 0.75

[a] Represents Cronbach's alpha coefficient.

The Emotional Eating Scale is a 25-item scale developed to evaluate eating in response to negative emotions (5). Validation of the instrument was conducted in a sample of obese women previously diagnosed with bulimia nervosa. Principal components analysis resulted in the identification of three main psychological factors: anger/frustration, anxiety, and depression. Construct validity was established by correlation of the scale to the Binge Eating Scale (87) and a 7-day binge recall (256). Waller and Osman (245) provided further validation of the Emotional Eating Scale by examining its psychometric properties in a nonclinical sample of normal weight women never diagnosed with an eating disorder. The entire scale demonstrated strong internal consistency reliability (Cronbach's alpha = 0.93) and the three subscales all achieved reliability coefficients ≥ 0.80. The authors also reported a significant relationship between BMI and both the anger/frustration and depression subscales. This scale is limited to the assessment of psychological motivations to eat and therefore cannot capture all influences on eating.

The Weight Efficacy Life-Style Questionnaire measures eating self-efficacy with regards to five situational factors: negative emotions, availability, social pressure, physical discomfort, and positive activities (38). The scale was validated in obese individuals enrolled in a weight loss program and a second sample of patients who sought hospital treatment for weight management. The negative emotions, availability, social pressure, physical discomfort, and positive activities subscales demonstrated sufficient internal consistency reliability in both samples. In weight loss intervention studies, this

scale has the ability to detect changes in self-efficacy over time (39), but does not correlate with weight loss (69). Additionally, this scale measures a single component and therefore cannot describe the multi-faceted nature of eating.

The Food Craving Inventory is a self-reported measure of food cravings and discriminates between those who crave high fats, sweets, carbohydrates/starches, and fast-food fats (252). It was validated in participants recruited from university and community settings. Reliability of the scale (Cronbach's alpha ≥ 0.86) and subscales (Cronbach's alpha ≥ 0.70) was acceptable. Preliminary research found that those with a higher BMI craved high fat foods [fat subscale score: BMI > 30 kg/m^2 = 2.41 vs. BMI 20-25 kg/m^2 = 2.06 ($P < 0.01$)] (252). Those with a high BMI and binge eating disorder craved sweets more often [sweets subscale scores: obese/binge eating disorder = 3.14 vs. obese = 2.72 ($P < 0.001$)] (251). Martin and colleagues (151) used the Food Craving Inventory to compare cravings after either a low calorie diet ($\approx$ 1200 kilocalories) or a very-low calorie diet ($\approx$ 800 kilocalories). Cravings decreased significantly in the very-low calorie diet group after 11 weeks of dieting. The Food Craving Inventory is another example of a scale that measures a single construct.

The Motivation to Eat scale measures multiple constructs, but it is limited to psychological influences on eating (111). It was based upon the four-category model for alcohol motivation, and intended to be used to evaluate disordered eating patterns, such as restricted eating, binging, and purging. Psychological motivations for eating assessed by this scale included coping, social, compliance, and pleasure constructs. The scale was validated in a sample of undergraduates enrolled in an introductory psychology course.

Confirmatory factor analysis revealed the presence of the four distinct factors listed above. Convergent and discriminant validity were established by comparison to the Dutch Eating Behavior Questionnaire (237), the Emotional Eating Scale (5), and the Marlowe-Crowne Social Desirability Scale (44). Preliminary data showed that women reported eating in response to coping motivations more frequently than men [coping subscale score = 1.78 (women) vs 1.40 (men), $P < 0.001$]. Biological motivations such as experiencing hypoglycemia or reduced energy intake were excluded from the scale.

Multiple determinants of eating behaviors can be assessed using the Three-Factor Eating Questionnaire (225) and the Dutch Eating Behavior Questionnaire (237). These scales were developed around the same time, and measure similar constructs. The Three-Factor Eating Questionnaire evaluates hunger, restrained eating, and disinhibition, the inability to resist a stimulus causing one to indulge in a behavior. The concepts of restrained eating and latent obesity were used to devise the questions. The Restrained Eating Theory states that intense dieting results in persistent hunger which leaves the individual more vulnerable to overeating during moments of weakness, such as when experiencing stress, anxiety, depression, fatigue, alcohol consumption, or exposure to highly palatable food. Latent obesity describes individuals who possess obese eating patterns, yet remain at a normal weight through conscious control of food intake. In a study of adults (14), the Three-Factor Eating Questionnaire was used to describe how these factors vary over a range of BMI values. Disinhibition was strongly correlated to BMI and obese persons exhibiting high disinhibition had low dietary restraint. Dykes and colleagues (58) also found a positive correlation between disinhibition and BMI in a

study of women. In this study, the heaviest subjects had low dietary restraint and high disinhibition, while the lightest had low dietary restraint and low disinhibition. This measure has been used widely; however environmental influences on food intake are not included.

The Dutch Eating Behavior Questionnaire was developed to assess eating disorders, and measured restrained, emotional, and external (or environmental) eating (237). It is based on three theories of eating behavior: psychosomatic, externality, and restraint. Psychosomatic theory attributes emotional overeating to a confusion of internal arousal states and hunger. External eating is defined as eating in response to food-related stimuli. Both of these theories relate the development of obesity to an individual's misperception of his/her internal state prior to eating. The confusion between the perception of hunger and actual hunger does not always result in obesity, and therefore restrained eating was included. In 2003, Van Strien and Ouwens (239) examined the ability of restrained, emotional, and external eating measured by the scale to predict cookie consumption after a preload. Only the emotional eating construct was related to intake; emotional eaters consumed more after a preload.

The Food Choice Questionnaire, identifies determinants of food choice in individuals (219). This questionnaire contains 36 items, with nine constructs identified by factor analysis from a sample of adults from a university and community sample in London. The constructs include health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity, and ethical concern. The stability of the scale over time was established through test-retest reliability (Pearson's $r = 0.70$). The scale

measures factors that influence the cognitive decision-making process in choosing an item to eat, rather than subtle stimulus originating from the environment or natural physiological processes such as hunger.

The Motivation for Eating Scale (96) also measures multiple constructs and identifies individuals that follow an "intuitive eating" pattern (the ability to eat in response to internal hunger cues rather than environmental cues. This questionnaire was validated in a university and community sample and contains four subscales: emotional, environmental, physical, and social eating. Convergent validity of the scale was established by comparison to the Emotional Eating Scale (EES) (5) and the Three Factor Eating Scale (TFEQ) (225). The emotional eating subscale significantly correlated to the EES and the disinhibition and hunger subscales of the TFEQ. The physical eating subscale significantly correlated with the disinhibition subscale of the TFEQ, but not the hunger subscale, which indicates poor construct validity. Preliminary findings of this scale show that normal weight subjects rely on physical hunger cues more than overweight subjects. Hawks and colleagues (95) compared the eating motivations of two different cultures, college students living in either the U.S. or Japan, using a truncated 12-item version of the Motivation for Eating Scale. Results showed that women in the U.S reported eating more for emotional reasons, while women living in Japan reported eating more for physical or environmental reasons. This instrument measures multiple determinants of food intake, but it has yet to be validated in low-income women or during the unique life stage of postpartum.

Theories of Food Intake

A new scale, the Eating Stimulus Index, was developed in the current research, since an ideal tool to assess motivations to eat in low-income women does not exist. This instrument was designed to encompass all of the reported influences on eating, which were categorized into environmental, biological, and psychological factors (Figure 1.1). Factors were derived from the recent theoretical frameworks developed to describe food intake, shown in Table 1.2.

McCrory and colleagues (153) used a biobehavioral framework to describe factors that influence food intake. This description of intake encompasses a wide variety of factors from environmental, biological, and psychological origins. Environmental determinants were numerous and included dietary variety, liquid versus solid energy, portion size, snacking, and restaurant versus food away from home. These influences capture the effect of specific foods and the quantity consumed as well as the source. Biological determinants were taste, which refers to the likelihood of excess energy intake while consuming palatable foods. Psychological determinants were disinhibition and dietary restraint, which reflect subconscious and conscious reasons for eating.

Mela (156) developed a three factor model of determinants of food choice. In this model of energy selection, perceived appropriateness (social situation), current internal state (hunger, thirst, and mood), and hedonic likes (taste) were the primary determinants of food selection. Situation refers to situational cues from the environment that influence the individuals' perceived appropriateness of food intake. Current internal state includes the psychophysiological condition, a combined psychological and biological state, which

Table 1.2. Theoretical frameworks of influences on food intake			
Theory	**Origin of eating stimulus**	**Constructs**	**Rationale**
Biobehavioral influences on food intake (153)	**Environmental**	Dietary variety	Consumption of a variety of foods increases energy intake
		Liquid vs solid energy	Consumption of energy-containing beverages increases daily energy intake
		Portion size	Consumption of larger than recommended portion sizes increases energy intake
		Snacking	Consumption of energy dense snacks results in greater energy intakes
		Restaurant vs food away from home	Foods eaten away from home are less nutritious, more energy dense, and increase energy intake
	Biological	Taste	Highly palatable meals/snacks increase energy intake
	Psychological	Disinhibition	Susceptibility to external stimuli leaves an individual vulnerable to over consumption
		Dietary restraint	Conscious control of food intake decreases the risk of over consumption
Determinants of Food Choice (156)	**Environmental/ Psychological**	Situation	Situational cues and context influence the perceived appropriateness of food consumption
	Biological/ Psychological	Current internal state	Psychophysiological state (mood, thirst, hunger) affects food choice
	Biological/ Psychological	Hedonic likes	Tastes preferences lead to food liking, subsequent food purchase, and then consumption

Homeostatic/hedonic regulation food intake (149)	**Environmental**	Hedonic	Palatable food in the environment stimulates the desire for food
	Biological	Homeostatic	Hunger/satiety signals regulate food intake
Dual factor model of food intake (46)	**Environmental/ Psychological**	Uncompensated factors	Factors that have no feedback mechanism encourage meal/snack consumption
	Biological	Compensated factors	Physiological responses to the feedback regulation of hunger/satiety influence eating behaviors
Control of food intake in the obese (19)	**Environmental**	Environmental processes	Stimulus from the obesigenic environment contributes to over consumption
	Biological	Biological processes	Physiological regulation of hunger/satiety influences food intake
	Psychological	Self-imposed modulations	Dietary restraint is necessary to control food intake and regulate body weight

cycles between periods of thirst and hunger and can be moderated by mood. Finally, hedonic likes, formed by biological and psychological interactions, represent taste preferences, which are purportedly developed through repeated associations with negative or positive events.

The dichotomous homeostatic-hedonic model of food intake regulation was defined by Lowe and Levine (149). This theory explains appetite motivation as a result of the availability of food (hedonic) and energy depletion (homeostatic), or wanting versus needing. Hedonic regulation refers to environmental stimuli such as the exposure to food, as well as palatability and taste preferences. All biological mechanisms related to meal consumption are classified under homeostatic regulation, such as hunger/satiety signals. This dual-factor explanation for energy consumption emphasizes the influence of environmental stimulus on the desire to eat. It further suggests that the passive overconsumption of food that occurs in response to the obesigenic environment leads to restrictive eating behaviors, possibly resulting in weight cycling and obesity.

De Castro (46) developed a dual factor model of food intake that describes eating behavior as a result of the influence of uncompensated and compensated factors. Uncompensated factors regulate food intake, but then do not have a feedback mechanism to inhibit the stimulus to consume meals or snacks. These include environmental and psychological factors such as social facilitation, seasonal rhythms, cost and availability of food, palatability, and energy density. Compensated factors are those that affect dietary intake, and in turn, intake affects their levels. Examples include biological variables such as circulating hormones related to hunger/satiety and % body fat. These components may

influence hunger sensations before a meal, but are compensated for after a meal is consumed via a feedback response mechanism that alters plasma levels.

Finally, Blundell and Gillett (19), suggest that energy intake is controlled rather than regulated. Therefore, self-imposed modulations were introduced into their model of food intake, which is known to affect consumption (41,71). Food intake is described as a network of complex interactions that form a psychobiological system. This system includes influences from environmental processes such as portion size and energy density, biological processes such as those that affect hunger/satiety, and psychological processes such as attempted self-control or dietary restraint.

Three underlying themes of influence on food intake emerged from the theoretical frameworks describe above. The main categories identified throughout the models were environmental, biological, and psychological factors. Constructs within these three components were used for the development of the Eating Stimulus Index and are discussed in the following sections.

Environmental Motivations to Eat

After reviewing the theories of food intake, potential determinants of eating to be evaluated in the Eating Stimulus Index were identified and categorized into environmental, biological, or psychological origins (Figure 1.1). Specific environmental aspects that influence food intake are the availability of healthful foods such as fruits and vegetables (21,127), eating in response to cues such as the sight or smell of food (61,234,240) and factors from the social environment, which includes interactions

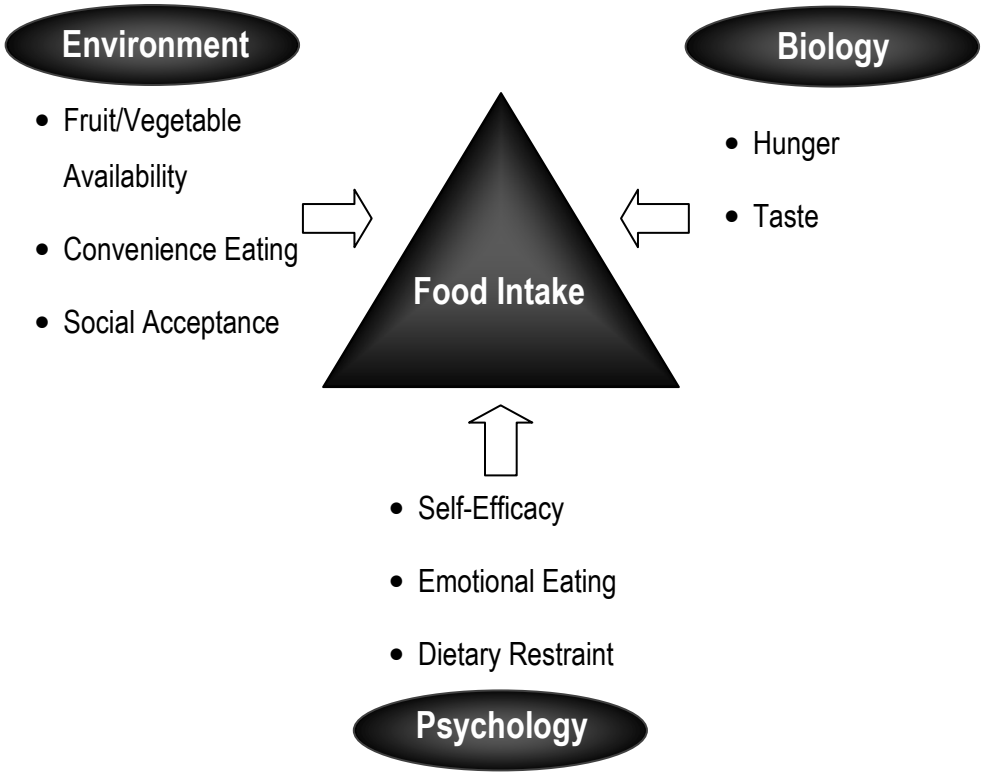

Figure 1.1. Factor structure of the Eating Stimulus Index

between family, friends, and peers (221), such as modeling and social norms (64,92). Low-income populations frequently report lack of availability, along with increased cost as reasons for reduced consumption of healthy foods such as fruits and vegetables (115,192). Local food environments vary by income and ethnicity with fewer fruit and vegetable markets, bakeries, specialty stores, and natural food stores available in poor, non-White areas (6,159). Consequently, healthful foods are replaced by convenience foods, which are in abundance in areas of low socioeconomic status (18). It has been

proposed that creating an environment conducive to behavior change must occur before interventions will be successful (63,81).

The visual presence or smell of food in the environment encourages eating in some individuals. Eating in response to these environmental cues and neglecting internal hunger signals has been defined as external eating (204). For example, Painter and colleagues (183) found that individuals consumed more candy when the item was convenient and visible, such as on the desk top, rather than in a drawer or some distance away. It has been documented that those with greater sensitivity to external eating have higher body weights (238), but not all studies have seen this relationship (146,218). In addition, external eating has been linked to food cravings (99) which have shown to elicit episodes of binge eating (214). Horchner and colleagues (105) observed improvements in external eating, measured by the Dutch Eating Behavior Questionnaire, in morbidly obese patients two years after receiving adjustable silicone gastric banding. Larsen and colleagues (132) found similar results in a study of patients receiving laparoscopic adjustable gastric banding, indicating weight loss as a positive influence on susceptibility to external food stimuli. Once individuals sensitive to eating in response to environmental cues are identified, methods of stimulus control can be taught to help modify behavior.

Social influences are well known to affect food intake (91,222). In certain environments where being overweight has become the cultural norm, individuals report greater satisfaction with current weight even when overweight or obese (65,182). A person's social environment also influences their readiness to lose weight (94) and

participation in weight loss behaviors (8). Participants enrolled in a weight loss intervention that incorporated strategies to increase social support lost more weight after 4- and 10-month follow up visits than controls (257). Methods for the intervention condition included selective enrollment for those who could bring a friend, group activities, instructions to contact each member of the group by phone to provide support, and intergroup competition. Weight loss interventions encouraging spousal involvement also have resulted in outcomes that are more successful (27,197). Thus environmental influences such as food availability, eating in response to environmental cues, and interactions with the social environment are significant contributors to food intake.

Biological Motivations to Eat

Biological influences on food intake include taste and hunger. Taste remains one of the most important determinants for meal selection (54,80). The ability to detect flavor in foods results from a combination of chemosensory mechanisms including taste, smell, mouthfeel, and chemesthesis (the ability of a chemical component from food to stimulate other senses) (215). Preferences for certain tastes may differ by race (158) and socioeconomic status (229), and can influence adiposity (83) and cardiovascular disease risks (57). A liking for healthful foods may originate from the consumption of and exposure to fruits and vegetables as a child. Haire-Joshu and colleagues (90) examined childhood influences on current fruit and vegetable intake in African American women, and found that women who reported eating more vegetables as a child had a stronger preference as adults. This finding is significant given that taste preferences in adulthood

do influence intake (235). In a study of parent-preschool child pairs, researchers found that taste preferences for fruits and vegetables were strongly related to dietary intake of these foods (164). While taste preferences are genetic, they remain a modifiable determinant of intake, as acclimatization to new foods can occur after multiple exposures and taste preferences can change over time (31,264).

Motivations to eat from biological origins also result from physiological responses to a state of energy depletion resulting in hunger. Feelings of hunger may occur during a decline in blood glucose levels (208), as a response to fluctuations in hormones related to appetite control (97). Individuals have varying intensities of hunger signals, which may be due to differences in circulating hormone levels and, presumably, affect weight. Two recent studies that measured hunger using the Three Factor Eating Questionnaire showed that a higher sensitivity to this feeling is positively correlated with BMI in women (14,58). Furthermore, hunger perceptions can be modified through changes in diet composition. Nickols-Richardson and colleagues (168) observed decreases in self-reported hunger obtained by the Eating Inventory (Three Factor Eating Questionnaire) after 6 weeks consumption of a low-carbohydrate/high protein [6.3 to 3.2 ($P < 0.05$)] diet but not a high-carbohydrate/low-fat diet [7.1 to 5.9 ($P > 0.05$)]. Thus, hunger appears to be a modifiable factor that motivates eating. Additional ways to modify the sensation of hunger through alterations in dietary behaviors include consumption of 4-6 small meals throughout the day (216), the addition of lean protein to each meal or snack (168), and reduction of the intake of simple carbohydrates (186). The

biological motivations to eat strongly influence dietary intake, and skills to alter the sensation or response to taste and hunger can be developed.

Psychological Motivations to Eat

The psychological state of the mind and cognitions are other major factors that influence food choice. Examples include self-efficacy (101), emotional eating (76,78,239), and dietary restraint (41,71). Self-efficacy is defined as the confidence in one's ability to perform a given activity (9) and is known to influence eating behaviors (101). People with greater self-efficacy for weight management behaviors exercise more often, and are more successful in weight loss interventions (16,49,50,228,246). Programs specifically designed to improve self-efficacy demonstrate that those with the greatest increases lost the most weight (50,194). In low-income women, high levels of self-efficacy have been shown to correlate with dietary control, exercise, and weight management behaviors (243). Thus, interventions aimed at increasing self-efficacy in low-income women would be effective in improving health related behaviors (152).

Emotional eating is the tendency to overeat when experiencing emotional arousal or stress. Individuals sensitive to emotional eating tend to be overweight (76,146) and are commonly affected by binge eating disorders (60,188). The psychosomatic theory indicates that those susceptible to this behavior confuse internal arousal states and hunger (237). Studies that employ the Dutch Eating Behavior Questionnaire to categorize eating behaviors have found a link between those identified as emotional eaters and increased food intake (236,239). Nuss and colleagues (172) followed low-income women through

the first year postpartum and found that at 1-year, obese women reported eating in response to emotional cues more frequently than their overweight counterparts. Interventions and nutritional support may benefit individuals exhibiting a high propensity to eat in response to emotional states.

Dietary restraint, or the cognitive ability to control food intake, has been widely studied within the context of obesity; yet, conflicting results have been produced. Herman and Mack (98) developed the Restraint Theory, which states that strict control of food intake leaves an individual consumed with thoughts of food, which eventually leads to over consumption. This theory may not entirely explain this behavior, as restraint is not consistently related to excessive food intake (180). A positive correlation between dietary restraint and body composition may be mediated by the psychological variable of restraint, termed disinhibition (12,70,143). Disinhibition is defined as a vulnerability to external eating cues, and this trait may be elevated in obese individuals (143,224). Once disinhibition is removed, high dietary restraint is associated with long-term weight maintenance (241). In low-income, minority women, high dietary restraint has been related to healthful food choices (41) and less frequent fast food consumption (71) indicating restraint as a predictor of dietary behavior in this population.

In a culture with an overabundance of food and increasing obesity rates, it becomes clear that body weight is not regulated successfully. If so, sedentary behavior would lead to decreased food consumption. The reported influences on eating are quite diverse and all exhibit varying effects on different individuals. For example, some people are more susceptible to external eating cues and hunger, while others may have

increased eating restraint. Therefore identifying the primary motivations to eat, whether from environmental, biological, or psychological origins, may help in the development of tailored weight loss messages used in intervention programs

EVALUATION OF THE IMPACT OF MOTIVATIONS TO EAT ON DIETARY INTAKE

After the Eating Stimulus Index was developed, it was important to determine if the factors selected for the scale were related to food intake. This was an important component in validation of the questionnaire as a measure of motivations to eat. Therefore, the second aim was to describe the relationship between motivations to eat and the impact on diet quality and nutrient intake in overweight and obese, low-income women in early postpartum. Different methods of dietary intake collection and evaluation exist; those used in this research are described below.

Food Frequency Questionnaire

The collection of food intake information that is reliable and valid is essential to the evaluation of dietary intake within a population. Obtaining accurate information is difficult due to inherent problems in all collection methods such as reliance on memory, inaccurate portion size estimation, and bias in subject reporting (123,150,198). Additionally, it is well known that underreporting occurs more frequently in obese individuals (123,198). The food frequency questionnaire has been commonly used to collect intake information because it has a relatively low subject burden (226) and

measures patterns of consumption over longer periods of time (100), as compared to other measures. Moreover, the validity of food frequency questionnaires has been strengthened by evidence of a relationship to biological markers (22,45,107).

Evaluation of Dietary Intake

Once information on food intake has been collected it must be evaluated for compliance to recommended levels. One method of evaluation includes comparison to the dietary guidelines. The dietary guidelines are established by the Department of Health and Human Services and provide recommendations to promote healthful diets and physical activity for individuals 2 years and older. The most recent version is the 2005 Dietary Guidelines for Americans (231), which advises the consumption of a nutrient dense diet by encouraging individuals to meet their recommended intakes within energy needs.

The Dietary Guidelines Adherence Index (DGAI) is a measure of diet quality and was designed to assess adherence to the 2005 Dietary Guidelines (68). This index contains 21 components that include the MyPyramid food groups (163), variety, fiber, fat, saturated fat, trans fat, cholesterol, and sodium. To calculate a DGAI score, the estimated energy requirement for each individual is calculated, and dietary intake is compared to the MyPyramid recommendations for the specific calorie level (163). Maximum points are earned for each component if an intake level within an established range was consumed. This process ensures that intakes beyond needs negatively impact the score. The Dietary Guidelines Adherence Index was chosen to assess diet quality for

this study because it penalizes for overconsumption. This index seemed appropriate for use in this sample of overweight women who frequently consume more energy than recommended (123,198).

WEIGHT LOSS IN POSTPARTUM

Once an instrument to assess motivations to eat in low-income women has been developed, it can be used to examine factors related to weight loss during postpartum. The identification of these factors will aid in the design of intervention programs for low-income populations and potentially increase the rate of success. Therefore, the third aim of this study is to evaluate factors that influence weight loss in low-income, women in early postpartum.

A return to prepregnancy weight after delivery is ideal; however, retention of the weight gained during pregnancy is common. It is estimated that women experience weight gains of approximately 2-3 kg after the birth of a child (213,254), potentially due to postpartum weight retention. Rooney and Schauberger (195) demonstrated that a failure to return to prepregnancy weight by 6 months has been shown to predict obesity later on in life. Low-income women are particularly vulnerable to postpartum weight retention and persistent weight gain as evidenced by trajectories of weight gain rather than loss through the first year after childbirth (244).

Reducing postpartum weight retention is an important strategy for the prevention of obesity. In spite of this knowledge, few interventions have been conducted during this time. Also, women may be reluctant to participate because they experience great stress

and demands as they adjust to having a newborn (142). Low-income mothers face even more challenges due to poor social support (40) and lack of economic resources (59). Interventions conducted in a socioeconomically disadvantaged sample of postpartum women have had less success than those in a general population. Leermakers and colleagues (141) designed a 6-month behavioral weight loss intervention for women between 3-12 months postpartum, which resulted in a 7.8 kg weight loss. In a similar study, O'Toole and colleagues (174) reported a weight loss of 7.3 kg after a 1-year structured intervention in 17 women 6 weeks to 6 months. In contrast, Klohe and colleagues (125) conducted an 8-week intervention in low-income mothers of 1-3 year old children that resulted in a mean weight loss of 2.7 kg. Weight loss interventions in low-income populations may be improved by identifying modifiable factors that contribute to reductions in body weight.

Influences on Weight Loss

Current factors that are known to associate with weight loss in low-income women include nutrition knowledge (124,173), satisfaction with appearance (40), social support (42), and self-efficacy (152). Nuss and colleagues (173) followed low-income women through the first year postpartum and found that higher nutrition knowledge was related to lower weight retention. Additionally, improvements in nutrition knowledge after an intervention have been associated with weight loss (124). In a similar intervention, women who were more dissatisfied with their appearance lost more weight (53). The implication of this finding was that some degree of dissatisfaction with

physical appearance is important to motivate one to change. Another determinant, social support, produced more successful changes in weight after an intervention conducted in Hispanic women (42). Finally, the concept of self-efficacy was evaluated by Martin and colleagues (152) in low-come women participating in either tailored treatment or standard care group. Participants with the greatest improvements in self-efficacy lost the most weight.

Application of the Social Cognitive Theory

Theoretical frameworks to describe behavior are important when evaluating factors that influence health related outcomes. In this study, the Social Cognitive Theory was used to describe determinants of weight loss in low-income women participating in a weight loss intervention. This theory of health behavior has been used widely in the context of obesity and the design of weight management interventions (2,125,166,179,249). It is guided by the principle of reciprocal determinism, which states that the interactions between behavior, environment, and the person lead to human action (10). Within this triad, behavior change can occur through modification of the main constructs. For example, behavioral factors such as dietary restraint (70,89), nutrition knowledge (124), and skills (103), environmental factors such as the presence of foods in the environment (155), and personal factors such as self-efficacy (152,184) and taste preferences (83) have all shown to influence weight loss. Additional determinants within this theory include social support (8,72) and outcome expectancies (32).

The weight gain associated with pregnancy and retention after childbirth may contribute to the future development of overweight and obesity, particularly in low-income populations. Due to the high economic cost and reduced quality of life associated with these conditions, action to reduce weight retention after childbirth should be taken. One way to accomplish this goal is to use effective intervention methods to induce behavior change. Programs designed for this purpose can be enhanced by expanding the current knowledge of factors that contribute to successful weight reductions after childbirth.

DIETARY INFLUENCES IN YOUNG WOMEN

The novel instrument created in this research was developed to be used in low-income women. However, application of the Eating Stimulus Index in other populations would be useful in the characterization of motivations to eat at the societal level. To determine if this scale was valid in other populations, it was also used in a sample of university nutrition students to evaluate influences on food intake. Therefore the fourth aim of this study is to identify determinants of diet quality and intake in young college women. This population was also chosen because young adulthood represents a time of transition and a key period in the development of overweight and obesity (85). The identification of major determinants of dietary intake in these women may be useful for the development of support programs to encourage more healthful dietary practices.

Multiple influences on food intake in young adults have been studied with the majority of research focused on factors originating in adolescence. Larson and

colleagues (135) discovered that home availability of fruits and vegetables in late middle to high school was a significant predictor of intake 5 years later. Separate reports using the same sample found that peer support for healthy eating (136) and frequency of family meals (134) in adolescence were also associated with better dietary intakes at follow up. Studies that have examined current influences of dietary intakes in this population have determined that less frequent food preparation behaviors (137) and consumption of "meals on the run" lead to reduced diet quality (133).

The transition to adulthood is accompanied by greater independence and decision making. In general, the adoption of negative dietary behaviors, such as increased fast food consumption and decreased breakfast consumption (169), occurs during this time. Subsequently, individuals become vulnerable to changes in weight (85) and may experience gains for the first time (29,104). Therefore, the identification of determinants to eat in this population may be beneficial for the prevention and treatment of overweight/obesity.

SUMMARY

The purpose of this research was to develop and validate an instrument to evaluate motivations to eat in low-income women during the early postpartum period. This questionnaire was then used to assess the impact of motivations to eat on diet quality and intake and weight loss in this unique sample. A model of the most significant factors related to changes in weight after an intervention was developed. A secondary purpose was to provide further validation of the instrument by examining the determinants of food

intake in a separate population. Young college women were chosen for this goal, as they also exhibit risks for the development of unhealthful eating patterns and weight gain. The products of this study were intended to be used in the development of intervention programs designed to reduce postpartum weight retention. The following chapters present the methods, results, discussion, and conclusions for each of these objectives.

Chapter 2: Development and Validation of the Eating Stimulus Index in Low-Income Minority Women in Early Postpartum

ABSTRACT

Dietary modification to achieve weight loss during the postpartum period may be critical for the prevention of obesity, particularly in low-income, minority women. The aim of this cross-sectional study was to develop and validate a measure to examine motivations to eat in low-income, minority women during early postpartum. A convenience sample of 179 triethnic women was recruited from the Special Supplemental Program for Women, Infants, and Children clinics from June, 2004-April 2007. Subjects made one visit to a study center where they completed the Eating Stimulus Index (ESI) and questions regarding individual demographic characteristics including ethnicity, age, income, education, marital status, breastfeeding, and employment status. Weight and height were also measured during this visit and used to calculate body mass index (BMI). An additional sample of 31 women completed the ESI on two occasions with two weeks between to establish test-retest reliability. The factor structure of the scale was examined with principal components analysis. Total scale scores and subscale scores were calculated and Pearson's correlation and multiple regression analysis examined relationships to BMI kg/m^2. Principal component analysis produced an eight factor structure with loadings >0.40. Cronbach's alpha coefficients for each subscale ranged from 0.54 - 0.89. Subscales of Convenience Eating, Emotional Eating, and Dietary Restraint were related to BMI in mothers. African American, exclusively formula

feeding and older women were most vulnerable to convenience eating. White women and those with the highest level of education were most vulnerable to emotional eating. The ESI is a valid and reliable instrument with the ability to discriminate by weight. It can be used to assess motivations to eat in order to facilitate the development of tailored weight loss messages during early postpartum.

INTRODUCTION

The prevalence of obesity is higher in Mexican American and African American women (175). Additionally, minority women have higher rates of diabetes (43) and cardiovascular disease risk factors (258). Weight gain associated with pregnancy and retention after childbirth may contribute to this incidence (145,195). Minority women are more vulnerable to weight gain in postpartum and fail to return to their pre-pregnancy weight (244). Weight loss interventions during this critical time are warranted (129,244). One strategy to improve the effectiveness of an intervention is to implement personalized health messages (152). In this study, it was hypothesized that a scale could be developed to identify motivations to eat and would reflect weight status. The Eating Stimulus Index, described in this research, may benefit weight loss programs targeted at minority, postpartum women by assisting in the development of tailored messages.

Various factors motivate individuals to eat, including environmental (221), biological (235), and psychological stimuli (101). Determinants of food intake from the physical environment include availability of healthful foods such as fruits and vegetables (21,127). Although, access to foods through the presence of small food stores has been

associated with obesity in women (247), proximity to supermarkets may positively influence diet quality (131). Additional environmental influences include eating in response to cues such as the sight or smell of food (61,234,240) and factors from the social environment, which includes interactions between family, friends, and peers (221), such as modeling and social norms (64,92). Biological factors that motivate eating include taste and hunger, with taste being the most important determinant of food choice (54,80). Psychological factors that influence eating include self-efficacy (101) (the confidence in one's ability to perform a given activity (9) while overcoming a barrier), emotional state (76,78,239), and dietary restraint (41,71).

The objective of this research was to develop and validate an Eating Stimulus Index (ESI) that identifies primary motivations to eat in overweight/obese low-income, minority women in early postpartum. While numerous questionnaires have been developed to assess eating behaviors, these are limited in scope or lack validation in this population. The ESI will facilitate development of tailored postpartum weight loss programs.

METHODS

Design of Study and Subjects

A convenience sample was recruited between June, 2004-April, 2007 to develop and validate the ESI. Low-income, postpartum mothers were recruited from the Special Supplemental Nutrition Program for Women, Infants, and Children clinics, doctors'

offices, and neighborhood centers. Primary enrollment criteria were: body mass index (BMI) ≥25, 18-40 years old, infant 0-4 months, income<185% poverty level, ability to read, speak, and write English, parity ≤3, absence of pregnancy and all forms of diabetes, and Hispanic, African-American, or White ethnicity. Women (N=179) made one visit to a study center and completed the ESI and questions regarding individual demographic characteristics, and were measured for weight and height. A modified demographics questionnaire (40) assessed self-reported ethnicity, age, income, education, marital status, breastfeeding, and employment status. Education categories included ≤ high school, partial college, and ≥ college.

An additional sample (N=31) of women was recruited to assess test-retest reliability. Eligibility criteria were identical except time postpartum was extended to 1 year to increase the number of potential subjects. Moreover, the target population for this scale was postpartum women, which is defined as birth to 12-18 months after delivery (207). Women who qualified completed questionnaires through mail on two occasions with 2-weeks apart. All subjects provided informed consent and The University of Texas at Austin Institutional Review Board approved this study protocol.

Anthropometrics

Height was measured with a wall mounted stadiometer to the nearest 0.1 centimeter (Medical Resources, Columbus, OH) and weight was determined via an electronic weighing scale to nearest 0.1 kilogram. Each measurement was taken one time

in light clothing without shoes (TBF-300A, Tanita, Arlington Heights, IL). BMI was calculated as weight (kilograms) / height (meters) ^{2}.

Eating Stimulus Index

The ESI was designed to evaluate motivations to eat in low-income, postpartum women. Previously developed instruments have not been designed for use in women during this critical time (96,111,225,237). Environmental, biological, and psychological constructs shown to influence food intake were chosen from the literature and described below. The environment was divided into Convenience Eating, Fruit and Vegetable Availability, and Social Acceptance. Convenience eating in this study was defined as eating in response to the presence of convenience foods in the environment. Environmental factors, such as vulnerability to environmental eating cues (61,234,240), availability and presence of fruits and vegetables in the home (127) or neighborhood environments (21), and social support and norms (64,92), influence food intake. Biological factors included Taste and Hunger. Stronger taste preferences for fruits and vegetables and the sensation of hunger promote food intake (14,235). Psychological factors included Self-Efficacy (101), Emotional Eating (76,78,239), and Dietary Restraint (41,71), which have all been associated with food intake. Questions for each construct were prepared at a sixth grade reading level in Likert format with response options from 1-5. The preliminary scale, 85 items, was reviewed for content validity by a panel of experts (n=10) and revised as suggested. A content validity index using universal agreement was calculated (189).

Data reduction was conducted through factor analysis, using principal components with varimax rotation. Before entry into the analysis, items were reverse-coded as necessary and eliminated if not, or inversely, related to the primary outcome variable. To reduce the item pool further, questions with low variability and skewed distributions were eliminated because these questions have little discriminatory power between subjects (170). This method may introduce bias by eliminating items that may have construct-relevance in a different sample (37), but was necessary because these items do not differentiate motivations in this study. The final scale included 23-items that were used for the principal components analysis; factors with eigenvalues >1 and items with factor loadings ≥0.40 were retained (227). Internal consistency reliability analysis was conducted using Cronbach's alpha coefficient.

Methods of Statistics

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS,15.0, 2006, Chicago, IL). Normality tests were computed and log or square root transformations were conducted as necessary. Demographics and scale characteristics were analyzed using frequencies, and independent samples t-test and one-way analysis of variance using Bonferroni post hoc analysis detected differences between groups. Response options were summed for a possible total score of 115, with a higher score indicating more beneficial response to motivations to eat. Temporal stability was established using Pearson's correlations and intraclass correlation coefficients (ICC) using the two-way mixed model and type consistency to examine test-to-test variation

(262). Linear regression was conducted using BMI as the dependent variable and ESI total and subscales as independent variables to explore possible relationships. Models were controlled for ethnicity, as BMI was significantly higher in African American and Hispanic women. BMI did not vary according to other demographic variables. Statistics reported include R^2, standardized beta coefficient and p value for each model. Statistical significance was established at $P<0.05$.

RESULTS AND DISCUSSION

In the validation sample (N=179), mean age and BMI were 26.4 years and 33.2 kg/m^2, respectively. The sample was 17.9% (n=32) African American, 59.8% (n=107) Hispanic, and 22.3% (n=40) White; 19.6% (n=35) had < high school education and 53.1% (n=95) had at least partial college. More than half of mothers (59.2%; n=106) were breastfeeding; of these, 83.0% (n=88) reported nursing ≥50% time. In the test-retest sample (N=31) mean age and BMI were 26.9 years and 31.8 kg/m^2, respectively. The sample was 48.4% (n=15) White, and 88.4% (n=24) had ≥a high school education. Mean ESI scores were 72.3±2.4, and did not differ from the validation sample. Total scale scores were strongly associated between both time points (Pearson's r=0.84, $P<0.001$) with a single measures ICC value of 0.83, demonstrating good test-retest reliability for the entire scale, and subscale values ranged from 0.50-0.76 (Table 1). Content validity for the final instrument was 0.90.

Validity of Construct

Factor analysis with varimax rotation revealed an eight factor structure, with loadings ≥0.40 (Table 2.1) that accounted for 67.8% of the total variance within the scale. The 23-item scale demonstrated good internal consistency (Cronbach's $\alpha = 0.75$) and all subscales were adequate ($\alpha > 0.60$) except Taste and Hunger (Table 2.1). Since the number of items in a subscale can positively influence coefficient values, it was not surprising that alpha levels were low given the small number of questions. However, these values are similar to those in other instruments with multiple factors (93,206,255).

Analysis of Eating Stimulus Index

Total scale scores did not differ by demographic variables. However, subscale scores varied by ethnicity, age, education, breastfeeding and marital status (Table 2.2). Convenience Eating scores were lowest in African Americans, exclusively formula feeding women, and those ≥30 years old. Older women also had the lowest dietary restraint scores. Individuals most vulnerable to eating in response to emotions were White and had the highest level of education. Self-efficacy was lower in women who were living with a spouse or partner (10.6±0.2 vs. 11.7±0.3, $P<0.01$). The shared environment of poor diet and exercise habits between partners (113) may make behavior modification appear difficult, lowering ones self-efficacy. However evidence of improvements in the home environment and spousal behavior exists when one individual participates in a health related treatment program (86). Scores did not differ by employment. Previous studies have not explored the relationship between these eating

Table 2.1. Validity and reliability of the Eating Stimulus Index and relationship to Body Mass Index (kg/m^2) in low-income, minority women in early postpartum

	Validity/Reliability			Regression Model[b]		
Construct/Questions[a]	**Factor loading**	**α[c]**	**ICC[d]**	**R^2**	**β[e]**	**P value**
Fruit/ Vegetable Availability		0.65	0.50	0.05	0.07	0.040
There are fresh vegetables in my home right now	0.74					
There are fresh fruits in my home right now	0.75					
When I shop, I buy many different kinds of fruits and vegetables	0.67					
Convenience Eating		0.69	0.72	0.09	-0.23**	0.001
I buy snacks when I stop at a convenience store[f]	0.80					
I buy cookies or snacks when I go to the mall[f]	0.68					
I eat at buffet style restaurants[f]	0.78					
Social Acceptance		0.89	0.70	0.05	-0.09	0.033
I am comfortable with my weight when I am with family and friends	0.93					
I am comfortable with my weight when I am out in public	0.93					
Hunger		0.54	0.76	0.04	0.05	0.049
I am most hungry in the morning	0.80					
It is easy for me to go without breakfast[f]	0.72					
I am most hungry at night[f]	0.51					
Taste		0.54	0.73	0.04	0.04	0.051
I enjoy the taste of green leafy salads without dressing	0.79					
I enjoy the taste of raw broccoli	0.76					

I enjoy the taste of orange or yellow vegetables	0.41					
Self Efficacy		0.70	0.73	0.05	-0.11	0.022
I am confident that I can control my weight	0.65					
I am confident I can follow a healthy, weight-loss diet	0.82					
I am confident that I can give up foods to lose weight	0.80					
Emotional Eating		0.88	0.66	0.09	-0.22**	0.001
I eat when I am sad, disappointed, or depressed [f]	0.88					
I eat when I am bored or restless [f]	0.81					
I eat when I am stressed or nervous [f]	0.89					
Dietary Restraint		0.61	0.72	0.09	-0.22**	0.001
I stop eating before I get too full	0.54					
I overeat when tempted by delicious foods [f]	0.70					
When I start eating foods I enjoy I just can't seem to stop [f]	0.79					

[a] Response options for questions were in a Likert format, with answers ranging from 1 to 5 ("Strongly Disagree" to "Strongly Agree" or "Never" to "Always").

[b] Individual Regression models were conducted using BMI as the dependent variable and the subscale as the independent variable, while controlling for ethnicity. Regression analysis for all 23-items to predict BMI while controlling for ethnicity was significant (R^2 =0.07, β= -0.17, P<0.01).

[c] Cronbach's alpha coefficient.

[d] Intraclass correlation coefficient indicating temporal stability. Obtained from test-retest sample (n=31).

[e] Standardized regression coefficient for each predictor variable.

[f] Item was reverse coded.

** Predictor variable is significant at P <0.01.

Table 2.2. Mean differences in Eating Stimulus Index scores by ethnicity, age, education, and infant feeding method in low-income, minority women in early postpartum

Demographic	ESI Total	Fruit/ Vegetable Availability	Convenience Eating	Social Acceptance	Hunger	Taste	Self-efficacy	Emotional Eating[a]	Dietary Restraint
Total (n=179)	73.9±0.8	10.9±0.2	9.8±0.2	4.6±0.2	8.8±0.2	10.3±0.2	10.9±0.2	9.6±0.2	9.0±0.2
Ethnicity									
Hispanic (n=107)	74.8±0.9	11.0±0.2	10.0±0.2 [y]	4.5±0.2	8.9±0.3	10.5±0.3	10.9±0.2	9.9±0.3 [w]	9.2±0.2
White (n=40)	72.6±1.8	10.8±0.5	10.4±0.4 [y]	4.5±0.3	9.5±0.5 [w]	10.0±0.4	10.4±0.3	8.5±0.3 [w]	8.7±0.4
African American (n=32)	72.2±1.9	10.8±0.6	8.5±0.5 [z]	5.0±0.4	7.8±0.5 [x]	10.3±0.4	11.3±0.5	10.0±0.6 [x]	8.6±0.5
Age									
18-24 (n=76)	74.4±1.1	11.5±0.3 [w]	9.6±0.3	4.5±0.3	8.8±0.3	10.1±0.3	11.1±0.2	10.1±0.3	9.0±0.3
25-30 (n=55)	74.0±1.4	10.1±0.4 [x]	10.5±0.4 [w]	4.8±0.3	8.7±2.6	10.3±0.3	10.6±0.3	9.4±0.5	9.5±0.3 [w]
30-40 (n=48)	72.2±1.6	11.1±0.4	9.4±0.3 [x]	4.3±0.3	8.9±0.4	10.7±0.2	10.8±0.3	8.9±0.5	8.3±0.3 [x]
Education									
≤ High School (n=84)	74.5±0.9	10.9±0.3	9.8±0.2	4.3±0.2	8.7±0.3	10.3±0.3	11.1±0.2	10.2±0.3 [y]	9.3±0.2
Partial College (n=73)	73.6±1.5	10.8±0.3	9.8±0.3	4.9±0.3	8.7±0.4	10.3±0.3	10.8±0.3	9.5±0.4	8.8±0.3
≥ College (n=22)	72.1±1.2	11.5±0.5	10.3±0.5	4.5±0.4	9.4±0.5	10.5±0.6	10.4±0.3	7.5±0.5 [z]	8.2±0.4
Infant Feeding Method									
Formula (n=73)	73.1±1.2	10.8±0.3	9.4±0.3 [w]	4.8±0.3	8.6±0.3	9.7±0.3 [w]	10.9±0.3	9.8±0.4	9.2±0.2

Formula/ Lactating (n=51)	75.5±1.5	11.6±0.4	9.8±0.3	4.5±0.3	9.1±0.4	10.9±0.3 [x]	11.4±0.3	9.4±0.5	8.9±0.4
Lactating (n=55)	73.4±1.2	10.6±0.3	10.5±0.3 [w]	4.3±0.3	8.8±0.4	10.6±0.4	10.3±0.3	9.5±0.4	8.7±0.3

[a] Pairwise comparisons for emotional eating and ethnicity were conducted using Fisher's least significant difference method. Analysis of variance was significant (F=3.04, P=0.05).

[w,x] Different superscripts across rows, within categories indicate significant differences at $p < 0.05$.

[y,z] Different superscripts across rows, within categories indicate significant differences at $p < 0.01$.

stimulus variables and demographics, although some have found a trend between age and increased dietary restraint (154,203).

Environmental and psychological stimuli were among the best predictors of weight status. High BMI was associated with lower Total ($r=-0.16$, $P<0.05$), Convenience Eating ($r=-0.25$, $P<0.01$), Emotional Eating ($r=-0.17$, $P<0.05$), and Dietary Restraint ($r=-0.21$, $P<0.01$) scores. Additionally, these subscales predicted BMI in regression analysis, after controlling for ethnicity (Table 1). Women with lower scores on the entire 23-item scale also had significantly higher BMI ($r=-0.16$, $P<0.05$; $R^2=0.07$, $\beta=-0.17$, $P<0.01$). These findings confirm other studies demonstrating a positive relationship between BMI and environmental eating (28,240), emotional eating (47,172), and dietary restraint (47,210). While high dietary restraint is not always associated with excess weight (14,190), it may be a positive weight control behavior in low-income populations, as it is associated with long-term weight maintenance (241), healthful food choices such as fruits and vegetables (41), and less frequent fast food consumption (71).

The Eating Stimulus Index can be used in clinical and public health settings to assist development of targeted weight loss interventions. Tailored messages, or personalized health related advice, are known to increase positive intervention outcomes (212). Studies that have applied this strategy have been successful (128,211), especially those in low-income women (112,116,119,152,196). Martin and colleagues (152) conducted a weight loss intervention for low-income women using tailored messages provided by a team of health professionals including dietitians who provided nutritional recommendations based on current eating practices and preferences. Individuals

receiving personalized information lost 2.0 kg compared to 0.2 kg gain in controls. This finding suggests that since inadequate resources in health promotion may not provide intensive treatment on a large scale, a tool to quickly and efficiently identify individual needs is warranted.

Limitations

The ESI measures a variety of influences on food intake; however, not all could be included in the scale. For example, a distinct measure for portion size was accounted for indirectly through Convenience Eating, as these items are often sold in larger than recommended portion sizes (263). Questions regarding taste were intended to capture preferences for all foods, as taste has been related to dietary intake (17). However, questions regarding vegetables were the only items retained after reducing the item pool. Fruit and vegetable availability were captured by a three-item subscale that did not inquire about canned or frozen items, which have been found to be more prominent in predominantly minority areas (161). Although only a limited concept of availability was examined, assessment of fresh fruit and vegetable availability versus canned or frozen is of greater importance as this may reflect disparities in access to healthful foods (221). Five questions regarding nutrition knowledge were developed for the scale since knowledge impacts food choices (248) and may be a key determinant for weight loss in low-income women (124). However, these items failed to meet criteria for inclusion in the final instrument. The diverse nature of the construct suggests that it may be too vast to be captured by a 3-5 question subscale. Thus, studies that utilize the ESI may be helped by using a secondary scale for knowledge. Overall, generalization of these

findings should be made with caution, as eating motivations related to BMI in this study may be unique to the postpartum period in low-income women. Validation in other populations is needed.

CONCLUSIONS

The need for sound weight loss advice is essential. While diet and exercise modification are the general techniques, inducing behavior change at the individual level is difficult. Obesity treatment requires consideration of multiple elements such as vulnerability to eating in response to environmental cues, the physical need or desire for food, or psychological distress. This research created a new instrument, which can be used in clinic and public health settings to quickly identify motivations to eat. Dietitians can use knowledge from this questionnaire to design personalized strategies that target vulnerable eating behaviors in the individual. For example, a person strongly influenced by convenience eating stimuli can be taught weight management strategies specific to this behavior. Therefore the Eating Stimulus Index may be a useful tool for the prevention and treatment of obesity in low-income, minority women.

Chapter 3: Motivations to Eat Impact Diet Quality and Nutrient Intake in Overweight and Obese, Low-Income Women in Early Postpartum

ABSTRACT

Healthful dietary practices and a return to prepregnancy weight are of significant importance in the prevention of obesity for women. To explore the impact of motivations to eat on diet, the Eating Stimulus Index (ESI) was used to identify relationships in 115 overweight and obese, low-income women in early postpartum. In this cross-sectional design, participants completed the Eating Stimulus Index (ESI) and a 195-item food frequency questionnaire. Diet quality was assessed using the Dietary Guidelines Adherence Index. In all subjects, diet quality was related to greater fruit and vegetable availability ($r=0.25$, $P<0.01$), convenience eating resistance ($r=-0.36$, $P<0.001$), and vegetable taste preference ($r=0.23$, $P<0.05$). Women with greater fruit and vegetable availability and convenience eating resistance consumed more fiber ($r=0.269$, $P<0.01$), magnesium ($r=0.221$, $P<0.05$), vitamin C ($r=0.200$, $P<0.05$), and potassium ($r=0.227$, $P<0.05$). In overweight women, diet quality was influenced more strongly by convenience eating resistance ($\beta=0.454$, $P<0.01$) and by vegetable taste preference ($\beta=0.42$, $P<0.001$) in those who were obese. Weight loss interventions in postpartum may benefit from delivering messages tailored according to weight status.

INTRODUCTION

The postpartum period is a critical time for achieving a healthy weight status to avoid future development of obesity (145,195). Low-income women may be at particular risk for weight gain due to higher weight retention during this time (185,213) and less than optimal dietary intakes as evidenced by poor adherence to the dietary guidelines (78). A longitudinal study of low-income women in the first year following childbirth observed that fruit, vegetable, and grain intakes declined following pregnancy, while energy from fat and sugar increased (77). A shift away from healthful diets after a baby is born is not surprising, given the high stress nature of this unusual time in a woman's life. While knowledge of food intake patterns is useful, a further understanding of the factors that motivate eating during this stage may be essential for the prevention and treatment of obesity.

Why people choose the foods they eat has been the subject of numerous studies (41,54,63). Motivations to eat are influenced by a variety of determinants, including environmental (221), biological (235), and psychological (101) factors. For example, greater availability of healthful foods in the home (127) and preferences for the taste of vegetables have been associated with higher intakes of these items (164). The Eating Stimulus Index (ESI) is a scale designed to evaluate motivations to eat in low-income women in early postpartum (30). Previously, this instrument has been used in this population to identify the relationships between vulnerability to motivations to eat and body mass index. Specifically, eating in response to the environment, negative emotional state, and low dietary restraint were determined to be related to increased weight status.

The influence of motivations to eat on dietary intake will be explored in the present research.

The purpose of this paper is to determine the impact of motivations to eat on food and nutrient intakes in low-income women just after childbirth. It is hypothesized that motivations to eat may relate to consumption of a more healthful diet and differ between overweight and obese women. Information regarding why people choose their foods may facilitate the development of tailored interventions to improve diet quality and decrease postpartum weight retention.

METHODS

Design of Study

The impact of motivators to eat on diet quality and intake were evaluated in overweight/ obese (BMI≥25), low-income women recruited from Special Supplemental Nutrition Program for Women, Infants, and Children clinics, doctor's offices, and neighborhood centers. On one visit to the study center, women (N=115) were measured for weight and height and completed the ESI, demographics, and food frequency questionnaires. Diet quality was evaluated using the Dietary Guidelines Adherence Index (68) and then relationships to intake were explored.

Subjects

Low-income mothers who expressed interest in the study were prescreened over the telephone and then enrolled in the study. Criteria for participation were BMI ≥ 25,

between 18-40 years of age, infant between 0-4 months, annual household income <185% of the poverty line, and Hispanic, African-American, or White ethnicity. Additional requirements were the ability to read, speak, and write English, parity ≤ 3, lack of participation in previous weight loss studies, and absence of pregnancy and diabetes. Subject characteristics, including ethnicity, age, income, education, parity and lactation status, were assessed via a modified demographics questionnaire (40). All subjects provided informed consent and The University of Texas at Austin Institutional Review Board approved this study protocol.

Anthropometrics

For all subjects, height was measured with a wall mounted stadiometer to the nearest 0.1 centimeter (Medical Resources, Columbus, OH) and weight was determined via an electronic weighing scale to the nearest 0.1 kilogram on one occasion without shoes, in light clothing (TBF-300A, Tanita, Arlington Heights, IL). Body mass index (BMI) was calculated as weight (kilograms) / height (meters)^2 and overweight and obesity were defined as BMI ≥ 25 and < 30 and BMI ≥ 30, respectively (165).

Eating Stimulus Index

The ESI is a 23-item questionnaire developed to assess motivations to eat in low-income women in postpartum (30). This scale measures multiple dimensions of eating stimuli including fruit and vegetable availability, convenience eating, social acceptance, hunger, taste, self-efficacy, emotional eating, and dietary restraint. Individual questions

have been reported previously (30). A high score signifies a more beneficial response to motivations to eat. For clarification, subscale names were slightly expanded to provide a better explanation for the construct measured, including convenience eating resistance, morning hunger/breakfast, vegetable taste preference, weight loss self-efficacy, and emotional eating resistance (Table 3.1).

Assessment of Dietary Intake

Dietary Intake was assessed using a 195-item food frequency questionnaire that has been validated previously in low-income, postpartum women (79). The instrument includes culturally appropriate foods such as migas, menudo, and fideo. Participants were provided instructions on how to complete the questionnaire by trained individuals and recorded the frequency and portion size of foods consumed since childbirth. Accurate portion size estimation was encouraged through visual demonstrations of measuring cups, spoons, and food models. Completed food frequency questionnaires were scanned for errors; forms with ≥ 15 items blank were considered incomplete and removed from analysis. Subjects whose total energy intake was ≤ 500 and ≥ 5000 kilocalories were excluded, as these cutoff values have been used in previous studies in similar populations (78,82,259,260). Daily intakes for nutrients were calculated via multiplication of the frequency, portion size, and nutrient content for each item and then summed across each nutrient. Nutrient content was obtained from the USDA National Nutrient Database, version SR19 (2006). The source of meals was estimated by the percentage of meals consumed from home, restaurants, fast food, or grocery carry out.

To assess diet quality, foods were assigned to categories based on the MyPyramid (163). Mixed foods were disaggregated and then assigned to the appropriate category. For example, a fast food breakfast sandwich was broken down into an English muffin, Canadian bacon, cheese, and eggs; these items were then assigned to the grain, meat, dairy, and meat group, respectively. In accordance with the 2005 Dietary Guidelines (231), legumes were first assigned to the meat group to fulfill requirements; then the remaining servings were counted towards the vegetable group. In this study, discretionary energy was determined by totaling the excess calories from solid fat, alcohol, and added sugar. However, only discretionary energy from added sugars was used to calculate the DGAI score, as defined by the index (68).

Dietary Guidelines Adherence Index

The DGAI consists of 21 items designed to assess adherence to the key recommendations of the 2005 Dietary Guidelines for Americans (68). Points for each item ranged from 0 to 1, with a maximum score of 20 for full adherence. Energy needs were calculated for each individual using the Estimated Energy Requirement (EER) (109). An additional 330 kilocalories/day were added to the EER of lactating mothers to account for milk production. Women were assigned to one of eight USDA energy patterns (231), ranging from 1800-3200 kcal/day. Index scores were calculated for each subject, according to recommended servings for the specific energy level.

Methods of Statistics

Statistical analysis was conducted using SPSS 15.0 (Chicago, IL, 2006). Normality tests were computed for each variable and natural log, inverse, or square root transformations were conducted as necessary. Frequencies and means ± standard error of the mean were used to describe the sample and one-way analysis of variance using Bonferroni post hoc analysis detected differences between groups. Pearson product moment and partial correlation coefficients were used to describe relationships between variables using total energy (kcals) as the covariate where applicable. A modified Bonferroni adjustment was applied to the alpha levels for correlations to correct for multiple comparisons (110). Statistical significance was established at $P<0.05$.

Linear regression analyses were conducted using food groups and DGAI as the dependent, and ESI subscales as the independent, variables. Demographic characteristics and BMI were entered into the initial models, but they were dropped from the final analysis due to lack of significance. In the analysis for DGAI score, BMI was retained in the final model, as it was significantly related to this variable. All other models were controlled for energy intake (kilocalories). Statistics reported included the standardized beta coefficient and p value.

RESULTS AND DISCUSSION

The majority of the women in the sample were 18-24 years old (44.3%), of Hispanic ethnicity (57.4%), and had at least partial college (53.9%). They reported an

average of 1.9±0.08 children, and over half (53.9%) were breastfeeding at least 50% of the time.

The mean DGAI score for the sample was 8.8±0.2, with a range of 3.0-14.0; it did not differ by demographics. This DGAI score is slightly lower than that reported in a national sample of adults (9.6 with a range from 2.5 to 17.5) (68). The sample was divided according to weight categories; mean BMIs for women classified as overweight (BMI ≥25 and <30 kg/m^2) or obese (BMI ≥30 kg/m^2) were 27.1±0.2 and 36.4±0.6 ($P<0.001$), respectively. Overweight women had significantly higher diet quality scores than did the obese women (9.6±0.3 vs 8.3±0.3, $P<0.01$); demographics did not differ.

Mean ESI scores were 74.6±0.9, ranging from of 49.0 to 97.0. Relationships between ESI subscale scores and dietary intake and source of meals are presented in Table 3.1. A better diet quality was associated with higher fruit and vegetable availability, more resistance to convenience eating, and a greater taste preference for vegetables. Additionally, women who reported greater fruit and vegetable availability consumed more servings of fruits and vegetables ($P<0.05$) and quantities of nutrients associated with these foods than those with lower scores. High discretionary energy intake was associated with low resistance to convenience eating and low morning hunger/breakfast scores. High total energy intake was associated with low resistance to convenience eating, weight loss self-efficacy, resistance to emotional eating, and dietary restraint. Furthermore, women who reported high fruit and vegetable availability consumed more meals at home ($P<0.001$) and fewer from fast food ($P<0.001$) than their counterparts.

Table 3.1. Correlation coefficients for subscales of the Eating Stimulus Index and overall diet quality and daily food group intake in low-income, minority women in early postpartum[a]

	Fruit and Vegetable Availability	Convenience Eating Resistance	Social Acceptance	Morning Hunger/ Breakfast	Vegetable Taste Preference	Weight Loss Self-Efficacy	Emotional Eating Resistance	Dietary Restraint
Dietary Guidelines Adherence Index	0.252*	0.352*	-0.013	0.051	0.233*	0.069	0.049	0.075
MyPyramid Food Group								
Grains (oz equivalents)	-0.026	-0.068	0.105	-0.053	-0.050	0.002	-0.034	-0.158
Fruit (cup equivalents)	0.203	0.293*	0.041	0.179	0.194	0.061	0.002	0.247*
Vegetables (cup equivalents)	0.274*	0.156	-0.224	-0.060	0.215	0.057	0.042	-0.118
Milk (cup equivalents)	-0.053	0.173	0.052	0.205	-0.122	-0.013	-0.102	0.015
Meat/beans (oz equivalents)	-0.053	0.173	0.052	0.205	-0.122	-0.013	-0.102	0.015
Discretionary Energy (kcals)	-0.103	-0.361*	-0.014	-0.321*	0.017	-0.203	0.011	-0.090
Nutrient								
Energy (kcals)	-0.088	-0.233*	-0.162	-0.077	-0.012	-0.342*	-0.233*	-0.292*
Carbohydrates (g)	0.048	0.071	0.117	-0.073	0.077	-0.090	0.149	0.018
Protein (g)	0.088	-0.018	-0.083	0.132	0.039	0.195	-0.092	-0.068
Fat (g)	-0.002	-0.221	-0.140	0.043	0.001	0.098	-0.125	-0.079
Fiber (g)	0.259*	0.281*	-0.141	0.079	0.195	0.058	-0.154	-0.103
Folate (mg)	0.175	0.226	-0.126	0.225	0.031	0.166	-0.007	-0.067
Magnesium (mg)	0.221	0.376*	-0.001	0.171	0.127	0.064	-0.203	-0.054
Potassium (mg)	0.229	0.318*	-0.137	0.202	0.221	0.211	-0.113	0.007
Vitamin K (μg)	0.189	0.307*	-0.047	0.107	0.184	0.111	0.049	0.191

Vitamin C (mg)	0.285*	0.146	-0.050	-0.088	0.250	0.251	-0.013	-0.117
Source of meals								
Home	0.380*	0.075	0.054	0.139	-0.012	-0.013	-0.039	-0.058
Restaurants	-0.155	0.048	-0.181	0.126	-0.018	-0.044	0.129	0.101
Fast foods	-0.293*	-0.046	-0.006	-0.122	0.004	-0.033	0.101	0.130
Grocery carry out	0.187	0.099	-0.090	0.158	-0.007	0.044	0.083	-0.028

[a] Partial correlation coefficients after adjusting for total energy (kcals).

* P<0.05 after Bonferroni adjustment.

Differences in motivations to eat and select food group intakes between overweight and obese women are shown in Table 3.2. Fruit and vegetable availability was positively related to intake in both groups. This subscale was significantly associated with vegetable intake in overweight ($P<0.01$) and with fruit intake in obese ($P<0.05$) women. The primary motivation to eat in overweight women was resistance to convenience eating, which was the strongest predictor of diet quality ($P<0.01$), fruit ($P<0.01$), vegetable ($P<0.05$), and discretionary energy ($P<0.001$) intakes. Additionally, greater feelings of hunger in the morning and breakfast consumption also were related to discretionary intake ($P<0.01$). In obese women, a taste preference for vegetables was the primary predictor of better diet quality ($P<0.001$), and fruit ($P<0.05$) and vegetable ($P<0.05$) intakes.

Impact of Motivations to Eat

In this study, overall diet quality was positively related to the fruit and vegetable availability, convenience eating resistance, vegetable taste preference subscales of the ESI. These results reflect previous studies that have shown that fruit and vegetable availability may improve intake of these foods (23,127). Fruit and vegetable availability also has been found frequently to be a strong indicator of consumption, especially in children (167,191,217). In adults, the few studies that have examined this relationship have found similar results. Kratt and colleagues (127) measured fruit and vegetable availability in parent-child pairs and observed that parents with the most availability also had the highest intake. Given that access to fresh produce is a reported barrier to consumption in

Table 3.2. Regression analysis of overall diet quality and food group intake using Eating Stimulus Index subscale scores in low-income, minority women in early postpartum

Category	Fruit and Vegetable Availability	Convenience Eating Resistance	Social Acceptance	Morning Hunger/ Breakfast	Vegetable Taste Preference	Weight Loss Self-Efficacy	Emotional Eating Resistance	Dietary Restraint
All (N=115)								
DGAI [b]	0.278**	0.224*	-0.068	0.076	0.239**	0.000	-0.098	-0.066
Fruit [c]	0.180*	0.266**	0.037	0.159	0.172*	0.057	0.001	0.228**
Vegetables	0.223**	0.131	-0.184*	-0.049	0.175*	0.049	0.035	-0.100
Discretionary Energy	-0.075	-0.277***	-0.009	-0.239***	0.015	-0.161*	0.010	-0.071
Overweight (n=46)								
DGAI	0.248	0.419**	0.028	0.179	-0.015	0.005	-0.112	0.184
Fruit	0.195	0.405**	-0.034	0.292*	0.144	0.100	-0.118	0.282
Vegetables	0.332**	0.290*	-0.179	0.152	0.107	-0.009	-0.113	-0.103
Discretionary Energy	-0.108	-0.449***	-0.101	-0.312**	0.148	-0.066	-0.081	-0.196
Obese (n=69)								
DGAI	0.292*	0.064	-0.157	-0.016	0.421***	-0.007	-0.099	-0.235
Fruit	0.214*	0.102	0.028	0.090	0.225*	0.048	0.006	0.161
Vegetables	0.167	0.019	-0.195	-0.169	-0.203*	0.073	0.111	-0.114
Discretionary Energy	-0.042	-0.087	0.054	-0.171	-0.066	-0.239*	0.092	0.038

[a] Models were conducted using each component of the ESI as independent variables and the DGAI[b] and food groups as dependent variables while controlling for energy intake. All values represent standardized beta coefficients.

[b] Dietary Guidelines Adherence Index was used to assess overall diet quality.

[c] All food group servings were computed in servings per day based on the MyPyramid recommendations.

*, **, *** P<0.05, 0.01, 0.001, respectively.

low-income populations (261), strategies to increase home availability such as purchasing items in season and providing vouchers to local farmers' markets (3) should be emphasized in educational programs.

Better quality diets were observed in women who were less vulnerable to environmental eating cues, or had more resistance to convenience eating, as evidenced by higher diet quality scores and fruit servings and lower discretionary energy intake. These findings are not surprising since convenience foods tend to be high in fat, calories, and sugar (55,114), and their consumption is associated with excess energy and lower micronutrient intakes (24,181). An interesting finding was that this motivation to eat had a more significant impact on dietary intake in overweight, as compared to obese, women. Previous research has found that obese individuals may be more responsive to environmental eating cues (28,238). Also, in a study using the ESI, convenience eating resistance was a significant predictor of BMI (30). While resistance to convenience eating did not predict food intake in obese women, their subscale scores were significantly lower than their overweight counterparts (9.6 ± 0.3 vs 10.6 ± 0.4, $P<0.05$). This indicates that obese women are more vulnerable to environmental eating cues; however a lack of variance within this group may have prevented the detection of an association with diet.

A taste preference for vegetables has been linked to a greater consumption of these foods (235). A stronger liking for vegetables was the primary influence on diet quality and vegetable intake in obese women. A study of parent-preschool child pairs found that taste preference and the purchase of fruits and vegetables were strongly related

to dietary intake of these foods (164). The origination of taste preferences in adults may result from consumption, and/or exposure to, fruits and vegetables as a child. When Haire-Joshu and colleagues (90) examined childhood influences on current fruit and vegetable intake in African American women, those who reported eating more vegetables as a child had a stronger preference as adults. Tastes continue to change through the life cycle and acclimatization to new foods can occur after multiple encounters (31,264). Thus, strategies to increase exposure to the taste of vegetables should be a main component in weight loss interventions targeted for obese women.

The DGAI was developed to assess diet quality according to the 2005 Dietary Guidelines for Americans (68). This measure was chosen as an assessment of diet quality because it penalizes for overconsumption. To calculate a DGAI score, the estimated energy requirement for each individual is calculated, and dietary intake then is compared to the MyPyramid recommendations for the specific calorie level. This process ensures that intakes beyond needs negatively impact the score. Thus, the DGAI seemed an appropriate measure to use in this sample of overweight women who frequently consume more energy than recommended (123,198).

In the present study eating in response to emotions and dietary restraint did not relate to overall diet quality or food group intakes. In contrast, eating in response to emotions has been reported as a barrier to healthful eating (35) and a trigger for overeating in low-income women (178). Also, dietary restraint in this population has been associated with healthful food choices, such as more fruits and vegetables and fewer cakes, cookies, and ice cream (41). In the current research, mothers with high dietary

restraint and a low tendency to eat in response to emotions consumed fewer calories, protein, and fat.

A limitation of this study was the absence of normal weight subjects to examine differences across a full range of BMI. Because the presence of healthy weight subjects in the Women Infants and Children low-income population we studied was almost nonexistent in early postpartum, this group could not be obtained within the period of data collection. Other potential difficulties in this study are the possible underreporting and misrepresentation of energy and dietary intakes in self-reported dietary measures, particularly in obese individuals (123,198).

CONCLUSIONS

Specific motivations to eat identified by the Eating Stimulus Index were related to food and nutrient intakes and overall diet quality in low-income women in early postpartum. Fruit and vegetable availability and convenience eating resistance most strongly predicted diet quality in overweight women, and fruit and vegetable availability and vegetable taste preference in obese women. These findings further validate the use of the ESI as a tool to identify factors that stimulate eating in this population. Once the primary eating stimuli are determined, care providers could use this information to offer behavior modification strategies specific to individual needs. This study suggests interventions designed to improve dietary intake and achieve weight loss would benefit by tailoring messages according to body size, similar to recommendations by others (34,122).

Chapter 4: Evaluation of Factors within that Influence Weight Loss in Low-Income, Women in Early Postpartum

ABSTRACT

Objective: To evaluate determinants of weight loss in low-income women in early postpartum.

Design: Low-income, triethnic women participated in an 8-week weight loss intervention. Subjects were measured for weight and height and completed demographics, the Eating Stimulus Index, a nutrition knowledge test, a food frequency questionnaire, and a household environment survey.

Subjects/setting: A sample of 58 women in early postpartum was recruited from the Special Supplemental Program for Women, Infants, and Children clinics, doctors' offices, and neighborhood centers. Primary enrollment criteria included White, Hispanic, or African-American ethnicity, income < 185% of the federal poverty level, infant between 1.5-4 months, and parity ≤ 3.

Statistical analysis performed: Means and frequencies described characteristics of the sample. Paired-samples t-tests and Wilcoxon signed rank tests were conducted to determine pre/post study differences and independent samples t-tests and Mann-Whitney U were conducted to determine differences between responders (n=36) and nonresponders (n=22). Correlations and linear regression determined associations with the outcome variable weight loss.

Results: All subjects improved their nutrition knowledge, skills, convenience eating resistance, and fruit and vegetable availability after the intervention. Responders had greater changes in dietary restraint, fruit juice servings, and discretionary energy than did nonresponders. Increases in dietary restraint, weight management skills, and weight loss self-efficacy and decreases in fruit juice servings and discretionary energy intake significantly predicted weight loss in individual regression analysis. After hierarchical regression analysis, improvement in weight loss self-efficacy was the most significant determinant followed by decreases in discretionary energy intake

Conclusions: Positive changes in the Social Cognitive Theory constructs are associated with weight loss in low-income postpartum women. Dietary restraint, weight management skills, weight loss self-efficacy and consumption of fruit juice and discretionary energy are modifiable factors that should be emphasized in interventions designed for this population.

INTRODUCTION

Postpartum represents an important time of transition that can impact the future development of obesity and related disease risks in the mother. For example, the risk of becoming obese increases 60-110% with the delivery of one child (254). This risk is even greater in low-income women (233). The weight gained during pregnancy and retention after childbirth may be responsible for this effect. In a study by Rooney and Schauberger (195), a failure to return to prepregnancy weight after 6 months predicted

obesity at a 10-year follow up. Additionally, a longitudinal study in low-income postpartum women found that weight loss occurs through the first 6 weeks after childbirth, followed by weight gains through the remainder of the first year (244). Factors related to these observations were ethnicity, prepregnant BMI, gestational weight gain, and energy intake. Thus, early postpartum may be a critical time to improve weight status in low-income women.

Many overweight individuals may be ready to lose weight, but less ready to perform the behaviors necessary to achieve their goals (130). Known factors that have been related to weight status in low-income women include nutrition knowledge (124), attitudes (172), and satisfaction with appearance (40). Nuss and colleagues (173) followed low-income women through the first year postpartum and found that higher nutrition knowledge was related to lower weight retention. Nutrition knowledge in low-income women also has been associated with weight loss after an intervention (124). The role of social support and satisfaction with appearance was examined by Clarke and colleagues (40) who determined that these factors predicted weight loss after an intervention. There are also significant barriers to healthful dietary practices and achieving weight loss, including neglect of self care, weight related distress, negative body image, stress, and depressive symptoms (78).

The Social Cognitive Theory posits that health behavior is guided by the principle of reciprocal determinism, which states that the interactions between behavior, environment, and the person lead to human action (10). This theory has frequently been used to design weight management interventions (2,125,166,179,249). Behavior change

can occur through modification of the three main constructs, which have all been associated with weight status. In this theory, behavior change arises from the dynamic interplay of behavioral, environmental, and psychological determinants. Many of these factors have been studied within the context of weight loss. For example a limited list includes behavioral factors such as dietary restraint (70,89), nutrition knowledge (124), and skills (103), environmental factors such as the presence of foods in the environment (155), and personal factors such as self-efficacy (152,184) and taste preferences (83). Additional determinants within this theory include social support (8,72) and outcome expectancies (32); however, these could not be measured within the scope of this study.

The purpose of this study was to evaluate determinants of weight loss within the framework of the Social Cognitive Theory using an intervention for low-income women just after childbirth. This population was selected because an intervention conducted during early postpartum could be instrumental for the subsequent prevention of obesity later in life. Results from this research will increase the understanding of modifiable factors that may facilitate successful weight loss.

METHODS

Design of Study

Low-income, overweight/obese women in early postpartum (n=58) participated in an 8-week weight loss intervention program. Subjects made ten visits to a clinic or classroom within the community. Prestudy and post-intervention data were collected at

visits one and ten, and weight loss classes were held during the other times. Prestudy included measurements for height and weight and administration of a demographics (40), Eating Stimulus Index (30), and food frequency questionnaire (79), as well as a nutrition knowledge test (124) and a household environment survey. The same measures were repeated at poststudy. All subjects provided informed consent and The University of Texas at Austin Institutional Review Board approved this study protocol.

Subjects

Low-income, postpartum mothers were recruited from the Special Supplemental Nutrition Program for Women, Infants, and Children clinics, doctors' offices, and neighborhood centers. Participants who expressed interest in the intervention were prescreened over the telephone and then enrolled in the study if they met the following criteria: BMI $\geq$ 25, between 18-40 years of age, infant between 0-4 months, annual household income <185% of the poverty line, and Hispanic, African-American, or White ethnicity. Additional requirements were the ability to read, speak, and write English, parity $\leq$ 3, lack of participation in previous weight loss studies, and absence of pregnancy and diabetes. Subject characteristics such as ethnicity, age, income, education, and lactation status were assessed via a modified demographics questionnaire (40). A total of 67 women completed the study and an additional 9 subjects were eliminated from the analysis for incomplete or missing questionnaires (n=7) and energy intake levels below (n=2) the cut off values.

Anthropometrics

For all subjects, height was measured with a wall mounted stadiometer to nearest 0.1 centimeters (Medical Resources, Columbus, OH); weight (to the nearest 0.1 kilograms) and % body fat were determined via an electronic weighing scale on one occasion without shoes in light clothing (TBF-300A, Tanita, Arlington Heights, IL). Body mass index (BMI) was calculated as weight (kilograms) / height (meters)^2. Gestational weight gain was calculated as self-reported weight just before birth minus prepregnancy weight. Self-reported measures have been used previously (118,200) as they are considered to be reliable (220). Weight loss was calculated as pre-study minus post-study weight.

Intervention for Weight loss

The 8-week intervention was designed according to the principles of cognitive-behavioral strategies within the Social Cognitive Theory (10). The program was derived from a curriculum by Klohe-Lehman and colleagues (125) for low-income mothers of 1-3 year old children. It was designed to be offered for a relatively short period of time to fit within the busy lifestyle of a new mother. Modifications included a focus on infant feeding methods and nutrition. The program emphasized improvements in Social Cognitive Theory constructs such as self-monitoring through food diaries, stimulus control through identification of vulnerable eating behaviors and alternatives, and contingency management including prizes for achieving weekly goals. Participants attended weekly 1 ½ hour sessions that included a diet recall, personalized feedback,

quiz, and discussion. The focus of the intervention was to improve nutrition related knowledge and skills, encourage self-monitoring behaviors (such as food diaries and pedometers), and increase physical activity.

Measures

The measures used in this study and their reliability coefficients are described in Table 4.1. Motivations to eat were assessed via the Eating Stimulus Index, a 23-item instrument previously developed and validated in low-income women (30). Levels of nutrition related knowledge were determined via a 46-item questionnaire that was modified from the original developed in mothers of 1-3 year olds; questions on infant feeding and nutrition were added (124). Additional constructs were assessed via a short household environment survey, which included items regarding weight management skills, availability of foods, eating habits, and self-reported engagement in cardiovascular exercise.

Assessment of Dietary Intake

A 195-item food frequency questionnaire was used to assess dietary intake (79). Completed questionnaires were scanned for errors and forms with ≥ 15 items blank were considered incomplete and removed from analysis. Subjects whose total energy intake was ≤ 500 and ≥ 5500 were excluded as these cutoff values have been used in previous studies in similar populations (78,82,259,260). Daily intakes for nutrients were calculated via multiplication of the frequency, portion size, and nutrient content for each

Table 4.1. Behavioral, environmental, and personal constructs measured in a weight loss intervention in low-income, minority women in early postpartum

Construct	Instrument	Description	Mean±SEM[a]	Prestudy Range
Environmental				
Convenience eating resistance	Eating Stimulus Index	Questions regarding resistance to the consumption and purchase of convenience foods	10.4±0.3	3-15
Fruit and vegetable availability	Eating Stimulus Index	Questions regarding the availability of fresh fruits and vegetables in the home	11.3±0.3	4-15
Types of sweetened beverages in home	Household environment survey	"How many types of fruit juices/Kool-aid do you have in your home?" "How many types of regular sodas/sweet teas do you have in your home?"	2.7±0.3	0-9
Types of desserts in home	Household environment survey	"How many types of cookies do you have in your home?" "How many types of doughnuts/muffins/pastries do you have in your home?" "How many types of cakes/cupcakes/brownies do you have in your home?"	1.3±0.2	0-8
Eating in front of television	Household environment survey	"Do you eat meals in front of the television?", "Do you eat snacks in front of the television?"	6.4±0.3	0-10
Behavioral				
Dietary restraint	Eating Stimulus Index[b]	Questions regarding ability to restrain eating	8.8±0.3	5-13
Nutrition knowledge	Nutrition knowledge test[c]	Test of macronutrient, micronutrient, infant nutrition, and weight management knowledge	31.8±0.6	22-39
Weight management skills	Household environment survey	"I use the information on a food label to select foods," "I keep track of the foods I eat on a daily basis," "I pack nutritious snacks when I go out for the day"	7.5 ±0.3	3-12

Dietary intake				
Dark green/orange vegetables	Food frequency[d] questionnaire	Weekly serving	3.3±0.3	0.0-10.6
Whole fruit	Food frequency questionnaire	Daily serving	1.2±0.1	0.0-4.8
Fruit juice	Food frequency questionnaire	Daily serving	0.8±0.1	0.0-3.1
Energy	Food frequency questionnaire	Daily kilocalories	2869.0±134.0	800.5-4904.9
Discretionary energy	Food frequency questionnaire	Daily kilocalories from solid fat, alcohol, and added sugars	446.4±39.1	33.8-1390.9
Aerobic exercise	Household environment survey	Self-reported number of hours per week for each of the following physical activity behaviors: aerobics, jogging, and fast walking	1.1±0.4	0-24
Personal				
Weight loss self-efficacy	Eating Stimulus Index	Questions regarding weight management self-efficacy	10.7±0.3	5-15
Social acceptance	Eating Stimulus Index	Questions regarding levels of comfort with weight	4.9±0.3	2-10
Morning hunger/breakfast	Eating Stimulus Index	Questions regarding feeling hungry in the morning or night and breakfast consumption	9.4±0.4	4-15
Vegetable taste preference	Eating Stimulus Index	Questions regarding taste preferences for different types of vegetables	10.5±0.3	5-15

[a] SEM represents standard error of the mean.

[b] The Eating Stimulus Index was previously validated in a sample of low-come women (30).

[c] The Nutrition knowledge test was previously validated in a sample of low-come women (124).

[d] The Food frequency questionnaire was previously validated in a sample of low-come women (79).

item, and then summed across each nutrient. Nutrient content was obtained from the USDA Food Search for Windows, Version 1.0, database version SR19. Foods consumed were assigned to categories based on the MyPyramid (163), as described previously. Discretionary energy was determined by totaling the excess calories from solid fat, alcohol, and added sugar.

Methods of Statistics

All analysis was conducted using SPSS 15.0 (Chicago, IL, 2006). Normality tests were computed for each variable; log, inverse, or square root transformations were conducted as necessary, and extreme outliers were identified and removed from individual analysis. Means ± standard error of the means were used to describe continuous and frequencies were used to describe categorical variables of the demographic characteristics. Independent samples t-test and chi-square test (χ^2) were conducted to determine differences between continuous and categorical variables, respectively. Social Cognitive Theory construct variables were examined using paired-samples t-tests and Wilcoxon signed rank tests to determine pre/post study differences and independent samples t-tests and Mann-Whitney U to determine differences between responders and nonresponders. Change after the intervention was calculated by subtracting the pre from the post intervention value for each construct. Pearson's product-moment and Spearman's rho correlation coefficients using a modified Bonferroni adjustment (110) were used to describe relationships between constructs of the Social Cognitive Theory and weight loss.

Linear regression analysis was conducted to describe the relationship between each variable of the Social Cognitive Theory and weight loss. To determine covariates for these analyses, associations between the outcome variable and demographics were initially examined via correlations, t-tests, one-way analysis of variance, and χ^2 tests. Gestational weight gain was the only variable that contributed significantly to the models. Statistics reported include R^2 change, standardized beta coefficient, and p value for each model.

Hierarchical regression analysis was conducted to develop a model to predict weight loss. Exploratory analysis using backwards stepwise regression was first conducted to determine the most important contributors to the model. Demographic variables entered in this regression included gestational weight gain and infant feeding method. Change variables that had the strongest relationship with the outcome variable also were incorporated. These included dietary restraint, weight management skills, fruit juice servings, total energy intake, discretionary energy intake, and weight loss self-efficacy. The variables that remained in the stepwise regression included gestational weight gain, change in discretionary energy intake, and weight loss self-efficacy scores. Total energy was the first excluded variable, followed by formula feeding, fruit juice, restraint, weight management skills, and finally breastfeeding. Second, hierarchical analysis was conducted using the demographic characteristics of gestational weight gain and infant feeding method as block 1 to control for their effect. Block 2 variables included change in discretionary energy intake and self-efficacy scores. The statistics

reported include the F change, standardized beta coefficient, adjusted R^2, and p value. Statistical significance was established at $P<0.05$.

RESULTS

The demographic characteristics of the sample (n=58) are shown in Table 4.2. Subjects were divided into responders and nonresponders to the intervention based on weight loss of ≥2.27 kg and < 2.27 kg, respectively. Women ranged from 19-39 years old, 57.3-136.6 kg body weight, 27.8-53.4 % body fat, 76.2-154.9 cm waist circumference, and -9.0-90.0 kg gestational weight gain. The majority of the sample was Hispanic, had at least a partial college education, breastfed, and lived with a spouse or partner. Women who responded to the intervention were more likely to breastfeed their infant full time than did nonresponders. However further examination by one way analysis of variance indicated that weight loss did not differ by lactation status. Mean weight loss for breastfeeding, combination feeding, and formula feeding mothers was 3.7±0.6, 2.2±0.7, and 2.8±0.8, respectively (P=0.292).

After completion of the weight loss intervention, participants significantly improved in environmental, behavioral, and personal areas (Table 4.3). Mean scores for the following were higher in all participants at post intervention: convenience eating resistance, fruit and vegetable availability, nutrition knowledge, and weight management skills. Additionally, more healthful dietary behaviors were adopted and all subjects reported the reduction of sweetened beverages and desserts within the home. All women increased their dark green/orange vegetable intake and decreased their fruit juice, total

Table 4.2. Prestudy demographic characteristics by weight category in low-income, minority women in early postpartum

Characteristic	All (N=58)	Weight loss category		P value
		Responder (n=36)	Nonresponder (n=22)	
	← mean±SEM [a] →			
Age (y)	28.0±0.7	27.9±0.8	28.1±1.4	0.905
Weight (kg)	84.8±2.4	82.8±2.8	88.2±4.3	0.273
Body fat (%)	41.3±0.8	40.8±1.0	42.2±1.4	0.374
Waist circumference (cm)	99.7±2.0	96.7±2.0	104.6±3.9	0.054
Gestational weight gain (kg)	37.2±2.5	40.6±2.6	31.2±4.9	0.067
Race/ethnicity	← n(%) →			
African American	7 (12.1)	4 (57.1)	3 (42.9)	0.664
Hispanic	31 (53.4)	18 (58.1)	13 (41.9)	
White	20 (34.5)	14 (70.0)	6 (30.0)	
Education				
≤ High school	18 (31.0)	11 (61.1)	7 (38.9)	0.964
Partial college	25 (43.1)	16 (64.0)	9 (36.0)	
≥College graduate	15 (25.9)	9 (60.0)	6 (40.0)	
Infant feeding method				
Breastfeeding	25 (43.1)	20 (80.0)	5 (20.0)	0.014
Combination	17 (29.3)	6 (35.3)	11 (64.7)	
Formula	16 (27.6)	10 (62.5)	6 (37.5)	
Living with spouse/partner				
Yes	48 (82.8)	29 (60.4)	19 (39.6)	0.570
No	10 (17.2)	7 (70.0)	3 (30.0)	

[a] Standard error of the mean.

Table 4.3. Difference in Social Cognitive Theory constructs before and after an intervention by weight loss category in low-income, minority women in early postpartum

	Responder (n=36)[a]		Nonresponder (n=22)[a]	
Construct	**Pre-study**	**Post-study**	**Pre-study**	**Post-study**
Environmental				
Convenience eating resistance	10.9±0.4	12.7±0.3***	9.7±0.5	11.3±0.4***
Fruit and vegetable availability	11.2±0.5	13.2±0.3***	11.4±0.4	13.1±0.4**
Types of sweetened beverages in home	2.7±0.4	1.0±0.2***	2.7±0.3	1.4±0.3*
Types of desserts in home	1.3±0.3	0.5±0.2**	1.2±0.4	0.4±0.1*
Eating in front of television	6.1±0.5	4.5±0.5*	7.0±0.4	6.3±0.5*
Behavioral				
Dietary restraint	8.7±0.4	10.9±0.4***	8.9±0.5	9.5±0.5
Nutrition knowledge	31.3±0.8	36.7±0.7***	32.5±1.0	36.8±1.0***
Weight management skills	7.6±0.4	11.8±0.3***	7.5±0.5	10.2±0.5***
Dietary intake				
Dark green/orange vegetables	3.6±0.5	5.2±0.7**	3.0±0.5	4.7±0.8**
Whole fruit	1.3±0.2	1.3±0.2	1.0±0.2	1.5±0.3
Fruit juice	1.0±0.2	0.1±0.0***	0.5±0.1	0.3±0.1**
Energy	3001.4±183.9	1634.3±117.1***	2657.1±182.3	2073.4±256.5***
Discretionary energy	461.2±49.2	129.0±15.3***	423.6±68.8	232.9±33.6***
Aerobic exercise	0.9±0.3	2.4±0.4***	0.6±0.2	1.0±0.3
Personal				
Weight loss self-efficacy	10.6±0.4	12.0±0.4**	10.9±0.4	10.8±0.5
Social acceptance	4.7±0.4	6.3±0.4***	5.2±0.5	6.1±0.5
Morning hunger/breakfast	9.7±0.5	10.4±0.3	8.9±0.5	8.9±0.6
Vegetable taste preference	10.6±0.4	11.4±0.4*	10.4±0.5	11.1±0.5

[a] Mean±standard error of the mean for each Social Cognitive Theory construct.

*, **, *** P<0.05, 0.01, 0.001, respectively.

energy and discretionary energy intakes. Only responders increased in time per week spent engaging in aerobic exercise and decreased eating in front of the television. Women who were most successful at achieving weight loss also had greater increases in dietary restraint (2.2±0.4 vs 0.6±0.4, $P<0.01$) and weight management skills (4.2±0.4 vs 2.7±0.4, $P<0.05$), and decreases in fruit juice servings (-0.8±0.1 vs -0.1±0.1, $P<0.01$) and discretionary energy (-332.2±45.8 vs -157.1±57.5, $P<0.05$) from baseline to post intervention.

Table 4.4 demonstrates how the factors measured at pre-study, post-study, and change after the intervention related to weight loss. After Bonferroni adjustment to the alpha level, post-study scores for convenience eating resistance and weight management skills were the only variables related to weight status in the correlation analysis. To determine which improvements most significantly impacted decreases in body mass after the intervention, linear regression models using change in construct as the independent and weight loss as the dependent variable were conducted while controlling for the effects of gestational weight gain. More significant weight losses were seen in women who improved in dietary restraint, weight management skills, and weight loss self-efficacy and decreased their juice (servings/d), total energy (kcals/d), and discretionary energy (kcals/d) intake.

Table 4.4. Relationship of Social Cognitive Theory constructs to weight loss in low-income, minority women in early postpartum

	Correlation with weight loss[a]			Regression analysis[b]		
Construct	**Prestudy**	**Poststudy**	**Change**	**F Change**	**β[c]**	**Adjusted R^2**
Environmental						
Convenience eating resistance	0.284	0.393*	0.063	0.08	0.035	0.080
Fruit and vegetable availability	-0.004	0.050	0.018	0.01	0.015	0.079
Types of sweetened beverages in home	-0.189	-0.217	0.048	0.95	0.126	0.095
Types of desserts in home	0.083	-0.139	-0.084	1.00	-0.128	0.096
Eating in front of television	-0.148	-0.226	-0.223	1.91	-0.179	0.113
Behavioral						
Dietary restraint	-0.137	0.239	0.272	5.83*	0.298*	0.169
Nutrition knowledge	0.054	-0.011	-0.039	0.22	-0.062	0.028
Weight management skills	0.060	0.412*	0.336	5.99*	0.298*	0.171
Dietary intake						
Dark green/orange vegetables	0.099	0.111	0.102	0.76	0.115	0.077
Whole fruit	0.191	0.082	-0.033	0.56	-0.095	0.088
Fruit juice	0.136	-0.232	-0.322	4.04*	-0.252*	0.137
Energy	0.122	-0.072	0.191	5.65*	-0.296*	0.167
Discretionary energy	0.038	-0.257	-0.207	4.62*	-0.265*	0.151
Aerobic exercise	0.202	0.332	0.229	2.61	0.207	0.133
Personal						
Weight loss self-efficacy	-0.112	0.178	0.205	5.85*	0.304*	0.169
Social acceptance	-0.189	-0.035	0.195	1.97	0.178	0.115
Morning hunger/breakfast	0.250	0.283	0.044	0.03	0.024	0.079
Vegetable taste preference	0.013	0.055	0.068	0.04	0.027	0.080

[a] Pearson's or Spearman's correlation coefficients between constructs with weight loss (N=58).

[b] Regression of change in scores from pre-to post-study to predict weight loss while controlling for gestational weight gain.

[c] Standardized beta coefficient

* P<0.05 after Bonferonni adjustment.

The overall model to predict weight loss is presented in Table 4.5. Factors were selected for entry into the model based on prior analysis including correlations, linear regression, and backwards stepwise regression. The first block included gestational weight gain and infant feeding method, which explained 11.8% of the total variance. The addition of the Social Cognitive Theory constructs, discretionary energy and weight loss self efficacy, significantly improved the model (F Change =4.5, $P<0.05$) which explained 22.1% of the variance in weight loss.

DISCUSSION

In this study, decreases in discretionary energy intake and increases in weight loss self-efficacy scores were the most important factors related to weight loss after an intervention in low-income women in early postpartum. A distinguishing aspect of this research is the use of a framework within the Social Cognitive Theory to establish the most significant contributors to weight loss. Mothers with the greatest improvements in behavioral and personal areas achieved greater reductions in body weight.

The most significant factor associated with successful intervention outcomes was improvement in self-efficacy. Self-efficacy, or the confidence in one's ability to perform a given activity (9), has been associated with weight loss in previous studies (4,152,250). For example, in an intervention of overweight/obese, low-income, African American women, larger improvements in self-efficacy were found to predict weight loss. Additionally, it was also demonstrated that change in self-efficacy may be more strongly

Table 4.5. Regression model to predict weight loss after an intervention in low-income minority women in early postpartum

Predictor Variable	F Change	β[a]	Adjusted R^2	Model P value
Block 1	3.50*		0.118	0.022*
Gestational weight gain		0.374**		
Infant feeding method [b]				
Breastfeeding		0.102		
Combination		-0.162		
Block 2	4.51*		0.221	0.003**
Discretionary energy change		-0.241*		
Self-efficacy change		0.263*		

[a] Standardized beta coefficient for predictor variable.

[b] Entered as a categorical variable with formula feeding as the reference category.

*, ** P value significant at <0.05 and <0.01, respectively.

associated with weight loss in minority groups. Annesi (4) conducted an intervention for overweight/obese White and African American women and found that while self-efficacy scores were associated with weight loss in both groups, it was the primary predictor of weight reduction only in African Americans. These results indicate that interventions designed for this population should include a component to increase self-efficacy such as self-monitoring, stimulus control, and/or contingency management.

The second factor that contributed to successful weight loss was decreased discretionary energy intake after the intervention. One message in the 2005 Dietary Guidelines for Americans is to consume a more nutrient dense diet (231). The concept of discretionary calories was introduced to help individuals meet the suggested intake and allow flexibility to consume limited amounts of added fats, sugars, and alcohol. In the current study, low discretionary energy consumption at post intervention and greater decreases over the intervention after controlling for gestational weight gain were associated with more successful weight loss, indicating that the adoption of a more nutrient dense diet may aid in weight reduction. These results are in agreement with others, for example, in the PREMIER trial (139), participants who decreased the energy density of their diet over a 6 month intervention lost more weight. Furthermore, a follow up study of adults who participated in the EatRight Weight Management Program (88) found that low energy dense eating habits were associated with weight maintenance. Ideally, the dietary changes made in this sample of new mothers will continue as elimination of excess fat and sugars has been associated with reduced weight gain over time (53,209,253).

It is not surprising that dietary restraint was a predictor of weight loss in this population, given that cognitive control of food intake is a critical strategy for weight reduction. Previous research has demonstrated the positive impact of dietary restraint on successful weight loss (70,89) and maintenance (10-13). In low-income women high dietary restraint also has been associated with healthful food choices, such as more fruits and vegetables and fewer cakes, cookies, and ice cream (41). Similar to our findings, a study of 223 obese women also found that those with the greatest change in restraint after a 5-6 month treatment program lost the most weight (70). Self-imposed restriction of food intake may be considered a positive weight reduction behavior in low-income women, as it has been associated with higher fruit and vegetable (41) and reduced fast food consumption (71) in this population.

Other significant predictors of weight loss in this sample were weight management skills, including the use of food labels, self-monitoring through food diaries, and packing nutritious snacks. Intervention responders had a greater change in weight management skill scores than those with less success. This finding reflects that of others who found that increases in behavior change skills resulted in improvements in overall diet quality (84), consumption of more fruits and vegetables (201), and successful weight loss (103). Another study of overweight/obese adults found that individuals who adopted self-monitoring skills and kept more food records per week lost more weight after a 20 week intervention (103). There is evidence to suggest that minority populations and those of lower socioeconomic status are less likely to perform other behaviors necessary for weight loss (130). Thus, intervention strategies should focus on the importance of

adopting weight maintenance skills such as using food labels, self-monitoring through food diaries, and packing nutritious snacks.

A decrease in fruit juice consumption also significantly predicted weight loss. Fruit juice is one of the primary benefits received by women enrolled in the Supplemental Nutrition Program for Women Infants and Children (WIC). During pregnancy and lactation, women can obtain 276 fluid oz (8.2 L) and 322 fluid oz (9.6 L) of juice, respectively, each month, representing a daily intake of approximately 9 (~130 kcals) and 11 (~160 kcals) oz of juice each day (232). In a low-income population with limited nutrition knowledge of kilocalorie amounts in fluids, the additional energy consumed from juice may be a significant contributor to weight gain. Juice is an important item used to increase energy intakes for those at risk for undernutrition (33,62); however, in the overweight/obese population we studied, caloric beverages may add energy in excess of needs, making weight loss difficult. One reason may be that the consumption of juice does not promote satiety and the energy consumed from a beverage may not be compensated for during a meal (67). Therefore, weight loss interventions designed for low-income women should encourage the consumption of lower calorie vegetable juice or whole fruit in place of energy dense fruit juices.

Nutrition knowledge is an important component of behavior change that falls under the realm of behavioral capability within the Social Cognitive Theory. Yet nutrition knowledge at any stage of this intervention was not related to weight loss. While this finding confirms that of some investigations (13,106), not all studies demonstrate a similar relationship (124). For example, Klohe-Lehman and colleagues

(124) conducted an intervention in a population of low-income mothers of 1-3 year old children and found that women with greater knowledge lost more weight; however weight loss was not affected by increased knowledge. The absence of a relationship between knowledge and success in the intervention in our study may result from the small sample size. Additionally, the level of knowledge in low-income women is lacking (162), and therefore gains in knowledge may not have been large enough to impact behavior change. Further studies on the impact of knowledge and weight loss in this early stage of postpartum are warranted.

The demographic characteristics that related to weight loss included gestational weight gain and infant feeding method. Gestational weight gain is known to be one of the strongest predictors of postpartum weight retention (1,7,20). However, once the mother is in postpartum it is too late to prevent excess weight gain during pregnancy. Thus, interventions are needed that focus on preventing weight retention or even weight gain in women following childbirth. Infant feeding method was less significantly associated to weight loss in this sample, but a small effect was evident. Duration of lactation may be an important aspect in weight loss and reduction of postpartum weight retention (7,117,144). A study found that duration of breastfeeding was significantly associated with less post partum weight retention in all but those with BMI $\geq$ 35 kg/m^2 (7). Breastfeeding has proven to benefit the infant and the mother tremendously. In overweight/obese women, weight loss of up to 0.5 kg per week achieved through diet and exercise has not shown to affect the growth of the infant (147). Therefore it is suggested

that women attempting to lose weight can safely reduce their energy intake by 500 kcals per day (148).

Multiple dimensions of the Social Cognitive Theory exist, but not all could be tested in this study due to the high subject burden for completion of questionnaires. For example, outcome expectancies and social support were not included in the analysis. Outcome expectancies are defined as the value one places on a specific outcome and more positive expectancies have been related to weight loss (32). Social support also has been related to weight loss (40). Living with a spouse or partner is one element of this construct that has predicted reductions in weight after an intervention (40). However in this study, cohabitation had no effect.

Limitations of this study include the small sample size. However, it was difficult to find subjects who could participate during early postpartum. The paucity of research in women immediately following childbirth reflects this challenge. Women during this time are greatly stressed by the physical demands of childbirth and infant care and feeding (142) . This stress is enhanced in the low-income population by other factors such as poor social support (40) and lack of economic resources (59). Thus, the inability of many participants to complete our program may indicate a need for a different approach. Ways to encourage participation may include strategies such as phone counseling, in-home visits, and/or providing information through the internet or mail (52,141).

CONCLUSIONS

The most important factors that influenced weight loss after an intervention for low-income women in early postpartum included increases in weight loss self-efficacy scores and decreases in discretionary energy intake. The results presented here suggest that interventions designed for this population should include a component to increase self-efficacy such as self-monitoring, stimulus control, and/or contingency management. Additionally, encouraging healthful dietary practices such as the consumption of a nutrient dense diet that includes whole fruits and vegetables may help women manage their weight during postpartum. Since fruit juice consumption was also associated with weight loss and women in this study were primarily recruited from WIC, it may be beneficial to encourage limiting the consumption of energy-dense fruit juice and replacing it with low-calorie beverages. Other implications of the findings reported in this study include providing support for the adoption of behaviors and skills such as restrained eating, reading food labels, and using a food diary. The results presented in this study may be used for consideration in the development of weight loss interventions in low-income, new mothers.

Chapter 5: Diet Quality and Intake in Young Women is Influenced by Motivations to Eat

ABSTRACT

Objective: To evaluate the influence of motivations to eat and environmental determinants on diet quality and intake in college women.

Design: A convenience sample of university students completed demographics, the Eating Stimulus Index, a nutrition knowledge test, a food frequency questionnaire, and a household environment survey. Diet quality was assessed via the Dietary Guidelines Adherence Index.

Subjects/setting: Young women (N=88) were recruited from a classroom environment at the beginning of an introductory nutrition course at a university.

Statistical analysis performed: Frequencies and means ± standard error of the mean were used to describe the demographic characteristics of the sample; t-tests and one-way analysis of variance were conducted to determine differences between groups. Pearson's product-moment and Spearman's rho correlation coefficients were used to describe relationships between dietary intake, motivations to eat, and environmental determinants.

Results: Reduced diet quality was associated with low scores for fruit and vegetable availability ($P<0.001$), convenience eating resistance ($P<0.05$), vegetable taste preference ($P<0.001$), and weight management self-efficacy ($P<0.01$). In contrast, high diet quality was associated with increased frequency of meals prepared at home ($P<0.01$) and higher reported availability of fruits, vegetables, whole grain cereals and yogurt ($P<0.05$).

Additionally, frequency of fast food meals was positively related to discretionary energy from fat and sugar ($P<0.01$).

Conclusions: Dietary behaviors were associated with motivations to eat and environmental determinants such as availability of foods and meal location. These results will aid in the development of nutrition related programs designed to promote healthful eating in college women.

INTRODUCTION

Healthful dietary practices in young college women are essential as this time of life may be key in the development of overweight and obesity (85). College life also represents a transition from the parental environment to one of independence. It is during the early years of adulthood that individuals begin making their own health related decisions and positive dietary behaviors decrease. For example, Niemeier and colleagues (169) studied individuals from adolescence to young adulthood and found that fast food consumption increased and breakfast consumption decreased during this time. The negative changes in dietary behaviors were accompanied by increases in weight. Additionally, an overall decrease in diet quality occurs, as evidenced by consumption of less fruit and juices and dairy and greater quantities of meats and sweets (48).

Knowledge of the present determinants of dietary intake in young adults is limited; however multiple studies have examined influences on dietary intake that originated in adolescence. For example, the home availability of fruits and vegetables

(135), taste preferences for vegetables (135), frequency of family meal consumption (134), fast food intake (136), and the adherence to a healthy dietary pattern (193) in adolescence have all been related to dietary intake in college aged adults. One study that did evaluate current factors related to intake in young women found that food preparation behaviors in young adults aged 18-23 years of age were associated with better dietary intake and less frequent fast food consumption (137). In another study of young adults, eating meals "on the run" was associated with unhealthful dietary choices such as increased soft drinks, fast food, total fat, and saturated fat consumption (133).

To assess determinants of eating in this population, a measurement tool designed for this purpose is required. The Eating Stimulus Index is a scale that was developed to evaluate environmental, biological, and psychological motivations to eat (30). Determinants of food intake assessed in this instrument include the availability of healthful foods such as fruits and vegetables (21,127), resistance to convenience eating (61,234,240), morning hunger/breakfast consumption (121,160), taste preferences for vegetables (135,202), self-efficacy (136), emotional state (76,78,239), and dietary restraint (41,71). This study aims to evaluate factors that motivate eating in a sample of young women using the Eating Stimulus Index.

In general, as adolescents transition into young adults, the adoption of suboptimal health related behaviors may occur (48,169). It is well established that young women entering college for the first time have been shown to gain weight (29,104), potentially due to a decrease in diet quality and physical activity (29). Thus, the purpose of the current study was to evaluate factors that contribute to diet quality in young women. The

results provided here will aid in the development of support programs to encourage better dietary practices in this population.

METHODS

Design of Study

A convenience sample of university students was recruited during the beginning of an introductory nutrition course. Subjects completed demographics, food frequency questionnaires, the Eating Stimulus Index, and a food environment survey and were measured for weight. Participants provided informed consent and The University of Texas at Austin Institutional Review Board approved the study protocol.

Subjects

Students (N=88) were recruited from a class conducted at the beginning of a semester long introductory nutrition course at a university. Criteria for participation were female, parity = 0, between 18-30 years of age, enrollment in at least an introductory nutrition course, and of Hispanic, African-American, or White ethnicity.

Demographics

A modified demographics questionnaire assessed subject characteristics such as age, self-reported height, ethnicity, employment, smoking, alcohol consumption, and

performance of activities to lose weight (40). Self-reported measures for height were included.

Anthropometrics

Weight was determined for all subjects via an electronic weighing scale to the nearest 0.1 kilogram on one occasion without shoes, in light clothing (TBF-300A, Tanita, Arlington Heights, IL). Body mass index (BMI) was calculated as weight (kilograms) / height (meters)^2. Individuals were divided into the following BMI categories for descriptive analysis: underweight <18.5, normal weight ≥18.5 and <25.0, overweight ≥25.0 and <30, and obesity ≥30 kg/m^2 (165).

Assessment of Dietary Intake

Dietary Intake was assessed using a 195-item food frequency questionnaire that was described and previously validated in low-income, postpartum women (79). The completed food frequency questionnaires were scanned for errors; forms with ≥ 15 items blank were considered incomplete and removed from analysis. Subjects whose total energy intake was ≤ 500 and ≥ 5500 were excluded, as these cutoff values have been used in previous studies (78,82,259,260). Daily intakes for nutrients were calculated via multiplication of the frequency, portion size, and nutrient content for each item, and then summed across each nutrient. Nutrient content was obtained from the USDA Food Search for Windows, Version 1.0, database version SR19. The source of meals was determined from percentage of meals consumed from home, restaurants, fast food, or

grocery carry out. Foods consumed were assigned to categories based on the MyPyramid (163). Total discretionary energy was calculated by totaling the excess calories from solid fat, alcohol, and added sugar.

Diet quality was assessed via the Dietary Guidelines Adherence Index (DGAI) (68). The DGAI consists of 21 items designed to assess adherence to the key recommendations of the 2005 Dietary Guidelines for Americans. Points for each item ranged from 0 to 1, with a maximum score of 20 to represent full adherence. Energy needs were calculated for each individual using the Estimated Energy Requirement (EER) (109). Index scores were calculated for each subject, according to recommended servings for the specific energy level.

Eating Stimulus Index

Motivations to eat were evaluated using the Eating Stimulus Index, a 23-item questionnaire developed to assess motivations to eat in low-income women in early postpartum (30). This scale measures multiple dimensions of eating stimulus including fruit and vegetable availability, convenience eating resistance, morning hunger/breakfast, vegetable taste preference, weight loss self-efficacy, emotional eating resistance, and dietary restraint (30). Subscales reflect motivations to eat from environmental, biological, and psychological origins. Questions for each construct were prepared at a sixth grade reading level in Likert format with response options from 1-5 ("Strongly Disagree" to "Strongly Agree" or "Never" to "Always"). Higher scores signify a more beneficial response to the motivation to eat. Reliability analysis was conducted in the current

sample resulting in a Cronbach's alpha coefficient of 0.75 for the entire scale, which demonstrated good reliability.

Food Environment Survey

A survey of questions regarding the home environment was completed by all subjects. Use of phone, TV, and computer was determined from the self-reported number of hours per week for each activity. Eating in front of the TV was determined via the questions: "Do you eat meals in front of the TV?" and "Do you eat snacks in front of the TV?" Response options were in a Likert format from 1= strongly disagree to 5= strongly agree, and were summed to achieve one variable. Locations of meal consumption (eats behind a desk, the living room, and at a fast food restaurant) were documented via the self-reported question "How many times per week do you eat in the following places?" Household availability of select foods (candy, chips, desserts, fruit, ice cream, juice, diet and regular sodas, sugared and whole grain cereals, vegetables, and yogurt) were estimated via the categorical question "Please check whether or not you have the following item in your home." Response options were "Yes" or "No."

Methods of Statistics

Statistical analysis was conducted using SPSS 15.0 (Chicago, IL, 2006). Normality tests were computed for each variable and extreme outliers were identified and removed from individual analysis. Frequencies and means ± standard error of the mean were used to describe the demographic characteristics of the sample; t-tests and one-way analysis of variance were conducted to determine differences between groups. Pearson's product-moment and Spearman's rho correlation coefficients using a modified

Bonferroni adjustment (110) were used to describe relationships between dietary intake, motivations to eat, and environmental determinants. Differences in diet quality scores between individuals grouped by food availability were determined via t-tests. Statistical significance was established at $P<0.05$.

RESULTS

The demographic profile of the women in this sample is described in Table 5.1. Mean age and BMI were 19.5±0.2 years and 22.7±0.4 kg/m^2, respectively. Women were categorized by BMI as follows: healthy weight - 77.3 % (n=68), underweight - 1.1% (n=1), overweight - 15.9% (n=14), and obese - 5.6% (n=5). More than half of the women were White, not employed, did not smoke, consumed alcohol, and had initiated activities to lose weight. Diet quality, as measured by the Dietary Guidelines Adherence Index, differed significantly between ethnic categories and employment status. White women had the highest diet quality scores, and African American women had the lowest ($P<0.05$). Women who were employed had lower diet quality scores than those who did not work ($P<0.05$).

Relationships between dietary intake and motivations to eat, as measured by the Eating Stimulus Index, are displayed in Table 5.2. High fruit and vegetable availability ($P<0.001$), convenience eating resistance ($P<0.05$), morning hunger/breakfast consumption ($P<=0.05$), vegetable taste preference ($P<0.001$), and weight management self-efficacy ($P<0.01$) were associated with higher diet quality scores. Women who

Table 5.1. Demographic characteristics and differences in overall diet quality in young college women

Characteristic	Frequency (%)	Dietary Guidelines Adherence Index Score	P value
Age (y)	n(%)	mean±SEM[a]	
≥18 - <19	22 (25.0)	9.7±0.7	0.802
≥19 - <21	51 (58.0)	10.1±0.4	
≥21	15 (17.0)	10.1±0.6	
BMI (kg/m^2)			
< 25.0	69 (78.4)	10.2±0.3	0.141
≥ 25.0	19 (21.6)	9.2±0.4	
Race/Ethnicity (%)			
African American	9 (10.3)	8.8±0.7	0.036
Hispanic	25 (28.7)	9.1±0.5	
White	53 (60.9)	10.5±0.4	
Employed			
Yes	26 (29.5)	9.2±0.3	0.017
No	62 (70.5)	10.3±0.4	
Smoke			
Yes	3 (3.4)	9.1±0.6	0.562
No	87 (96.6)	10.0±0.3	
Consume alcohol			
Yes	46 (54.1)	10.1±0.4	0.559
No	38 (44.7)	9.8±0.4	
Perform activities to lose weight			
Yes	74 (88.1)	9.9±0.3	0.720
No	10 (11.9)	10.4±1.3	

[a] Standard Error of the Mean.

Table 5.2. Motivations to eat and the relationship to diet quality and intake in young college women

	Motivation to Eat						
Dietary Variable	**Fruit and Vegetable Availability**	**Convenience Eating Resistance**	**Morning Hunger/ Breakfast Consumption**	**Vegetable Taste Preference**	**Weight Management Self-Efficacy**	**Emotional Eating Resistance**	**Dietary Restraint**
Dietary Guidelines Adherence Index	0.454*	0.256*	0.227*	0.366*	0.311*	0.087	0.127
MyPyramind Food Groups							
Grains (oz equivalents)	0.090	-0.235	0.035	-0.070	-0.160	0.057	-0.009
Whole grains (oz equivalents)	0.289	0.049	0.275	0.176	0.090	0.103	0.088
Fruit (cup equivalents)	0.309*	0.053	0.139	0.131	0.307	0.077	0.206
Vegetables (cup equivalents)	0.435*	0.199	-0.054	0.202	0.072	0.027	0.012
Dark green vegetables (cup equivalents/wk)	0.280	0.357*	0.030	0.303	0.151	-0.028	-0.072
Legumes (cup equivalents/wk)	0.415*	0.127	-0.040	0.164	-0.005	-0.070	-0.036
Orange vegetables (cup equivalents/wk)	0.316*	0.042	0.203	0.364*	0.168	0.189	0.124
Starchy vegetables (cup equivalents/wk)	0.088	-0.159	-0.146	-0.038	-0.084	0.191	0.123
Other vegetables (cup equivalents/wk)	0.379*	0.200	-0.023	0.203	0.168	0.010	0.093
Milk (cup equivalents)	0.066	0.132	-0.014	-0.114	-0.007	-0.020	0.047
Low-fat dairy (cup equivalents/d)	0.111	0.214	0.151	-0.078	0.141	0.038	0.100
Meat/beans (oz equivalents)	0.146	-0.013	-0.117	-0.071	-0.082	0.013	-0.009
Lean meat (oz equivalents)	0.300	0.191	0.055	0.103	0.112	0.036	0.005
Discretionary energy (kcals)	-0.151	-0.204	-0.220	-0.282	-0.108	-0.016	0.049
Discretionary energy from fat (kcals)	-0.150	-0.341*	-0.180	-0.276	-0.187	0.076	-0.003
Discretionary energy from sugar (kcals)	-0.099	-0.281	-0.146	-0.190	-0.182	0.057	0.122

[a]Data shown include Pearson's r and Spearman's rho correlation coefficients.

* P Value <0.05 after Bonferroni adjustment

reported greater fruit and vegetable availability consumed more orange and total vegetables. Women with a stronger resistance to convenience eating reported fewer discretionary calories from fat.

Nutrient intake was significantly related to motivations to eat in this study after Bonferroni adjustment. Greater fruit and vegetable availability was related to increased fiber (g) ($r = 0.400$, $P<0.05$), vitamin C (mg) ($r = 0.305$, $P<0.05$), vitamin K (μg) ($r = 0.289$, $P<0.05$). Convenience eating resistance was related to a higher percent energy from protein ($r = 0.324$, $P<0.05$). Women who reported stronger morning hunger and breakfast consumption also had lower percent energy from fat ($r = -0.292$, $P<0.05$) intakes.

The association between eating behaviors and food intake is presented in Table 5.3. Lower diet quality was seen in the subjects who reported eating in front of the television ($P<0.05$), behind a desk ($P<0.05$), and at a fast food restaurant ($P<0.001$). Whole grain ($P<0.05$) and dark green vegetable ($P<0.05$) consumption were negatively associated with number of visits to a fast food restaurant per week. Similarly, fast food meals were positively related to discretionary energy from fat (Spearman's rho = 0.376, $P<0.001$), sugar (Spearman's rho = 0.315, $P<0.01$), and total (Spearman's rho = 0.349, $P<0.01$). Greater energy intakes from added fats, sugars, and alcohol also were seen in women who spent more hours per week using the phone, television, and computer ($P<0.01$), ate in front of the television ($P<0.05$), or ate in the living room ($P<0.01$).

Diet quality was also influenced by the source and location of meals. Dietary Guidelines Adherence Index scores were positively related to percentage of meals

prepared and consumed at home ($P<0.01$) (Figure 1). In contrast, percent of meals eaten at fast food restaurants was negatively associated to healthier eating (Spearman's rho = -0.459, $P<0.0001$). Additionally, the reported presence of specific foods in the household also corresponded to better diet (Figure 2). Women with fewer regular sodas ($P<0.05$), and more fruits ($P<0.01$), vegetables ($P<0.01$), whole grain cereals ($P<0.05$), and yogurt ($P<0.05$) achieved higher scores.

Table 5.3. Correlation coefficients for environmental conditions and diet quality and intake in young college women

	Eating Related Behavior				
Dietary Variable	**Use of phone, TV, Computer**	**Eat in front of TV**	**Eat behind a desk**	**Eat in Living Room**	**Eat at Fast Food Restaurant**
Dietary Guidelines Adherence Index	-0.071	-0.284	-0.275	-0.076	-0.371*
MyPyramind Food Group					
Grains (oz equivalents)	0.078	0.104	0.048	0.097	0.085
Whole grains (oz equivalents)	0.000	-0.150	-0.144	-0.087	-0.221
Fruit (cup equivalents)	-0.027	-0.202	-0.242	-0.089	-0.077
Vegetables (cup equivalents)	-0.020	-0.097	-0.209	0.039	-0.110
Dark green vegetables (cup equivalents/wk)	-0.181	-0.107	-0.132	-0.029	-0.275
Legumes (cup equivalents/wk)	0.103	-0.111	-0.128	0.091	-0.186
Orange vegetables (cup equivalents/wk)	-0.125	-0.253	-0.204	-0.067	-0.102
Starchy vegetables (cup equivalents/wk)	0.004	0.030	-0.022	-0.089	0.305
Other vegetables (cup equivalents/wk)	-0.060	-0.042	-0.293	0.074	-0.108
Milk (cup equivalents)	0.076	-0.038	-0.014	0.143	0.063
Low-fat dairy (cup equivalents/d)	-0.028	-0.117	-0.023	0.066	0.005
Meat/beans (oz equivalents)	0.114	0.080	-0.036	0.208	0.086
Lean meat (oz equivalents)	0.076	-0.037	-0.167	0.132	-0.112
Discretionary energy (kcals)	0.347*	0.267	0.076	0.309	0.349*
Discretionary energy from fat (kcals)	0.195	0.223	0.108	0.213	0.376*
Discretionary energy from sugar (kcals)	0.248	0.278	0.097	0.282	0.315*

[a]Data shown include Pearson's r and Spearman's rho correlation coefficients.
* P Value <0.05 after Bonferroni adjustment.

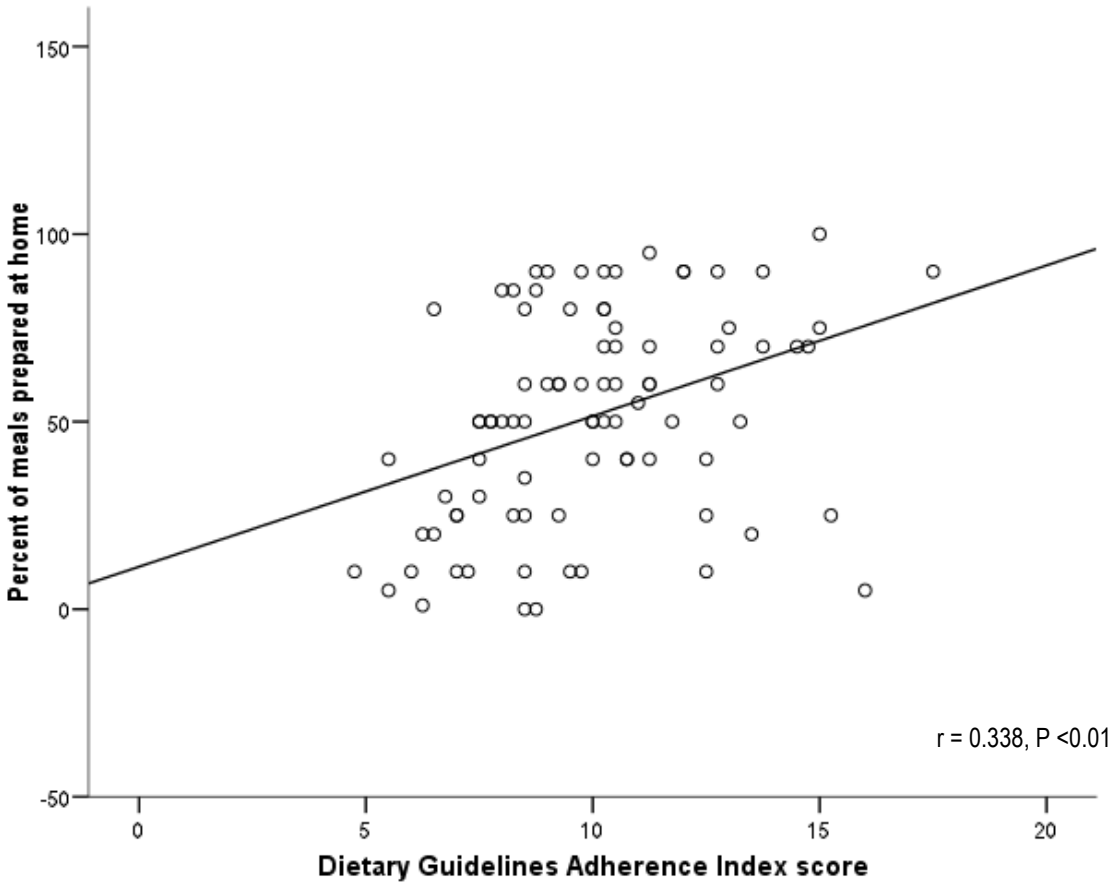

Figure 5.1. Relationship of diet quality and percent of meals consumed at home in young college women.

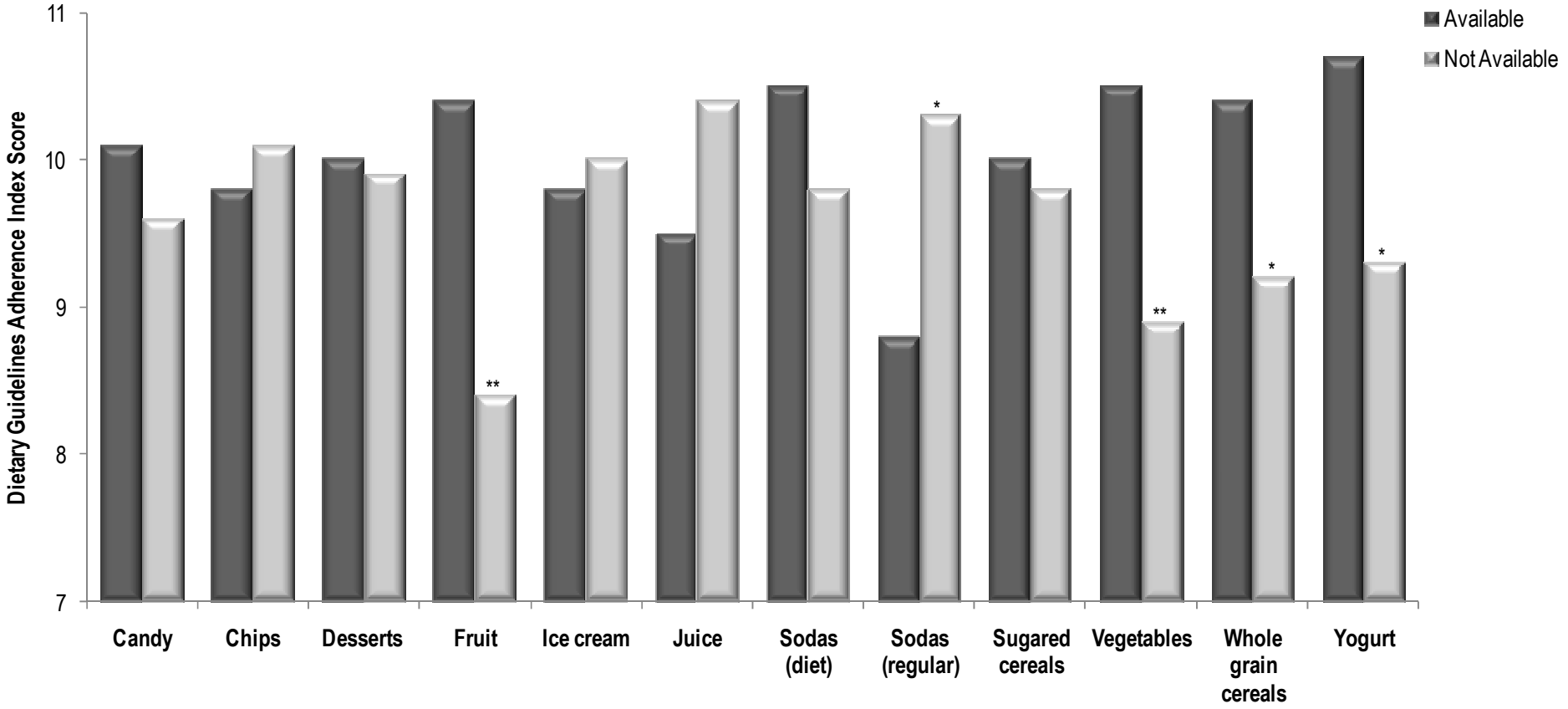

Figure 2. Mean differences in Dietary Guidelines Adherence Index scores and household availability of select food items in young college women. *, ** Represent significant differences between groups at P<0.05 and P<0.01, respectively.

DISCUSSION

Motivations to eat significantly impacted overall diet quality and food and nutrient intake in this population of young women. In particular, fruit and vegetable availability, resistance to convenience eating, morning hunger/breakfast consumption, taste preference for vegetables, and weight management self-efficacy were all associated with higher Dietary Guidelines Adherence Index scores. Additional factors related to less healthful intake included eating in front of the television, behind a desk, or at a fast food restaurant.

In addition to the positive influence on food intake, women who reported higher fruit and vegetable availability also ate more servings of fruits and vegetables. These results are supported by others. In a study of parent-child pairs, Kratt and colleagues (127) found that intake in adults was greatest in those in the highest category of fruit and vegetable availability. One contributing factor to increased fruit and vegetable availability in young women may be home availability in adolescence. In a follow-up study to Project Eat, Larson and colleagues (135) examined correlates of fruit and vegetable intake in adolescents in high school and 5 years later. Home availability of these foods at baseline was a significant predictor of intake at the 5-year follow-up. The creation of a home environment that is more conducive to healthy eating in youth may be important for encouraging the consumption of a fruits and vegetables into adulthood.

The availability of low-cost convenience and fast foods is ubiquitous (55,114). These items tend to be high in fat, calories, and sugar (55,114) and often sold in larger than recommended portion sizes (263). In this sample, women who reported more

frequent eating at fast food restaurants consumed more discretionary energy from fat and sugar, more starchy vegetables, and fewer dark green vegetables. Results were similar for women with less resistance to convenience eating. These behaviors are of great concern because of the association with higher weight (71), energy, and saturated fat intakes (24,71).

In contrast, young women in the current study who consumed a greater percent of meals prepared at home had higher diet quality scores. These data reflect findings of Larson and colleagues who determined that food preparation behaviors were a strong indicator of meeting dietary recommendations (137). Encouraging individuals to select more healthful options when dining out or increasing the frequency of grocery store trips may be important strategies that young adults could use to increase nutrient densities of their diets (15).

The results presented here also demonstrate a positive relationship between diet quality and morning/breakfast consumption and whole grain cereal availability. Meal patterns, specifically breakfast consumption, have been associated with better diet quality and higher micronutrient intakes (121,160). More specifically, whole grain cereal consumption may improve diet quality by maintaining micronutrient intakes at recommended levels (157). In a study of individuals participating in a 12-week weight loss intervention, consumption of a hypocaloric diet that included whole-grain cereals resulted in diets higher in fiber, vitamin B-6, and magnesium, and lower in total fat and energy intakes (157). Breakfast consumption also has been associated with lower BMI (120) and reduced weight gain (11). Additionally, the consumption of whole grain

cereals at breakfast may be associated with decreased risk of diabetes (126) and heart disease (51). Evidence presented here supports the continued effort to encourage whole-grain consumption, particularly at breakfast.

A stronger taste preference for vegetables was related to higher diet quality and increased dark green and orange vegetables and decreased discretionary energy in these young women. Similar to findings in this study, taste preferences for vegetables were associated with greater vegetable intake including the consumption of raw vegetables and salads (202). Just as fruit and vegetable availability in adolescence impacted dietary intake into adulthood, taste preferences in youth were also a strong predictor of these foods at 5-year follow-up (135). Taste preferences may be due to genetics. For example individuals sensitive to the bitter taste of 6-n-propylthiouracil (PROP) reported reduced preferences for vegetables such as Brussels sprouts, cabbage, and spinach (56). However, taste preferences can be altered through multiple exposures of specific foods (31,264), which may have positive influences on dietary intake.

Weight management self-efficacy also was associated with better diet quality in this sample of young women. This construct has frequently been associated with positive health behaviors. A study by Larson and colleagues (136) found that self-efficacy for healthy eating was associated with reduced fast food intake at a 5-year follow up in young adults. Additionally, self-efficacy has been associated with higher BMI and weight increases over time (8) and engagement in more positive nutrition and physical activity health behaviors (242). New methods to improve self-efficacy in young adults are being developed, such as the use of educational computer games (187).

One limitation of this study is that the design was cross-sectional. Thus, causality between factors cannot be determined. However current research on motivations to eat in young adults is limited; therefore, the results presented here may offer insight into the eating behaviors in this population. Another limitation was the use of self-reported height for the calculation of BMI. While some inaccuracies may exist, self-reported measures have been used in previous studies (118,200) and demonstrated agreement with measured values (220).

CONCLUSIONS

This study identified factors that contribute to diet quality and intake in a sample of young college women. More healthful dietary intake was significantly related to motivations to eat, including fruit and vegetable availability, resistance to convenience eating, morning hunger/breakfast consumption, taste preference for vegetables, and weight management self-efficacy. Characteristics that were associated with low diet quality included eating in front of the television, behind a desk, or at a fast food restaurant. The transition into college represents a time of heightened risk for less than optimal health related behaviors and weight gain. These results will aid in the development of nutrition related programs to encourage better dietary practices in this population.

Chapter 6: Conclusions and Recommendations

The purpose of this research was to evaluate motivations to eat in low-income women during the early postpartum period. The first aim was to develop and validate a novel instrument to assess eating stimuli in this population called the Eating Stimulus Index. In the second aim, this questionnaire was then used to determine the effect of motivations to eat on dietary intake. To achieve this goal, usual dietary intake was collected using a food frequency questionnaire; then the Dietary Guidelines Adherence Index was utilized to assess overall diet quality. In aim three, an 8-week weight loss intervention, called "The Austin Weight Loss Program for New Mothers" was conducted to establish the influence of motivations to eat on successful weight reduction. The intent of the fourth and final aim was to further validate the Eating Stimulus Index as a measure to assess motivations to eat and examine the impact of factors measured within this scale on consumption patterns in a different population, young college women. This research is unique in that the sample that was selected includes individuals at high risk for the development of obesity and related diseases. Few studies have examined women during the early weeks after childbirth, and therefore the results presented here provide distinct insight into the dynamic period of postpartum.

Weight loss is difficult to achieve and if successful, recidivism is common. Low-income women face exceptional barriers to the adoption of healthful behaviors including low levels of social support (40) and lack of economic resources (59). One method of increasing the odds of success in this population is through the implementation of targeted health related messages (152). In aim 1, the purpose was to develop a new

instrument to assess motivations to eat in low-income postpartum women. Psychometric evaluation of the Eating Stimulus Index indicated that this is a valid and reliable measure for low-income populations. The questionnaire produced a Cronbach's alpha coefficient of 0.75, indicating good reliability. The construct validity of the scale was established through principal components analysis, which resulted in the identification of eight factors. A secondary purpose of this aim was to examine the relationship between these eight factors and weight status. A strong ability to resist eating for convenience and in response to emotions as well as the ability to exercise high levels dietary restraint were all associated with an elevated body mass index. Thus, interventions designed for low-income women should include components that address these elements. In addition to the assessment of general characteristics of a population, the Eating Stimulus Index can be used at the individual level to identify motivations to eat so health related advice can be tailored to specific needs.

The purpose of aim 2 two was to determine the impact of motivations to eat on food and nutrient intakes in low-income women in the period following childbirth. This aim was an important component of the study, as it provided further characterization of influences on eating and validation of the Eating Stimulus Index in these women. The primary determinants of high diet quality identified in this aim were the availability of fruits and vegetables, the ability to resist convenience eating, and a taste preference for vegetables. Given this finding, health care providers should employ strategies to increase home availability of healthy foods such as purchasing items in season and providing vouchers to local farmers' markets. Methods to decrease the consumption of

convenience foods should also be developed, for example improving stimulus control through the identification of unhealthy triggers and preparation of healthy snacks in advance. Finally, raising the exposure to the taste of vegetables may be important in the acclimatization of new flavors and foods which could encourage their consumption.

An interesting observation in this aim was that primary influences on food intake differed between overweight and obese women. The main determinant of diet quality in the overweight subjects was resistance to convenience eating, while in the obese it was a taste preference for vegetables. The implication of this finding is that interventions targeted for low-income women may benefit by tailoring messages according to body size.

In aim 3, the purpose was to evaluate determinants of weight loss using constructs within the Social Cognitive Theory. To accomplish this aim, an 8-week intervention was conducted while collecting select measures of the environment, behavior, and the person. For example, environmental factors were convenience eating resistance, availability of foods, and eating in front of the television. Behavioral components were dietary restraint, nutrition knowledge, skills, dietary intake, and exercise. Personal determinants were self-efficacy, social acceptance, hunger, and taste preferences. Responders to the intervention, women who lost ≥ 2.27 kg, made significant improvements in almost all areas. Comparatively, nonresponders achieved some gains, but failed to improve in dietary restraint, aerobic exercise, eating in front of the television, weight loss self-efficacy, social acceptance, and taste preference for vegetables. The differences seen

between subjects achieving favorable outcomes after the intervention versus those that did not indicate the potential relevance of these factors on successful changes in weight.

In addition, women who achieved greater reductions in weight improved more in behavioral and personal areas. Women who accomplished significant increases in dietary restraint, weight management skills, and weight loss self-efficacy and decreases in fruit juice servings, total and discretionary energy intake had greater reductions in size after the intervention while controlling for the influence of gestational weight gain. After exploration of the principal determinants of intervention outcomes, only gestational weight gain, decreases in discretionary energy, and increases in weight loss self-efficacy were related to greater changes in body mass. The results presented here suggest that encouraging healthful dietary practices such as the consumption of a nutrient dense diet that includes whole fruits and vegetables may help women manage their weight during postpartum. Additionally, interventions designed for this population should include a component to increase self-efficacy such as self-monitoring, stimulus control, and/or contingency management.

The purpose of aim 4 was to evaluate factors that contribute to diet quality in young college women. A secondary aim of this study was to determine if this scale was valid in other populations, which would broaden the utility of the instrument as a measure of motivations to eat. College women also represent a unique population since it is during this time that individuals begin making their own health related decisions and positive dietary behaviors decrease. In this aim, key motivators to eat that were related to diet quality were fruit and vegetable availability, convenience eating resistance, taste

preference for vegetables, and weight management self-efficacy. Environmental determinants also were examined. Not surprisingly, participants who consumed more meals prepared at home and fewer meals at fast food restaurants had healthier intakes. The frequency of fast food consumption was also an indicator of high discretionary energy from fat and sugar. Finally, the presence of healthful foods and lack of sweetened beverages in the household were associated with high diet quality. For example, a greater supply of fruits, vegetables, whole grain cereals, and yogurt in the environment were associated with higher Dietary Guidelines Adherence Index scores in these women. The determinants of intake in this population were all modifiable factors that could be improved through nutrition education interventions. These programs should focus on increasing food preparation skills, reduction of fast food consumption, and the adoption of healthful grocery shopping habits.

This research significantly contributes to the body of knowledge concerning diet and weight loss during early postpartum. However, it is not without limitations. Although, the Eating Stimulus Index measures a variety of influences on food intake, not all constructs could be included in the scale. For example, a distinct measure for portion size was accounted for only indirectly through convenience eating. Also, questions regarding taste capture only preferences for vegetables, since these were the only items retained after psychometric analysis. A major limitation of aims 1-3, was the absence of normal weight subjects, which prevented examination of differences across a full range of BMIs. Healthy weight subjects in the low-income population studied were almost nonexistent and therefore, this group could not be obtained within the period of data

collection. The use of retrospective dietary collection methods such as the food frequency questionnaire has potential limitations such as possible underreporting and misrepresentation of energy and dietary intakes, particularly in obese individuals (123,198). In aim #3, the results of the intervention are limited by the small sample size. Low-income women face significant challenges and therefore many subjects were not able to complete the program. For example, these women are greatly stressed by the physical demands of childbirth and infant care and feeding (142) and face barriers such as poor social support (40) and lack of economic resources (59). In aim #4, a cross-sectional design was utilized; therefore, causality between factors cannot be precisely determined. Furthermore, self-reported height was used for the calculation of BMI. This method may be inaccurate; however it has been used frequently in previous studies (118,200).

In sum, this research can be utilized first to assess the individual needs of women during the critical time of early postpartum and then to develop personalized strategies that target vulnerable eating behaviors. Future directions include the application of the Eating Stimulus to different stages of the life cycle to ensure validity in various populations. Once accomplished, the utilization of this instrument in large samples to characterize eating motivations at the societal level may help in the development of health related messages. Additionally, the difficulty encountered while conducting an intervention during early postpartum indicates the need for a different approach. Suggested ways to improve participation are the use of phone counseling, in home visits, and/or providing information through the internet or mail (52,141). However, each of

these methods is costly and may be unsuitable for sustainability for interventions in this population. The results presented here may be used for consideration in the development of tailored weight loss messages for low-income women in efforts to reduce postpartum weight retention and the prevention of obesity.

APPENDIX A: The Eating Stimulus Index

Think about your behavior over the past month. Please answer whether you agree or disagree with the statements listed below.	Strongly Disagree	Disagree	Agree Sometimes	Agree	Strongly Agree
1. There are fresh vegetables in my home right now.	1	2	3	4	5
2. There are fresh fruits in my home right now.	1	2	3	4	5
3. When I shop, I buy many different kinds of fruits and vegetables.	1	2	3	4	5
4. I am comfortable with my weight when I am with family and friends.	1	2	3	4	5
5. I am comfortable with my weight when I am out in public.	1	2	3	4	5
6. I am most hungry in the morning.	1	2	3	4	5
7. It is easy for me to go without breakfast.	1	2	3	4	5
8. I am most hungry at night.	1	2	3	4	5
9. I enjoy the taste of green, leafy salads without dressing.	1	2	3	4	5
10. I enjoy the taste of raw broccoli.	1	2	3	4	5
11. I enjoy the taste of orange or yellow vegetables(carrots, corn, sweet potatoes)	1	2	3	4	5
12. I am confident that I can control my weight.	1	2	3	4	5
13. I am confident I can follow a healthy, weight-loss diet	1	2	3	4	5
14. I am confident that I can give up foods to lose weight.	1	2	3	4	5
15. I eat when I am sad, disappointed, or depressed.	1	2	3	4	5
16. I eat when I am bored or restless.	1	2	3	4	5
17. I eat when I am stressed or nervous.	1	2	3	4	5
18. When I start eating foods I enjoy I just can't seem to stop.	1	2	3	4	5
Think about your behavior over the past month. Please answer how frequently you feel or do the things indicated in the questions below.	Never	Rarely	Sometimes	Most of time	Always
19. I stop eating before I get too full.	1	2	3	4	5
20. I overeat when tempted by delicious foods.	1	2	3	4	5
21. I eat at buffet style restaurants.	1	2	3	4	5
22. I buy snacks when I stop at a convenience store.	1	2	3	4	5
23. I buy cookies or snacks when I go to the mall.	1	2	3	4	5

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