
# RHEALTH: Evaluation of a pilot intervention to promote healthy eating and reduce excess weight gain among men in residential treatment facilities

by Jennifer Areen Cowan

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# RHEALTH: EVALUATION OF A PILOT INTERVENTION TO PROMOTE HEALTHY EATING AND REDUCE EXCESS WEIGHT GAIN AMONG MEN IN RESIDENTIAL DRUG TREATMENT FACILITIES

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# RHEALTH: EVALUATION OF A PILOT INTERVENTION TO PROMOTE HEALTHY EATING AND REDUCE EXCESS WEIGHT GAIN AMONG MEN IN RESIDENTIAL DRUG TREATMENT FACILITIES

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Unhealthy eating patterns and weight gain have been reported in people recovering from substance addiction. People in recovery are at an increased risk for diet-related chronic diseases, and environments in drug treatment facilities may be unsupportive of healthy food choice behaviors. Recovery Healthy Eating and Active Learning in Treatment Houses (RHEALTH), a theory-based pilot nutrition intervention was designed to promote healthy eating and reduce excess weight gain among men in residential treatment programs through both food and nutrition education classes and changes in the food environment in the treatment facilities via the promotion of healthy food-related policies. This dissertation reports the outcome and process evaluation of the implementation of RHEALTH in six residential treatment facilities for men in recovery from drug addiction.

The study participants were 124 men (103 men enrolled before the control and 21 men enrolled after the control period ended), aged 18 years and older in recovery from substance addiction, and who were assessed at three different times: at baseline, at pre-intervention following a six week control period, and at post-intervention. The main intervention outcomes were dietary intake, diet-related psychosocial factors, measured height and weight from which body mass index was derived, and waist circumference. Independent variables included demographic characteristics, self-reported addiction history and physical activity. A structured process evaluation

assessed the impact of program participation, dose, fidelity and intervention implementation levels on study outcomes.

At baseline study participants reported poor dietary intakes; average intakes exceeded recommendations for total energy, fats and sweets but were inadequate in daily servings of fruits and vegetables. Seventy-three percent of the men were either overweight or obese, and 36% had a waist circumference that put them at risk for chronic disease. Multivariate analysis at baseline also revealed that better dietary quality was associated with longer time spent in the treatment program, higher self-efficacy for healthy eating among younger participants, readiness for diet change in the next 30 days, and satisfaction with diet and weight. Lower body mass index and waist circumference were associated with younger age, higher educational levels, and with higher self-efficacy among men who were satisfied with their diet and weight.

The outcome analysis included 55 men who had completed two or more assessments (43 who completed all three assessments and 12 who completed only the baseline and post-intervention). Mixed model regression analysis was used to assess the impact of the RHEALTH intervention on dietary intake, diet-related psychosocial factors, and body composition measures. In multivariate analyses, the intervention period was associated with significantly greater intake of fruits and vegetables, lower intakes of calories from sweets and desserts, and greater improvement in food-related psychosocial factors compared to the control period. Reduction in waist circumference was also associated with the intervention period.

The process evaluation revealed that better study outcomes were associated with both greater participation in food and nutrition classes and a higher level of implementation of healthy changes in the food environment. Challenges to implementation included staff and resident turnover and staff commitment. The findings of this pilot intervention provide evidence supporting the need for and the

potential for efficacy of large-scale randomized dietary intervention trials aimed at increasing healthy food choice behaviors and healthy food environments in drug treatment facilities.

## BIOGRAPHICAL SKETCH

Jennifer Cowan received her BS in Nutritional Sciences with a concentration in dietetics from Cornell University, May 1997. Upon graduation, she worked for the Department of Human Development at Cornell University as a research project coordinator. During her three and half year employment as a project coordinator, Jennifer was responsible for coordinating all the research activities for "The Socialization Practices of Minority Families Study," located in Rochester, New York.

January 2001, Jennifer returned to the Division of Nutritional Sciences at Cornell to pursue the MS/PhD program in Community Nutrition. Her plans were cut short because of a family emergency that resulted in her taking a leave of absence during August 2001-2003 academic years. During her absence, Jennifer worked as a chemical dependency counselor providing rehabilitative and supportive counseling for women recovering from substance addiction in Rochester, New York. She also worked as a "relief" counselor at the residential drug program for men at the same agency as well as taught nutrition education to both men and women in treatment for substance addiction. She became interested in the weight and the nutritional concerns of people in recovery from substance addiction during her employment as a substance addiction counselor. Jennifer determined that after this experience it would be gratifying to dedicate her professional career to helping people in recovery from substance addiction obtain better health through nutrition and other preventive health measures.

The author returned to Cornell in August 2003, to complete her MS/PhD studies under the guidance of Dr. Carol Devine and Dr. Barbara Strupp as her DNS field mentor. Dr. John Cawley and Dr. Mark Constas served as mentors for her minors

in Policy Analysis Management and Education respectively. Jennifer's thesis for the M.S. degree (2006) examined the construction of food, eating and weight change issues of men in recovery from substance addiction, which laid the foundation for her doctoral research.

This research was born from many years of interest, inquiry and observation of eating behaviors of men in drug treatment facilities. The topic has been nurtured and supported by my mentor and chair, Dr. Devine from its inception. Professionally, Jennifer seeks to become involved with health promotion initiatives in underserved communities, and looks forward to the successes, challenges and discoveries in future research endeavors.

I dedicate this work to Mr. Franklin and Mrs. Jacqueline Cowans

*for their love, encouragement and steadfast support*

*throughout the years.*

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I am appreciative of the generosity and honesty of the study participants in sharing their lives with me during the duration of the project, and to the directors and staff in the treatment facilities for allowing me to share their space in order to conduct this research. They have all been incredibly generous with their time, accommodation and support. Without their continual support the completion of this project would not have been possible.

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## TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

# RHEALTH: EVALUATION OF A PILOT INTERVENTION TO PROMOTE HEALTHY EATING AND REDUCE EXCESS WEIGHT GAIN AMONG MEN IN RESIDENTIAL DRUG TREATMENT FACILITIES

## ABSTRACT

Unhealthy eating patterns and weight gain have been reported in people recovering from substance addiction. People in recovery are at an increased risk for diet-related chronic diseases, and environments in drug treatment facilities may be unsupportive of healthy food choice behaviors. Recovery Healthy Eating and Active Learning in Treatment Houses (RHEALTH), a theory-based pilot nutrition intervention was designed to promote healthy eating and reduce excess weight gain among men in residential treatment programs through both food and nutrition education classes and changes in the food environment in the treatment facilities via the promotion of healthy food-related policies. This dissertation reports the outcome and process evaluation of the implementation of RHEALTH in six residential treatment facilities for men in recovery from drug addiction.

The study participants were 124 men (103 men enrolled before the control and 21 men enrolled after the control period ended), aged 18 years and older in recovery from substance addiction, and who were assessed at three different times: at baseline, at pre-intervention following a six week control period, and at post-intervention. The main intervention outcomes were dietary intake, diet-related psychosocial factors, measured height and weight from which body mass index was derived, and waist circumference. Independent variables included demographic characteristics, self-reported addiction history and physical activity. A structured process evaluation

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At baseline study participants reported poor dietary intakes; average intakes exceeded recommendations for total energy, fats and sweets but were inadequate in daily servings of fruits and vegetables. Seventy-three percent of the men were either overweight or obese, and 36% had a waist circumference that put them at risk for chronic disease. Multivariate analysis at baseline also revealed that better dietary quality was associated with longer time spent in the treatment program, higher self-efficacy for healthy eating among younger participants, readiness for diet change in the next 30 days, and satisfaction with diet and weight. Lower body mass index and waist circumference were associated with younger age, higher educational levels, and with higher self-efficacy among men who were satisfied with their diet and weight.

The outcome analysis included 55 men who had completed two or more assessments (43 who completed all three assessments and 12 who completed only the baseline and post-intervention). Mixed model regression analysis was used to assess the impact of the RHEALTH intervention on dietary intake, diet-related psychosocial factors, and body composition measures. In multivariate analyses, the intervention period was associated with significantly greater intake of fruits and vegetables, lower intakes of calories from sweets and desserts, and greater improvement in food-related psychosocial factors compared to the control period. Reduction in waist circumference was also associated with the intervention period.

The process evaluation revealed that better study outcomes were associated with both greater participation in food and nutrition classes and a higher level of implementation of healthy changes in the food environment. Challenges to implementation included staff and resident turnover and staff commitment. The findings of this pilot intervention provide evidence supporting the need for and the

potential for efficacy of large-scale randomized dietary intervention trials aimed at increasing healthy food choice behaviors and healthy food environments in drug treatment facilities.

# CHAPTER 1:

# BACKGROUND AND SIGNIFICANCE

Poor eating and excessive weight gain are common among people in recovery from substance addiction (Hodgkins et al., 2003; Cowan & Devine, 2008; Emerson et al., 2009). Public health initiatives to improve nutritional status in this population are critical given the central role that nutrition plays in health, obesity prevention (Dolormier et al, 2009), and the diet-related chronic diseases for which recovering addicts are at increased risk (Howard et al., 2004; Sutter & Vetter, 1995; Poilkolainen, 1998; van de Wiel, 2004). More than twenty-two million Americans reportedly abuse or are dependent on alcohol or illicit drugs (SAMHSA, 2009). Of these, four million people receive treatment at specialty substance abuse settings such as rehabilitation facilities (e.g. halfway houses), hospitals or mental health centers (SAMHSA, 2009). These treatment settings provide the necessary care for the addicted patients/clients at any stage in their recovery. Abstinence from drug and alcohol use is usually the main focus of substance treatment modalities. A considerably amount of time and effort is spent to facilitate sobriety in the lives of the recovering addicts, but little attention is given to food behaviors and weight management even though there is strong evidence for concern. Some experts propose a possible correlation between drug abstinence and weight gain (Putnam et al., 1990; Hodgkins et al., 2003; Emerson et al., 2009), though the underlying reasons remain an open question and warrant further investigation. Men are more likely to be dependent on or abuse alcohol and illicit drugs; and they typically accounted for more than 65 percent of substance abuse treatment admissions (SAMHSA, 2009). Therefore men

living in community residential treatment facilities for substance abuse were the focus of this pilot intervention study.

Active addiction is marked by periods of food deprivation, poor diets and weight loss; and many drug addicts are at nutritional risk when they enter treatment programs (Hudson et al., 1992; Hauser & Iber, 1989). Some weight gain may be necessary in recovery to compensate for the weight loss experienced in active addiction. However, recovering addicts have a tendency to choose unhealthy foods that are high in sugar and fat (Hatcher, 2004; Farkas & Dwyer, 1984). In both animal and human studies there is evidence suggesting that carbohydrates, fats, and sweets are substituted for alcohol and cocaine use (Gosnell & Krahn, 2001; Gosnell et al., 1998; Krahn et al., 1992); this may provide some explanation for the poor food choice behaviors observed in recovery.

**Obesity, substance abuse, and disordered eating**

More than sixty-five percent of American adults are overweight or obese, defined by a body mass index of 25 or higher (Brownell & Horgen, 2004; Flegal et al., 2010). This public health problem is a growing concern in the substance addiction population as well. There is evidence suggesting that overweight and dysfunctional eating behaviors are common among people in the drug-addicted population, particularly those in recovery (Jackson & Grilo, 2002). High rates of dysfunctional eating, particularly overeating and poor food choice behaviors have been observed in both male and female populations seeking treatment for substance addiction (Grilo et al., 1997, 1998; Striegel-Moore et al, 1999). Numerous studies have identified high rates of co-morbidity between eating disorders and substance addictions in both eating-disordered and substance-addicted populations (Mitchell et al, 1992; Krahn, 1991; Wiseman et al, 1995; Hudson et al, 1992; Cepik et al, 1995). The co-morbidity

between these two disorders is poorly understood and is reportedly more prevalent in clinical or treatment communities than in the general population. While there has been extensive research into the role of food and eating behaviors in the eating-disordered population, the same is not true in substance-addicted groups. Relatively few studies have examined eating disorders or intervention strategies in substance abuse populations. Treatment facilities need to develop healthy ways to systematically reintroduce food as an alternative to drug and alcohol use without encouraging the replacement of one addiction for another.

Recovery from substance addiction is a developmental process. It is manifested by total abstinence and a period of change in which the addicted person begins to move away from destructive behavioral patterns towards more productive ways of living, and away from the use or need for alcohol or other drugs (Milhorn, 1990). The opportunity is therefore available for treatment facilities to provide a efficient channel where recovering addicts can learn additional skills, including healthy eating behaviors, to prepare them for a healthy lifestyle when they are living on their own. Moreover, recovery provides a platform for the body to begin the healing process from damages resulting from active substance addiction. Proper nutrition is critical to ameliorate the damages caused during active substance use.

**Food, nutrition, and weight concerns in addiction**

One study documenting weight gain concerns of Latina and African American women in four residential drug treatment facilities found that both personal and environmental factors contributed to excess weight gain (Emerson et al., 2009). The study revealed barriers to healthy eating including the need to change menus, shopping habits, and types of snacks served during the meetings held at the treatment facilities. The authors also reported that the residents were frustrated with not knowing how to

eat well (Emerson et al., 2009). Although this study focused on weight gain among women in recovery from substance addiction, the results support the need for targeted nutrition interventions to address personal, behavioral and environmental factors in residential drug treatment facilities for other populations.

Prior research by our team also suggest that environmental factors such as the type of food available, food access, and the social norms of the food environment were important elements that influenced the food choice and eating behaviors of men in the substance addiction population. Additionally we found that men in recovery from addiction used food to regulate moods and alleviate boredom as well as to satisfy cravings early in the recovery process (Cowan & Devine, 2008; Cowan, 2006).Binge eating and the use of food as a substitute for drug use were also reported by these men. The roles of food in the lives of the recovering addicts may also be associated with the excessive weight gain they experienced in recovery. For example, the use of food as a substitute for drug use and the use of food to satisfy cravings were reported by men in early recovery from drug addiction (Cowan & Devine, 2008; Cowan, 2006). These eating and weight concerns warrant attention because people in addiction are at an increased risk for chronic diet-related diseases such as diabetes and cardiovascular diseases such as coronary heart disease, hypertension, and stroke (Howard et al., 2004; Sutter & Vetter, 1995; Poilkolainen, 1998; van de Wiel, 2004). Obesity plays a primary role in these chronic diseases (Howard et al., 2004; Sutter & Vetter, 1995; Poilkolainen, 1998; van de Wiel, 2004); the excess weight gained in recovery may further exacerbate these health problems, and thereby add substantial burden to the recovering person's life.

**Environmental Interventions to Prevent Obesity**

Several studies have examined the role of the food environment in shaping food choices, eating behaviors, and weight changes in various populations (Pomerleau et al., 2005; Wellman et al., 2007; Wilson et al., 2007; Pratt et al., 2007; Robroek et al., 2009). In a nonrandomized school-based environmental intervention to promote vegetable and fruit consumption, French and Stables (2003) found significant increases in fruit and vegetable consumptions among students. Kubik and colleagues reported similar associations between changes in the food environment and dietary behaviors of school-age children. Their findings suggest that students with access to low-nutrient, energy-dense vending machine snacks consumed more unhealthy foods instead of healthier food alternatives such as fruits (Kubik et al., 2003).

Similarly, worksite-based interventions are frequently implemented to promote healthy food choice behaviors in our society; and these environmental trials, which provide a great platform for health promotions, have increased considerably since 1985 (Sorensen et al., 1999). In a previous environmental intervention (Jeffery et al., 1994) aimed at increasing fruit and salad purchases in a worksite cafeteria setting (at a university office building with 700 employees), the authors reported that fruit and salad purchases increased significantly during and after the intervention period. The intervention design included an increase in the availability of fruits and salad bar choices (from 3 to 6 choices and 3 additional choices respectively) and a 50% reduction in the price for both fruits and salads. The study reported a strong intervention effect for salad: 36% of the customers reported eating salad during the intervention compared with 16% at baseline and 20% at follow-up. A similar effect was observed for fruit consumption, 15% of respondents reported eating fruit during the intervention compared with 8% and 10% at baseline and follow-up respectively.

Although the consumption of fruits and salads decreased after the treatment period, the consumption reported during the follow-up period was significantly higher than at baseline, which may suggest that environmental interventions that provide more access to fruits and vegetables is an effective strategy for changing food purchasing behavior.

In a recent 18-month worksite environment intervention to prevent obesity among metropolitan transit workers similar results were found (French et al., 2010). In this study the intervention components included changing the physical and social environment at transit garages to support more healthful food choice through the availability of affordable and healthy options in vending machines, free fresh fruit and vegetable samples, and a mini-farmer's market held at each of the intervention garage. The investigators reported that fruit and vegetable intake increased significantly and energy intake decreased significantly in the intervention garages compared to the control garages (French et al. 2010). Although these previous studies were conducted within school and worksite contexts, the findings are consistent with the interpretation that the food environment can have a great impact on food choice and eating behavior.

Attention to food choice behaviors as well as the food environment in residential treatment modalities is critical to reduce the level of weight gain commonly observed in recovery. The literature on nutrition intervention in residential treatment facilities to promote healthy eating and reduce weight gain is sparse. Much of the research in this population primarily focuses on non-nutrition education services such as nutrition screening, assessment, and nutrition supplementation (Farkas & Dwyer, 1984; Hauser & Iber, 1989), though there is some evidence suggesting that nutrition education is positively associated with substance treatment program outcomes (Grant et al., 2004). We are aware of no interventions aimed at weight gain prevention among men in recovery.

Hodgkins and colleagues (2003) investigated the effectiveness of a physical activity and nutrition education intervention in a residential treatment setting with 517 substance-addicted adolescents. The study included three treatment groups: (i) a group that was exposed to aerobic exercise with nutrition education (AENE), (ii) a group that received only physical activity (AEO), and (iii) a control group that received no intervention treatment, that is, the residents received treatment-as-usual (TAU). The authors reported that the adolescents in the combined exercise and nutrition education treatment group had a significantly lower post-BMI compared to the control group (23.97 and 24.86 for AENE and TAU respectively). No significant difference was reported between the physical activity-only group and the control group (Hodgkins et al., 2003). These findings support our expectation that nutrition interventions targeting eating behaviors and weight concerns in residential treatment facilities could have a positive impact on weight outcomes.

RHEALTH program, based on our formative research (Cowan, 2006), was developed on the proposition that if we increased the capacity for healthy food choices and cooking skills among men in residential treatment programs, that would enable them to make healthier food choices and reduce the excess weight gain often experienced in recovery. This pilot nutrition intervention included both a food and nutrition education and a food environment component designed to increase self-efficacy and skills in choosing and preparing healthy foods, and change environmental factors such as food-related policies in residential drug-treatment facilities to increase access to healthy foods.

The primary objective of the RHEALTH intervention was to increase the self-efficacy and skills of men in the six drug treatment facilities to choose and prepare healthy foods. We hypothesized that increasing skills and efficacy for healthy food choices and food preparation through nutrition education and food preparation

activities would lead to better behavioral outcomes. Specifically, we expected that the men residing in the drug residential treatment facilities would eat more fruits and vegetables, prepare more lower-fat foods, and eat fewer sweetened foods at the end of the intervention period compared to the control period.

A second objective was to make small food policy changes in the drug treatment facilities relating to menu development, food procurement, food availability, and food access. We expected that working collaboratively with the director and staff members in each study facility to provide healthy guidelines for menu development, food procurement as well as the availability and accessibility to healthy foods would enable the residents in these treatment facilities to make healthier food choices.

We are aware of no other study designed to increase the capacity and confidence to choose and prepare healthier foods through food and nutrition education and changes in the residential food environment among adult men living in residential drug treatment facilities. The novelty of this research was the inclusion of personal, behavioral, and environmental factors in promoting healthy food choice behaviors among men in substance treatment facilities. We have strengthened this design by including a strong process evaluation as an integral tool to assess the intervention implementation in this recovery population. These results will fill a gap in the literature and provide useful information for future research and dietary interventions in drug treatment facilities.

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# CHAPTER 2:

# ANALYSIS OF BASELINE CHARACTERISTICS

## DIETARY INTAKE AND BODY COMPOSITION AMONG MEN IN RECOVERY FROM SUBSTANCE ADDICTION


### ABSTRACT

Unhealthy eating behaviors, weight gain, and increased risk for chronic diet-related diseases have been reported among people in recovery from substance addiction. Prior work in this population identified barriers to healthy eating including poor food choices, lack of cooking and food choice skills, as well as limited access and availability to healthy foods in treatment facilities. The objective of this investigation was to examine factors associated with dietary intakes and body composition among men in residential drug-treatment. A non-random sample of 103 ethnically diverse men being treated for substance addiction in 6 residential drug treatment facilities in New York State participated at the beginning of the study. Measured weight, height, and waist circumference, dietary intake by food frequency, socio-demographic characteristics, history of addiction, and psycho-social measures related to food and eating were assessed through individual interviews with participants. Seventy-three percent of the study participants were either overweight or obese, and 36% had waist circumferences that put them at increased risk for cardio-metabolic diseases. Our findings also revealed that the study participants had poor dietary intake patterns. Average dietary intakes exceeded recommendations for total energy, % kcal from fat, daily servings of fats, oils, sweets, and sodas, but were inadequate in daily servings of fruits, vegetables, and dietary fiber. In multivariate

analysis better dietary quality was associated with longer time spent in the treatment program, higher self-efficacy for healthy eating among younger participants, readiness for diet change in the next 30 days, and satisfaction with diet and weight. Lower body mass index and waist circumference were associated with younger age, higher educational levels, and with higher self-efficacy among men who were satisfied with their diet and weight. These findings provide new insights about factors associated with dietary intake and body composition in an understudied at-risk population, men in recovery from substance addiction. These findings will be useful in the design of health promotion programs designed to improve dietary quality and weight management among men in treatment for substance abuse.

## INTRODUCTION

Overweight and obesity have been reported in the substance addiction population (Jackson et al., 2002; Kliener et al., 2004; Warren et al., 2005; McIntyre et al., 2007), however most reports included self-reported weight measures. People in addiction are at an increased risk for chronic diet-related diseases such as diabetes and cardiovascular diseases such as coronary heart disease, hypertension, and stroke (Howard et al., 2004; Sutter et al., 1999; Poilkolainen, 1998; van de Weil, 2004). Because obesity plays an integral role in these chronic diseases, the excessive weight gained in recovery may further exacerbate these health problems, and may compromise abstinence, a key component in the treatment of drug and alcohol addictions.

In 2009, more than twenty-two million Americans reportedly abused or were dependent on alcohol or illicit drugs (SAMHSA, 2009). Of these, 4 million people received treatment at specialty substance abuse programs such as rehabilitation facilities (e.g. community residential programs), hospitals or mental health centers

(SAMHSA, 2009). These treatment settings provide the necessary care for the addicted patients/clients throughout their recovery. Abstinence from drug and alcohol use is usually the main focus in substance treatment modalities. A considerably amount of time and effort is spent to facilitate sobriety in the lives of the recovering addicts, and little attention is given to food behaviors and weight management even though there is strong evidence for concern. Some experts propose a possible correlation between drug abstinence and weight gain (Putnam et al., 1990; Hodgkins et al., 2003), though the underlying reasons remain an open question and warrant further investigation.

Recovery is a developmental process. Active addiction is marked by periods of food deprivation, poor diets and weight loss; consequently many drug addicts are at nutritional risk when they enter treatment programs (Hudson et al., 1992; Hauser et al., 1989). Recovery is marked by total abstinence from addictive substances and is a period of change in which the addicted person begins to move away from unhealthy behavioral patterns towards more healthy and productive ways of living without the use or need for alcohol or other drugs (Milhorn, 1990). During recovery some weight gain is necessary to compensate for the weight loss experienced in active addiction. However, there is a propensity for recovering addicts to choose foods with low nutrient density and high caloric values (Hatcher, 2004; Farkas et al., 1984). In both animal and human studies there is evidence suggesting that fats and sweets may act as substitutes for alcohol and cocaine use (Gosnell et al., 2001, 1998; Krahn et al., 1992.

Our prior qualitative research among men in community residential treatment programs revealed: (i) dysfunctional eating patterns and large weight gains in recovery; (ii) resident responsibility for preparing the evening meals without needed skills for choosing and preparing healthy foods in the program; and (iii) food environments that did not support healthy eating or provide food and eating skills

needed by residents during and after the completion treatment (Cowan, 2006; Cowan & Devine, 2008). The findings of this prior research informed the study design, choice of variables, and analysis of the current study (Cowan & Devine, 2008).

The aim of this investigation was to examine socio-demographic, addiction history, and psychosocial factors associated with dietary intakes and body composition among men in residential drug-treatment facilities. Men are two times more likely to be dependent on or abuse alcohol and illicit drugs than women, and they accounted for a larger percent of substance abuse treatment admissions (SAMHSA, 2009), thus they were the focus of the current study. We are aware of no other studies that have broadly assessed socio-demographic, addiction history, and psychosocial correlates of dietary intake and body composition among men in recovery from substance addiction. This study adds to research in this population by its broad examination of demographic, addiction and psychosocial variables, measured weights, and high quality dietary intake measures. The sparse reports on dietary intakes and/or weight issues in this population have relied primarily on self-reported measures. The results of this study will provide a basis for future research and dietary interventions in this high risk and understudied population.

## METHODS

### Theoretical Framework and Design

The current analysis reports on the baseline characteristics of men who were recruited to participate in a subsequent intervention to promote the adoption of healthy food choice behaviors in residential treatment facilities for substance addiction. Social cognitive theory (Bandura, 1977) and prior formative research with this population (Cowan & Devine, 2008) guided this study. Social cognitive theory including self-efficacy and self-regulation constructs was employed because of their connections to

behavioral outcomes (Bandura, 1997). This framework proposes that a person's actions are determined through continuous interactions between personal factors, behaviors, and environmental influences (Bandura, 1977). Self-efficacy, which deals with personal agency is described as a person's cognition of confidence and capability to perform a behavior necessary to attain a desired goal or an expected outcome (see also Allison et al., 1999; Brug et. al, 1995; Masse et. al., 2006). Thus, we believed that the participants' confidence in their ability to choose healthy foods would have a positive association with the actual intake of those foods. Self-regulation may also play a role in food intake and body composition. It is described as a cyclical strategy that a person uses in the attainment of personal goals. The process involves self observation, monitoring and adjusting cognitive and affective states with regards to a behavior within an environment (see also Zimmerman, 2000). Self-regulation is motivational in nature and requires effort and careful self-reflection; therefore is used when outcomes are highly valued. Consequently, when an outcome is not perceived as valuable, there is no incentive to self-regulate (Zimmerman, 2000). Therefore, we operationalized this construct by assessing participants' satisfaction with their current diet and body weight. We anticipated that less satisfaction would be associated with greater healthy behavioral outcomes.

A social support construct was employed to assess support for healthy eating and cooking skills in the treatment facilities because it has been linked to number of health outcomes (Heaney et. al., 2000, 2008; Sallis, 1987). It is believed that social support can serve as a protective buffer that may reduce a person's vulnerability to negative effects of stress on health. We anticipated that perceiving strong social support for healthy eating behaviors in the treatment facilities would enhance the residents' ability to make healthy food choices.

We assessed participants' attitudes toward dietary behaviors using constructs from the theory of planned behavior (TPB) because of the link between attitude, intention and behavior (Armitage, 1999). According to the theory, a person's behavior is guided by "attitude toward the behavior, subjective norm, and perception of the behavioral control, which leads to the formation of a behavioral intention," and hence behavior (Ajzen, 2002, 2001; Armitage, 1999). We proposed that if participants had a positive attitude toward changing eating behaviors, then they would be more likely to transfer the positive attitude into behavioral intention, and ultimately healthy eating behaviors.

The Stages of Change Model, also known as the Transtheoretical Model, was used to assess readiness to change dietary behavior (Prochaska & DiClemente, 1982, 1983). The model consists of five distinctive stages of change that are based on a person's perceptions of his/her behavior and intentions to change the behavior in the future (Verheijden, 2004). These changes are said to occur as a process over time in a non-linear manner (Prochaska, 1994). The five stages of change (pre-contemplation, contemplation, preparation, action, and maintenance) were collapsed into three categories pre-contemplation stage, contemplation (participants who were in contemplation or preparation stage), and the action stage (action or maintenance stage) in order to better assess participants' intentions. Others have suggested that positive behavioral intentions are comparable to contemplation/preparation stages, and may be more useful to compare the intention of people in this "pseudostage" with those in the pre-contemplative stage with regards to behavioral changes (Vet et al., 2007). We included the action stage in order to identify those participants who were already engaged in healthy dietary practices.

The analytical framework used in this study illustrates the factors hypothesized to be associated with the study participants' dietary intake and body composition

(Figure 2.1). We expected that 1) demographic characteristics such as age, race/ethnicity and education; 2) addiction history, which included time in the current treatment program, drug of choice, the number of treatment episodes, sobriety time and the number of years spent in active addiction; and 3) psychosocial characteristics such as self-efficacy for healthy eating and cooking skills, social support, satisfaction with diet and weight, attitude toward changing diet and cooking skills, and readiness to change would be associated with key dietary and body composition outcomes. We hypothesized that participants with greater self-efficacy and social support for healthy eating and cooking skills would consume more fruits and vegetables, less fatty and sugary foods, and would have lower BMI's and waist circumference. We also hypothesized that participants who had spent longer time in active addiction, in the current treatment program, and with longer abstinence from drug and alcohol consumption would have higher BMI's and waist circumferences. Additionally, we hypothesized that participants who had shorter sobriety times and those who had been in the current treatment for shorter periods would consume more fatty and sugary foods; however they would have lower BMI's and waist circumferences due to excessive weight loss in active addiction and the shorter time in recovery.

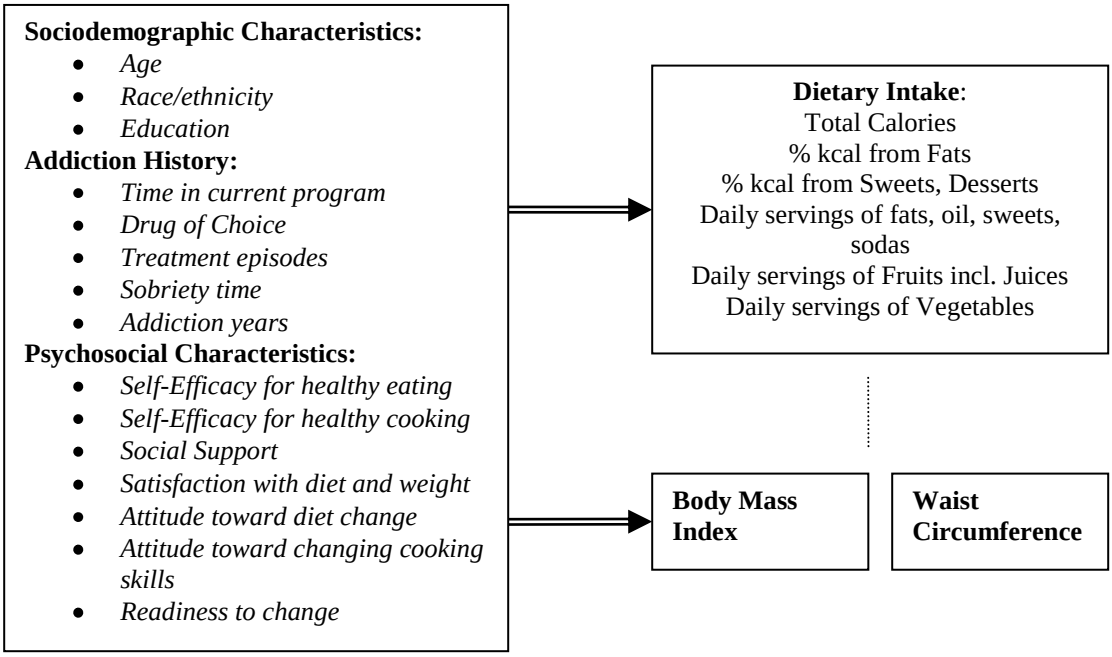


**Figure 2.1 Analytical Framework for assessing the relationship of socio-demographic, addiction history, and psychosocial characteristics of men in recovery from drug and alcohol addiction: relationship to dietary intake and body composition.**

## Sample and Recruitment

A nonrandom sample of 103 multi-ethnic men between the ages of 19 and 59 years living in six residential drug-treatment facilities in New York State was recruited to participate in the study. The six study sites were recruited through connections with the study population from previous research and from referrals. Preliminary discussions with the directors, staff, and residents of each of the six treatment sites were held before data collection began to determine the most appropriate methods of recruitment and retention in each facility. Study participants in each site were recruited through a combination of personal contacts, peer recruiting, community meetings at the treatment facilities, and fliers posted in common areas. Interested residents

(approximately 90% of the residents) were asked to complete a recruitment form with a contact name, telephone number and a convenient time and date to be contacted.

The six study sites were community residential treatment programs that provided twenty-four hour rehabilitative services for men in recovery from substance addiction in Upstate New York. All facilities were certified by New York State Office of Alcoholism and Substance Abuse Services (OASAS) that provided strict regulations for substance-abuse treatment providers (OASAS, 2006). One of the six treatment facilities (site #1) was a governmental facility that provide treatment services to veterans while the other study sites were private non-profit organizations that were funded by grants, contracts with state agencies (e.g. Department of Social Services), and private insurance fees. In all study sites, residents were typically screened for admission and were accepted based on treatment criteria. Study sites two and five had stricter admission guidelines, and they had reputations in the community for being the best and strictest treatment facility respectively. Residents in five out of the six sites were assigned to cook teams that were responsible for preparing the evening meals five days per week while the remaining site (site 6) had hired cooks who were responsible for all food services.

Three of the six study sites (4, 5 & 6) were located in inner-city neighborhoods; one facility (site 2) was in a historical and more affluent community, and two sites (1 & 3) were located in an urban residential area. All six sites were non-mandatory treatment facilities; residents entered treatment voluntarily. However site number five had more stringent treatment guidelines, and worked more closely with the correctional system in the study area. At the time of the study, all the sites were operating below capacity due to program discharges and admittance protocols. All the sites that were approached participated in the study.

**Data collection and measures**

The primary investigator conducted individual interviews with all of the men who were interested in participating in the study. Individual interviews were used to avoid possible literacy problems in this population. All of the participants provided signed consent following procedures reviewed by the Cornell University Institutional Review Board. Interviews lasted approximately two hours and included: measured weight, height, and waist circumference, completion of a food frequency questionnaire, and assessment of individual socio-demographic characteristics, history of addiction, and psycho-social measures related to food and eating.

Socio-demographic characteristics were assessed using standard measures of age, race and ethnicity, marital status, education, and employment status before treatment. Age was grouped for analysis into two categories, above and below the sample mean age of 41 years. We included three educational levels: less than high school, high school or GED, and more than a high school education, which included some college credits, undergraduate and graduate degrees. We used two categories for marital status: single or divorced and married or separated. The married participants were living away from their families while in the treatment facilities, and in most cases were only allowed limited family visits.

The primary researcher collected weight and height measurements on each participant using a digital portable scale that recorded weight in pounds and kilograms and a stadiometer against a vertical wall with the base plate placed on the floor while the tape extended upwards until the head bar rested on the participant's head. Waist circumference (WC) measurement was taken at midpoint between the bottom of the rib cage and above the top of the iliac crest. Both height and WC measurements for each participant were taken three times, and the averages were computed for each participant. The body mass index (BMI) was calculated as measured weight in

kilograms divided by the average height in meters squared ($kg/m^2$). We used the continuous measures of BMI and WC as well as BMI categories and cut-off point for WC in our analyses. The cutoffs used to categorize BMI and WC was derived from the U.S. Centers for Disease Control and Prevention (CDC, 2005).

Each participant was asked about his addiction history including: "primary drug of choice," the substance for which he was undergoing treatment; "current sobriety," how long he had been 'clean and sober' since the current treatment; "time in current program," how long he had been in the current treatment facility; "treatment episodes," how many treatments he had had for any substance including the current treatment; and "active addiction," the total number of years and months he had spent habitually using drugs.

We used the computer-scannable version of the 110-item Block Food Frequency questionnaire (Block 2005 FFQ) to assess the frequency and serving size intake of foods consumed. The foods assessed were fruits including 100% fruit juices, vegetables, breakfast foods, meats including beef, fish, poultry, and lunch items, breads, snacks and spreads, dairy products, sweets and beverages (Block 2005). The study participants were asked to rate how often during the current treatment episode or on average they usually ate each set of foods and the usual amount eaten. Responses for frequency of food eaten ranged from never ate to every day. Portion size (small, medium, or large) for each food item was asked separately using a pictorial illustration of plate sizes that ranged from ½ cup to 2 cups of food where applicable, and number of pieces of food, glasses of drinks, or cans when appropriate. Seasonal use of some foods and the types of food, for example, meatless entrees, low-fat and sugar-free foods were also assessed. The completed food frequency questionnaires (with only participants' ID numbers as identifiers) were sent to the Block Dietary Data System (NutritionQuest®) for analysis. This food frequency instrument has been extensively

studied and validated for use with dietary intake assessments (e.g. Block, 1982; Block & Hartman, 1989; Sobell et al., 1989).

The following psycho-social measures were assessed in the interview.

*Self-efficacy for healthy eating. The* self-efficacy scale used in the current study was modified from a longer scale developed by Sallis and colleagues (Sallis et al., 1988; Sallis, 2006). We included a 12-item scale measured on a 5-point response scale (e.g., "Eat 3 servings of vegetables most days," *I know I cannot-I know I can*). Factor analysis of the 12-item scale using principal-components analysis with varimax rotation generated 4 different factors. We omitted one factor because it loaded by itself and did not seem to fit the construct. The remaining three factors were: self-efficacy for "choosing healthy foods" (4 items), "reducing fats, sweets, and portions" (3 items), and "eating the recommended serving of fruits and vegetables on most days" (2 items). All three factors had Eigenvalues greater than 1.0. The Cronbach alpha for the eleven items was 0.78. The mean scores for the three factors were computed and a mean self-efficacy score for healthy eating was then derived.

*Self-efficacy for healthy cooking skills.* Our measure of self-efficacy for healthy cooking skills was also adapted from the Sallis (1988). We used 6-items measured on a 5-point response scale (e.g., "add less fat than the recipe calls for," *I know I cannot-I know I can)* that generated two factors in factor analysis using principal-components analysis with varimax rotation. One factor (4 items) addressed healthy cooking skills while the other (2 items) dealt with healthy cooking methods. Because the two factors covered the same construct, and the Cronbach alpha was moderately high (0.72) we combined the two factors and computed an overall mean score for all six items.

*Attitude toward preparing vegetables.* An attitude toward cooking vegetables measure was modified from the Sisters in Health nutrition program aimed at

increasing fruit and vegetable intake among low income women (Devine et al., 2005). The five items were measured on a 5-point Likert scale (e.g., "I think fresh vegetables are easy to prepare," *strongly disagree-strongly agree*). Factor analysis revealed one extracted component. The Cronbach alpha for the 5 items was .60; however, alpha increased to .74 when one item ("the other guys [residents] like the way I prepare vegetables") was dropped from the scale, which seems to assess the attitudes of others. The final scale included four items.

*Satisfaction with diet and body weight.* Satisfaction with food choices, body weight, and cooking skills, adapted from (Chance Program), was measured with a composite score derived from three items. Each item was rated on a 5-point Likert scale (e.g., "I feel satisfied about my current eating habits," *strongly disagree-strongly agree*). Factor analysis generated a single factor and the mean score of the three items were then computed for an overall satisfaction score. The Cronbach alpha for the three items was .71.

*Social support for healthy eating.* We used a modified version of Sallis and colleagues' (1988) measure of social support for healthy eating that included both positive and negative support. The modified scale included 14 items, tailored toward the eating behavior of people in drug treatment communities. We added four items to assess social support for healthy cooking in the treatment facilities. The initial factor analysis using principal-components analysis with varimax rotation with the 14-items revealed five components. We then compared our factors with the original scale (Sallis et al., 1988), omitted four items that did not load in the same components, and then conducted another factor analysis with 10-items (including three of the four we developed), which generated three factors, "social support encouragement," social support discouragement," and "social support for healthy cooking skills." The sum of each the three subscales was computed. In order to compute an overall social support

score, the 3 items of the "discouragement" subscale were reversed, and the sum of the three social support categories was computed for an overall social support score.

*Readiness to change diet and cooking skill in the next 30 days.* One item*:* "How important is it to you that you change your diet habits in the next 30 days?" was assessed on a 0-10-point response scale from "not at all important" to "very important." The item was adapted from the Healthy Worksite study (BRFSS)**.** Readiness to change cooking skills in next 30 days: ("How important is it to you that you change your cooking skills in the next 30 days?") was also assessed on a 0-10-point response scale from "not at all important" to "very important."

*Readiness to change food choices and cooking skills*. We used Prochaska and colleague (1982, 1983) stage of change model to assess participants' readiness to change their diets. Three items were used to assess participants' readiness to change their current consumption of fruits, vegetables and low-fat foods. For example the 4-response options for fruit intake were *"I currently do not eat at least 2 servings of fruits per day, and I do not intend to start eating them in the next 6 months," "I currently do not eat at least 2 servings of fruits per day, but I am thinking about starting in the next 6 months, "I currently eat at least 2 servings of fruits per day, but I have only begun in the last 6 months," and "I currently eat at least 2 servings of fruits per day, but I have done so longer than 6 months."*

Participants were also asked to describe current cooking skills with vegetable and low-fat recipes or cooking methods, which were measured on similar 4-response options (e.g. *"I currently do not cook with vegetables regularly, and I do not intend to start cooking with them regularly in the next 6 months and I currently do not cook with low-fat recipes/substitutes or low-fat cooking methods regularly, and I do not intend to start regularly in the next 6 months*" respectively).

**Statistical Analysis**

Analyses were conducted using the Statistical Package for the Social Science (SPSS for Windows Version 16, SPSS, Inc.). Simple statistical procedures such as descriptive analysis including scatter plots, histogram distributions, and other tests for normality were conducted to check data for outliers, and log transformations were computed when appropriate. Means, medians standard deviation, and proportions were also assessed. Bivariate associations were evaluated between demographic characteristics, addiction history, and psychosocial measures as the independent variables, and dietary intake, body mass index and waist circumference as the dependent variables. We eliminated variables from further analysis that did not demonstrate a statistically significant relationship ($p = < 0.05$) with the main study outcomes. A mixed model regression analysis was then used to evaluate multivariable associations between dietary intake, BMI and waist circumference with the independent variables that were significantly associated in bivariate analyses ($p = <0.05$) or relevant to the study objectives. Age and education were included in all multivariate models because of known relationships with dietary behaviors. Pearson's correlation was analyzed to examine relationships between key outcome variables and socio-demographic and addiction history variables, and interaction terms (e.g. self-efficacy for healthy eating with education, age and satisfaction with diet and weight) were included in the models if relationships among these independent variables were significant ($p = <0.05$). Models were built separately for each outcome, and the study sites were controlled for in all multivariate analyses.

## RESULTS

### Characteristics of the Study Participants

The socio-demographic characteristics of the 103 men from six sites who enrolled in the study are listed in Table 2.1. Almost half of the study participants were African Americans; 36% were white of European descent. Eleven percent self-

**Table 2.1 Socio-demographic Characteristics of Study Participants (n=103 men)**

| | Mean (SD) | Range | n | % |
|---|---|---|---|---|
| Age (years) | 41.7 (9.6) | 19-59 | | |
| <41 years | | | 40 | 38.8 |
| ≥41 years | | | 63 | 61.2 |
| Race/ethnicity: | | | | |
| African-American | | | 50 | 48.5 |
| White | | | 37 | 35.9 |
| Other | | | 5 | 4.9 |
| Hispanic | | | 11 | 10.7 |
| Education: | | | | |
| < High school | | | 24 | 23.3 |
| High School or GED | | | 48 | 46.6 |
| >High School Diploma | | | 31 | 30.1 |
| Single or Divorced | | | 91 | 88.3 |
| Not employed before Treatment | | | 70 | 68.0 |
| Smoke Cigarettes | | | 83 | 80.6 |
| Diagnosed with Diet-related Health Condition | | | 59 | 57.3 |
| Take Medication (for at least one diet-related condition) | | | 29 | 28.2 |
| Received weight loss advice from physician | | | 31 | 30.1 |

identified as being of Hispanic origin. Most were divorced or had never been married. More than three-fourths of the men had a high school education or more; twenty-three

percent had not completed high school. More than half had been unemployed for at least one year before entering treatment for addiction. Most participants smoked cigarettes at the time of the study; more than half were diagnosed with a diet-related health condition such as diabetes, hypertension, high cholesterol, and cardiovascular diseases; and 28% reported taking a prescribed medication for at least one diet-related condition. Also more than a quarter had received some weight loss advice from a primary care physician.

More than half of the study participants were either overweight or obese, 20% were at or above the Obese Class II category, and more than a third had a waist circumference above 102 cm, the cut-point corresponding to obesity in men (Table 2.2).

**Table 2.2 Anthropometric Characteristics of Study Participants (n= 103 men)**

| | Mean (SD) | Range | n | % |
|---|---|---|---|---|
| Body Mass Index | 29.2 (6.5) | 19.9-50.6 | | |
| Average Height (cm) | 177.4 (6.6) | 158.9-193.7 | | |
| Weight (kg) | 92.3 (22.4) | 52.8-158.9 | | |
| Average Waist Circumference (cm) | 100.8 (18.4) | 69.9-153.3 | | |
| **BMI Categories**: | | | | |
| Normal (BMI= 18.5-24.9) | | | 28 | 27.2 |
| Overweight (BMI= 25-29.9) | | | 36 | 35.0 |
| Obese Class I (BMI= 30-34.9) | | | 18 | 17.5 |
| Obese Class II (BMI= 35-39.9) | | | 15 | 14.6 |
| Severely – Super Obese (40-59.9) | | | 6 | 5.8 |
| Waist Circumference (≥ 102 cm) | | | 37 | 35.9 |

The addiction history of the study participants is presented in Table 2.3. More than a third reported alcohol and another third crack or cocaine as their primary drug of choice. Almost one-fourth used heroin or other opiates. Only a few reported marijuana as primary drug of choice. The mean sobriety time was 5.5 (±8.2) months

while the average time spent in the current residential drug treatment program was 2.7 (±2.9) months. On average, the men reported 6 treatment episodes and about twenty two years spent in active addiction.

**Table 2.3 Drug and Alcohol History of Study Participants (n=103 men)**

| | Mean (SD) | Range | n | % |
|---|---|---|---|---|
| **Primary Drug of Choice:** | | | | |
| Alcohol | | | 39 | 38 |
| Crack/Cocaine | | | 36 | 35 |
| Heroin/Opiates | | | 24 | 23 |
| Marijuana | | | 4 | 4 |
| | | | | |
| Current Sobriety (months) | 5.5 (8.2) | .03-60 | | |
| Time in Current Program (months) | 2.7 (2.9) | .07-15 | | |
| Treatment Episodes (n) | .24 (5.4) | 1-25 | | |
| Active Addiction (years) | 21.5 (10.8) | 0.5-40 | | |

Men from the six treatment facilities were similar in many characteristics. However, the participants in one site (#6) had a longer history of addiction, maintained longer continuous abstinence to their drug of choice at the time of the study, and generally were in the current treatment program longer than their counterparts in the other study sites (Table 2.4). These men were older and almost half had less than a high school education. Also, 47% reported crack or cocaine as their primary drug of choice; and more than two-thirds were either overweight or obese, and more than half had a waist circumference above 102 centimeters.

**Table 2.4 Study Participant Characteristics by Study Site (n= 103 men)**

| Site # | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **Participants (n)** | 14 | 15 | 14 | 17 | 28 | 15 |
| **Race/ethnicity: n (%)** | | | | | | |
| White | 4(29) | 9(60) | 3(21) | 5(29) | 14(50) | 2(13) |
| Black | 9(64) | 4(27) | 8(58) | 11(65) | 8(29) | 10(67) |
| Hispanic | 1(7) | 0(0) | 2(14) | 1(6) | 5(19) | 2(13) |
| Other | 0(0) | 2(13) | 1(7) | 0(0) | 1(3) | 1(7) |
| **Age**: **n (%)** | | | | | | |
| <41 years | 1(7) | 9(60) | 5(36) | 8(47) | 15(54) | 2(13) |
| ≥41 years | 13(93) | 6(40) | 9(64) | 9(53) | 13(46) | 13(87) |
| **Education: n (%)** | | | | | | |
| < High school | 0(0) | 2(13) | 3(21) | 5(29) | 7(25) | 7(47) |
| High School/GED | 6(43) | 7(47) | 5(36) | 10(59) | 15(54) | 5(33) |
| > High Diploma | 8(57) | 6(40) | 6(43) | 2(12) | 6(21) | 3(20) |
| **Marital Status: n (%)** | | | | | | |
| Single/Divorced | 10(72) | 14(93) | 14(100) | 15(88) | 25(89) | 13(87) |
| Married/Separated | 4(29) | 1(7) | 0(0) | 2(12) | 3(11) | 2(13) |
| **Primary Drug: n (%)** | | | | | | |
| Alcohol | 7(50) | 6(40) | 8(57) | 9(53) | 5(18) | 4(27) |
| Cocaine/Crack | 5(36) | 6(40) | 4(29) | 5(29) | 9(32) | 7(47) |
| Heroin/Opiates | 2(14) | 3(20) | 2(14) | 3(18) | 11(39) | 3(20) |
| Marijuana | 0(0) | 0(0) | 0(0) | 0(0) | 3(11) | 1(6) |
| **Addiction History: mean (±SD)** | | | | | | |
| Time in Program: (Months) | 3.0±4.3 | 3.7±3.5 | 2.5±2.9 | 1.1±1.3 | 1.9±1.6 | 5.0±2.7 |
| Sobriety Time: (Months) | 12.1±18.4 | 6.0±3.5 | 3.2±3.0 | 3.8±6.2 | 3.5±2.2 | 7.2±5.9 |
| Active Addiction: (Years) | 22.6±11.3 | 17.3±10.4 | 25.0±8.8 | 23.3±9.5 | 8.6±12.1 | 25.2±10.0 |
| **BMI** (Mean ±SD) | 29.8 ±6.7 | 26.7±5.8 | 30.2±9.2 | 27.7±5.9 | 29.3±5.2 | 32.1±6.6 |
| **BMI** Categories: n (%) | | | | | | |
| Overweight/Obese† | 5(64) | 8(53) | 11(79) | 12(71) | 22(79) | 13(87) |
| Obese‡ | 6(43) | 4(27) | 5(36) | 5(29) | 12(43) | 9(60) |
| **WC**¥ | 6(43) | 3(20) | 4(29) | 5(29) | 11(39) | 8(53) |

† BMI ≥ 25; ‡ BMI ≥ 30, ¥ Waist circumference ≥102 cm

**Dietary Intake**

Descriptive summaries for the participants' dietary intakes are presented in Table 2.5. The average total caloric intake was 3,515 kcal, with 38.1% calories from fat, and 21.0% calories from sweets and desserts. These men reported an average of 2.9 (±2.0) daily servings of vegetables, and 1.3 (± 0.8) servings of fruit per day including juices. The average servings of fats, oils, sweets and sodas reportedly was 6.0 (±2.6) per day.

**Table 2.5 Dietary Intake of Study Participants (n=103 men)**

| | Median | Mean (SD) | Dietary Guidelines[¤] |
|---|---|---|---|
| Total Energy[†] (kcal) | 3134 | 3515 (1478) | 2000 kcal |
| % of Kcal from Carbohydrate | 48.1 | 47.5 (6.4) | 45-65 |
| % of Kcal from Protein | 15.5 | 15.6 (2.9) | 18 |
| % of Kcal from Fat[†] | 38.1 | 38.1 (4.4) | 20-35 |
| % of Kcal from Sweet, Desserts[†] | 19.6 | 21.0 (10.1) | sparingly |
| Saturated Fat (gms) | 42.6 | 47.3 (21.4) | 20 |
| Trans Fat (gms) | 4.8 | 5.3 (2.8) | 5.8 |
| Monounsaturated (gms) | 50.9 | 58.1 (26.4) | 24 |
| Polyunsaturated (gms) | 20.1 | 32.0 (15.2) | 20 |
| Cholesterol (mgs) | 521 | 556 (294) | 230 |
| Sodium (mgs) | 5293 | 5878 (2596) | <2,300 |
| Dietary Fiber (gms) | 20.3 | 23.3 (11.0) | 31 |
| Potassium (mgs) | 3694 | 4069 (1706) | 4,700 |
| **Daily Servings**: | | | |
| Vegetable intake[†] | 2.6 | 2.9 (2.0) | 5 |
| Fruit intake incl. juices[†] (freq.) | 1.1 | 1.3 (0.8) | 4 |
| Fats & Oils, Sweets, Soda[†] | 5.7 | 6.0 (2.6) | 3-4 |
| Daily Servings of Meats[*] | 4.4 | 5.0 (2.7) | ≤6 |
| Daily Servings of Whole Grains | 0.2 | 0.7 (1.0) | 3-4 |
| **MyPyramid Servings** (cups): | | | |
| All Vegetables | 1.3 | 1.5 (0.9) | 2.5 |
| Dark green vegetables | 0.3 | 0.4 (0.3) | .43 |
| Orange Vegetables | 0.1 | 0.1 (0.2) | .29 |
| Other incl. Tomatoes | 0.8 | 1.0 (0.6) | .93 |
| Total Fruit (incl. juices) | 1.2 | 1.3 (0.9) | 2 |

[†] outcome variables

[*] Meat servings including fish, poultry, beans, eggs

[¤] USDA Dietary Guidelines for adult based on 2,000 daily caloric intake (USDA, 2008).

Notes: MyPyramid recommendations are divided by 7 to get daily servings (HHS & USDA, 2005).

With the exception of fruit and vegetable intakes, study participants reported higher dietary intakes than the U.S. Dietary Guidelines; intakes were also higher than those of U.S. men of this age group in the general population (Table 2.5). The men in our study reported higher total energy (3500 ± 1478 kcal), percent calories from fat (38% ±4.4), and fewer daily fruits (1.3 ±0.8 servings) and vegetables (2.9 ±2.0 servings) than the national averages for men of this age group: 2800 kcal and 31% of fat in 2005-06 and 1.4 ±0.1 and 3.9 ±0.2 daily servings of fruits and vegetables respectively in 1999-00 (USDA, 2008; Guenther, 2006).

**Psychosocial characteristics**

Summaries of the psychosocial characteristics for study participants are presented in Table 2.6.

**Bivariate Analysis**

Based on the analytic model that guided this research (Figure 2.1), bivariate analyses were performed to investigate the hypothesized relationships between the key measures of dietary intake (Total Calories, % Kcal from Fat, % Kcal from Sweets & Desserts, Daily Servings of Fat, Oil, Sweets, & Sodas, Daily Servings of Vegetable and Daily Servings of Fruit including Juices), and body composition (BMI, waist circumference) with socio-demographic, addiction history and psychosocial characteristics of participants. Following bivariate analysis, key independent variables such as participants' age, educational level, time in the treatment program (TIP), self-efficacy for healthy eating, satisfaction with diet and weight, and readiness to change

**Table 2.6 Psychosocial Characteristics of Study Participants (n=103 men)**

| | Mean (SD) | Range* |
|---|---|---|
| Self-Efficacy for Healthy Eating | 11.7 (2.0) | 1-15 |
| Self-Efficacy for Healthy Cooking | 3.7 (0.8) | 1-5 |
| Satisfaction with diet and weight | 2.9 (1.0) | 1-5 |
| Attitude toward Preparing Vegetables | 4.0 (0.8) | 1-5 |
| Social Support for Healthy Eating: | 24.4(7.2) | 0-50 |
| Readiness to change diet (30 days) | 7.1(2.8) | 0-10 |
| Readiness to change cooking Skills (30 days) | 6.2 (3.2) | 0-10 |
| **Stages of Change:** | **n** | **%** |
| **Readiness to Change Diet: Eat 2 Servings of Fruit** | | |
| *Pre-contemplation* | 6 | 5.8 |
| *Contemplation & Preparation* | 77 | 74.8 |
| *Action & Maintenance* | 20 | 19.4 |
| **Readiness to Change Diet: Eat 3 Servings of Vegetables** | | |
| *Pre-contemplation* | 21 | 20.4 |
| *Contemplation & Preparation* | 77 | 74.8 |
| *Action & Maintenance* | 5 | 4.9 |
| **Readiness to Change Diet: Eat Lower-fat Foods** | | |
| *Pre-contemplation* | 43 | 41.7 |
| *Contemplation & Preparation* | 52 | 50.5 |
| *Action & Maintenance* | 8 | 7.8 |
| **Readiness to Change Cooking Skills: Prepare Vegetables** | | |
| *Pre-contemplation* | 9 | 8.7 |
| *Contemplation & Preparation* | 58 | 56.3 |
| *Action & Maintenance* | 36 | 35.0 |
| **Readiness to Change Cooking Skills Prepare Lower-fat Foods** | | |
| *Pre-contemplation* | 24 | 23.3 |
| *Contemplation & Preparation* | 63 | 61.2 |
| *Action & Maintenance* | 16 | 15.5 |

*Range of possible scores

diet in the next 30 days were retained in the multivariate analysis if a significant relationship ($p=<0.05$) was found with diet and body composition measures (Tables 2.7-2.14).

In bivariate analysis, older age was positively associated with higher total energy, BMI and waist circumference (Tables 2.7, 2.13 & 2.14). The only addiction history variable that was associated with diet (but not with body composition) was time in the current treatment program. As hypothesized, longer time in program was associated with significantly lower intake of total energy (p=0.01), % calories from fat (p=0.01), and fewer daily servings of fat, oil, sweets, and sodas (p=0.05).

For the psychosocial variables, significant negative associations were found between self-efficacy for healthy eating and percent kcal from sweets and desserts (p=<0.05), and positive associations with daily servings of vegetables (p=0.003) in the expected directions (Tables 2.9 & 2.11), but we did not find expected associations between self-efficacy and body composition measures (Tables 2.13 & 2.14). We did not find an association between self efficacy for healthy eating and body composition or between self efficacy for healthy cooking and most diet measures or body composition (Tables 2.7-2.10 & 2.12 – 2.14). Self-efficacy for healthy cooking was positively associated (p=0.002) with daily servings of vegetables (Table 2.11). We hypothesized that participants with greater self-efficacy for healthy eating and cooking skills would consume more fruits and vegetables, less fatty and sugary foods, and would have lower BMI's and waist circumference.

A positive attitude toward preparing vegetables was associated (p=0.002) with more daily servings of vegetables (Table 2.11). Participants' satisfaction with their current diet and weight was significantly and positively associated (p=<0.05) with daily servings of vegetables and fruits (Tables 2.11 & 2.12), and negatively associated with BMI and WC (p=<0.0001) in the predicted direction except for total energy, which revealed higher intakes among men who reported greater satisfaction with diet and weight (p= 0.04).

A greater readiness to change diet in next 30 days was negatively associated (p= < 0.05) with total energy, percent calories from sweets and desserts, and daily servings of fat, oil, sweets (Tables 2.7, 2.9 & 2.10) but positively associated with BMI and WC (Tables 2.13 & 2.14). Similarly, men with greater intention to change their cooking skills in the next 30 days had significantly higher BMI (p=0.01) and WC (p=0.05). We did not find significant associations between the readiness to change food choices and cooking skills variables and most diet measures or body composition. The biviarate results of the stage of change variables are presented in Appendix A.

**Table 2.7 Association of Total Calories (kcal) with Participant Characteristics (n= 103 men)**

| | | | Bivariate | | |
|---|---|---|---|---|---|
| **Characteristic** | | **n** | **β** | **F** | **p** |
| **Age** | <41 years | 40 | | 5.445 | 0.02 |
| | ≥41 years† | 63 | | | |
| **Race/ethnicity**: | African American | 50 | | 0.183 | 0.91 |
| | White | 37 | | | |
| | Other | 5 | | | |
| | Hispanic | 11 | | | |
| **Education:** | <High school | 24 | | 0.311 | 0.73 |
| | High school diploma/GED | 48 | | | |
| | >High school | 31 | | | |
| **Time in Program (months)** | | | -0.251 | | 0.01 |
| **Pyschosocial Variables:** | | | | | |
| Self-Efficacy for Healthy Eating | | | 0.014 | | 0.89 |
| Self-Efficacy for Healthy Cooking | | | -0.028 | | 0.78 |
| Attitude toward Preparing Vegetables | | | 0.132 | | 0.18 |
| Satisfaction with diet and weight | | | 0.207 | | 0.04 |
| Social Support for Healthy Eating | | | -0.113 | | 0.25 |
| Readiness to change (next 30d) | | | -0.256 | | .009 |
| Readiness to change Cooking Skill (next 30d) | | | -0.131 | | 0.19 |

† Highest mean

**Table 2.8 Association of % Kcal from Fat with Participant Characteristics (n= 103 men)**

| Characteristic | n | Bivariate β | F | p |
|---|---|---|---|---|
| **Age:** <41 years | 40 | | 0.016 | 0.90 |
| ≥41 years | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 1.840 | 0.15 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic | 11 | | | |
| **Education:** <High school | 24 | | 0.633 | 0.50 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | -0.244 | | 0.01 |
| **Psychosocial variables**: | | | | |
| Self-Efficacy for Healthy Eating | | 0.089 | | 0.37 |
| Self-Efficacy for Healthy Cooking | | 0.070 | | 0.48 |
| Attitude toward Preparing Vegetables | | 0.152 | | 0.13 |
| Satisfaction with diet and weight | | - 0.031 | | 0.76 |
| Social Support for Healthy Eating | | 0.113 | | 0.26 |
| Readiness to change diet (next 30d) | | 0.053 | | 0.59 |
| Readiness to change cooking skill (next 30d) | | -0.053 | | 0.60 |

**Table 2.9 Association of % Kcal from Sweets, Desserts with Participant Characteristics (n= 103 men)**

| | | Bivariate | | |
|---|---|---|---|---|
| **Characteristic** | **n** | **β** | **F** | **p** |
| **Age:** <41 years | 40 | | 2.397 | 0.13 |
| ≥41 years | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 0.946 | 0.42 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic | 11 | | | |
| **Education**: <High school | 24 | | 0.868 | 0.42 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | 1.328 | | 0.19 |
| **Psychosocial Variables:** | | | | |
| Self-Efficacy for Healthy Eating | | -0.403 | | <0.0001 |
| Self-Efficacy for Healthy Cooking | | -0.109 | | 0.27 |
| Attitude toward Preparing Vegetables | | -0.051 | | 0.60 |
| Satisfaction with diet and weight | | -0.110 | | 0.27 |
| Social Support for Healthy Eating | | 0.060 | | 0.55 |
| Readiness to change Diet (next 30d) | | -0.210 | | 0.03 |
| Readiness to change cooking skill (next 30d) | | -0.150 | | 0.13 |

**Table 2.10 Association of Daily Servings of Fats & Oils, Sweets, Sodas with Participant Characteristics (n= 103 men)**

| | | Bivariate | | |
|---|---|---|---|---|
| **Characteristic** | **n** | **β** | **F** | **p** |
| **Age**: <41 years | 40 | | 2.187 | 0.14 |
| ≥41 years | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 2.448 | 0.07 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic† | 11 | | | |
| **Education**: <High school | 24 | | 0.403 | 0.67 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | -0.190 | | 0.05 |
| **Psychosocial Variables**: | | | | |
| Self-Efficacy for Healthy Eating | | -0.118 | | 0.23 |
| Self-Efficacy for Healthy Cooking | | -0.530 | | 0.60 |
| Attitude toward Preparing Vegetables | | 0.040 | | 0.69 |
| Satisfaction with diet and weight | | 0.056 | | 0.58 |
| Social Support for Healthy Eating | | -0.101 | | 0.31 |
| Readiness to change diet (next 30d) | | -0.295 | | 0.003 |
| Readiness to change cooking skill (next 30d) | | -0.141 | | 0.15 |

† Highest mean

**Table 2.11 Association of Daily Servings of Vegetables with Participant Characteristics (n= 103 men)**

| | | Bivariate | | |
|---|---|---|---|---|
| **Characteristic** | **n** | **β** | **F** | **p** |
| **Age**: <41 years | 40 | | 1.516 | 0.22 |
| ≥41 years | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 0.654 | 0.58 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic | 11 | | | |
| **Education**: <High school | 24 | | 1.624 | 0.20 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | -0.168 | | 0.09 |
| **Psychosocial Variables**: | | | | |
| Self-Efficacy for Healthy Eating | | 0.288 | | 0.003 |
| Self-Efficacy for Healthy Cooking | | 0.239 | | 0.015 |
| Attitude toward Preparing Vegetables | | 0.296 | | 0.002 |
| Satisfaction with diet and weight | | 0.239 | | 0.015 |
| Social Support for Healthy Eating | | -0.134 | | 0.18 |
| Readiness to change diet (next 30d) | | -0.076 | | 0.44 |
| Readiness to change cooking skill (next 30d) | | -0.111 | | 0.26 |

† Highest mean

**Table 2.12 Association of Daily Servings of Fruit including Juices with Participant Characteristics (n= 103 men)**

| | | Bivariate | | |
|---|---|---|---|---|
| **Characteristic** | **n** | **β** | **F** | **p** |
| **Age**: <41 years | 40 | | 1.533 | 0.22 |
| ≥41 years | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 1.018 | 0.39 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic | 11 | | | |
| **Education**: <High school | 24 | | 0.359 | 0.70 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | -0.058 | | 0.56 |
| **Psychosocial Variables**: | | | | |
| Self-Efficacy for Healthy Eating | | 0.120 | | 0.23 |
| Self-Efficacy for Healthy Cooking | | 0.004 | | 0.97 |
| Attitude toward Preparing Vegetables | | 0.088 | | 0.38 |
| Satisfaction with diet and weight | | 0.289 | | 0.003 |
| Social Support for Healthy Eating | | -0.220 | | 0.03 |
| Readiness to change diet (next 30d) | | -0.062 | | 0.53 |
| Readiness to change cooking skill (next 30d) | | -0.086 | | 0.39 |

† Highest mean

**Table 2.13 Association of BMI (kg/m$^2$) with Participant Characteristics (n= 103 men)**

| | | Bivariate | | |
|---|---|---|---|---|
| **Characteristic** | **n** | **β** | **F** | **p** |
| **Age**: <41 years | 40 | | 4.223 | 0.04 |
| ≥41 years† | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 2.065 | 0.11 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic | 11 | | | |
| **Education**: <High school | 24 | | 2.093 | 0.13 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | 0.157 | | 0.11 |
| **Psychosocial Variables**: | | | | |
| Self-Efficacy for Healthy Eating | | 0.124 | | 0.21 |
| Self-Efficacy for Healthy Cooking | | 0.034 | | 0.73 |
| Attitude toward Preparing Vegetables | | 0.102 | | 0.30 |
| Satisfaction with diet and weight | | -0.339 | | <0.0001 |
| Social Support for Healthy Eating | | -0.114 | | 0.25 |
| Readiness to change diet (next 30d) | | 0.375 | | <0.0001 |
| Readiness to change cooking skill (next 30d) | | 0.249 | | 0.01 |

† Highest mean

**Table 2.14 Association of Waist Circumference (cm) with Participant Characteristics (n= 103 men)**

| | | Bivariate | | |
|---|---|---|---|---|
| **Characteristic** | **n** | **β** | **F** | **p** |
| **Age:** <41 years | 40 | | 8.767 | .004 |
| ≥41 years† | 63 | | | |
| **Race/ethnicity**: African American | 50 | | 1.298 | 0.28 |
| White | 37 | | | |
| Other | 5 | | | |
| Hispanic | 11 | | | |
| **Education**: <High school | 24 | | 1.462 | 0.24 |
| High school diploma/GED | 48 | | | |
| >High school | 31 | | | |
| **Time in Program (months)** | | 0.129 | | 0.20 |
| **Psychosocial Variables:** | | | | |
| Self-Efficacy for Healthy Eating | | 0.047 | | 0.64 |
| Self-Efficacy for Healthy Cooking | | -0.011 | | 0.91 |
| Attitude toward Preparing Vegetables | | 0.051 | | 0.61 |
| Satisfaction with diet and weight | | -0.355 | | <0.0001 |
| Social Support for Healthy Eating | | -0.106 | | 0.29 |
| Readiness to change diet (next 30d) | | 0.31 | | 0.001 |
| Readiness to change cooking Skill (next 30d) | | 0.192 | | 0.05 |

† Highest mean

**Multivariate Analysis**

Overall, findings for mixed models with dietary intake as the outcome variable indicated that longer time in program (TIP) and greater readiness to change diet in the next 30 days was associated with lower intakes of calories and % calories from fat. Self-efficacy for healthy eating was negatively associated with % calories from sweets and desserts. Self-efficacy for healthy eating and satisfaction with diet and weight were positively associated with daily servings of fruits and vegetables respectively.

With body composition as the outcome, lower BMI and waist circumference was associated with younger age and higher educational levels; there was an interaction between self-efficacy and satisfaction with diet and weight (Table 2.16).

With total energy as the dependent variable, the results indicated that longer time in the treatment program and greater intention to change one's diet in the next 30 days were associated with ($p=<0.05$) lower calorie intakes (Table 2.15a). Similarly with percent of calories from fat as the outcome variable, there was a significant main effect for time in program with those who had been in the program longer reporting a significantly lower percent of calories from fat ($p=0.02$). There was a non-significant trend ($p=0.065$) for younger participants (under age 41 years) to consume a lower percent of calories from fat, relative to the reference group of participants who were 41 years or older. There was an interaction between education and self-efficacy for healthy eating. As self-efficacy scores increased, those with only a high school education reported a greater percent of calories from fat, ($p =0.004$) relative to the reference group of participants with some college/graduate school (Table 2.15a).

Percent of calories from sweets and desserts was negatively associated with the following psycho-social variables: self-efficacy for healthy eating ($p=0 .000$) and readiness to change diet in the next 30 days ($p= 0.021$). There was a non-significant trend for satisfaction with diet and weight to be negatively associated with percent of calories from sweets and desserts, ($p= .08$).

There was an interaction between age and self-efficacy for healthy eating with daily servings of fats including oils, sweets and sodas (Figure 2.2). This one-way interaction revealed that as self-efficacy increased, the daily servings of fats decreased among participants who were younger ($p=0.024$), relative to the reference group of participants who were 41 years or older (Table 2.15b).

**Table 2.15a. Parameter Estimates of Mixed Model for Dietary Intake Variables by Key Socio-demographic, Addiction and Psychosocial Variables**[†]

| ***Independent Variable*** | **Energy (Kcal)** | | | **% Fat Kcal** | | | **% Sweet, Dessert Kcal** | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Parameters*** | B | ρ | 95% CI | B | ρ | 95% CI | B | ρ | 95% CI |
| **Intercept** | 8.44 | **.000** | (8.21, 8.67) | 48.7 | **.000** | (37.3, 60.1) | 4.67 | **.000** | (4.00, 5.34) |
| **Age**: <41 yrs | 1.03 | .067 | (-.075, 2.13) | -1.74 | .065 | (-3.58, .109) | | NI | |
| ≥41 yrs | | | | 0[a] | . | . | | | |
| **Education:** | | NI | | | | | | NI | |
| < High School | | | | -7.69 | .284 | (-21.8, 6.49) | | | |
| High School | | | | -18.9 | **.007** | (-32.5, -5.29) | | | |
| >High School | | | | 0[a] | . | . | | | |
| **Time in Treatment Program** | -.035 | **.015** | (-.063, -.007) | -.347 | **.020** | (-.639, -.055) | | NI | |
| **Readiness to change diet in 30d** | -.038 | **.013** | (-.068, -.008) | | NI | | -.048 | **.021** | (-.088, -.007) |
| **Self-Efficacy For healthy eating** (SE) | | NI | | -.805 | .092 | (-1.74, .132) | -.093 | **.000** | (-.142,-0.044) |
| **Interactions:** | | NI | | .798 | .184 | (-.386, 1.98) | | NI | |
| **<HS*SE** | | | | 1.66 | **.004** | (.527, 2.79) | | | |
| **HS*SE** | | | | 0[a] | . | . | | | |
| **>HS*SE** | | | | | | | | | |
| **Satisfaction with diet and weight** | | NI | | | NI | | -.097 | .082 | (-.206, .012) |

NI: Variables with highly non-significant p-values were dropped from the final mixed model.
[a] This parameter is set to zero because it is redundant**.**

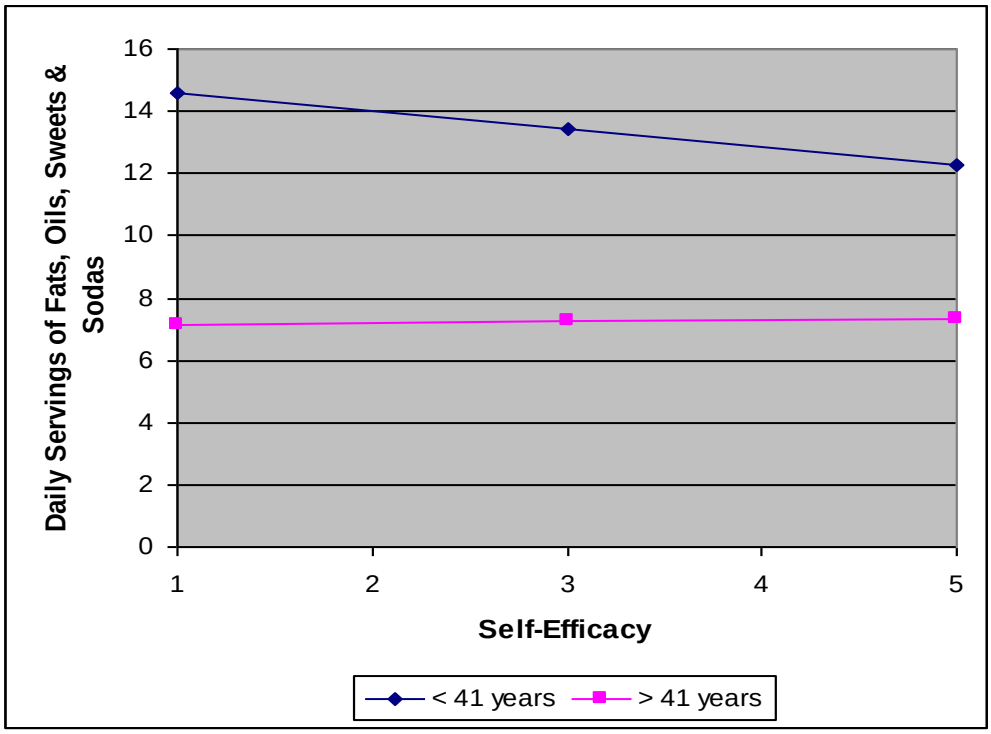


**Figure 2.2 Interaction between participants' age and self-efficacy for healthy eating with daily servings of fats, oils, sweets & sodas.**

Self-efficacy for healthy eating and satisfaction with diet and weight were significant predictors for daily servings of vegetables in the expected direction. The results indicated that participants who had higher self-efficacy for healthy eating (p=.005) and who were more satisfied with their diets and weight reported significantly more daily servings of vegetables (p=0.028). For daily servings of fruits including juices, only satisfaction with diet and weight was a significant positive predictor of consumption (p=0.003).

A mixed model analysis was also conducted to investigate the relationships between anthropometric characteristics such as body mass index (BMI) and waist (WC) circumference with the predictors listed in Table 2.16**.** There were significant main effects for age, education, and self-efficacy, and a marginal effect of satisfaction

with diet and weight. Younger participants were more likely to have lower BMI's, (p=0.009), relative to their older counterparts who were 41 years or older. Those with a high school education or less were more likely to have higher BMI values (p = < 0.05) than participants with higher educational levels.

**Table 2.15 b. Parameter Estimates of Mixed Model for Dietary Intake Variables by Key Socio-demographic, Addiction and Pyschosocial Variables**

| ***Independent Variable*** | **Daily Servings of Fats, Oils, Sweets, Sodas** | | | **Daily Servings of Vegetables** | | | **Daily Servings of Fruits** | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Parameters*** | B | ρ | 95% CI | B | ρ | 95% CI | B | ρ | 95% CI |
| **Intercept** | 7.10 | **.000** | (3.71, 10.5) | .200 | .484 | (-.366, .767) | .858 | **.000** | (.575, 1.14) |
| **Age**: | | | | | | | | | |
| <41 years | 8.05 | **.016** | (1.52, 14.6) | | | NI | | | NI |
| ≥41 years | 0[a] | . | . | | | | | | |
| **Readiness to change diet in 30d** | -.256 | **.007** | (-.438, -.073) | | | NI | | | NI |
| **Self-Efficacy For Healthy Eating (SE)** | .043 | .770 | (-.249, .336) | .065 | **.005** | (.020, .109) | .009 | .426 | (-.013,.031) |
| **Interactions:** | | | | | | | | | |
| <41years*SE | -.623 | **.024** | (-1.16, -.082) | | | NI | | | NI |
| >41years*SE | 0[a] | . | . | | | | | | |
| **Satisfaction with diet and weight** | | NI | | .101 | **.028** | (.011, .191) | .068 | **.003** | (.023, .113) |

Note: Education and time in treatment program variables were not included in models for these three dietary Intakes. NI: Variables with non-significant p-values were dropped from the final mixed model.
[a] This parameter is set to zero because it is redundant**.**

**Table 2.16 Parameter Estimates of Mixed Model for Body Mass Index (BMI kg/m$^2$) and Waist Circumference (WC) by Key Socio-demographic and Psychosocial Variables**

| Independent Variable | BMI | | | WC | | |
|---|---|---|---|---|---|---|
| **Parameters** | β | ρ | 95%CI | β | ρ | 95%CI |
| **Intercept** | 2.73 | **.000** | (2.26, 3.21) | 40.6 | *.073* | (-3.81, 85.0) |
| **Age:** | | | | | | |
| <41 years | -.097 | **.009** | (-.170, -.025) | -11.4 | **.001** | (-18.2, -4.69) |
| ≥41 years | 0[a] | . | . | 0[a] | . | . |
| **Education:** | | | | | | |
| < HS | .151 | **.002** | (.057, .246) | 12.9 | **.005** | (4.10, 21.7) |
| HS | .082 | **.041** | (.004, .161) | 6.83 | .068 | (-.503, 14.2) |
| >HS | 0[a] | . | . | 0[a] | . | . |
| **Self-Efficacy for healthy eating (SE)** | **.**074 | **.001** | (.033, .116) | 6.75 | **.001** | (2.88, 10.6) |
| **Interaction:** | | | | | | |
| SE*SAT | -.017 | **.010** | (-.030, -.004) | -1.75 | **.005** | (-2.96, -.532) |
| **Satisfaction with diet and weight (SAT)** | .127 | .092 | (-.021, .276) | 13.4 | **.058** | (-.443, 27.2) |

Note: time in treatment program and readiness to change diet in 30 days variables were not included in models for body composition.
NI: Variables with non-significant p-values were dropped from the final mixed model.
[a] This parameter is set to zero because it is redundant**.**

A significant interaction was found between self-efficacy for healthy eating and satisfaction with diet and weight (p= .010); (Figure 2.3). As satisfaction with diet and weight increased, the slope between self-efficacy and BMI decreased. Thus, greater self-efficacy for healthy eating was associated with lower BMI's in participants with higher perceived satisfaction scores; (Table 2.16).

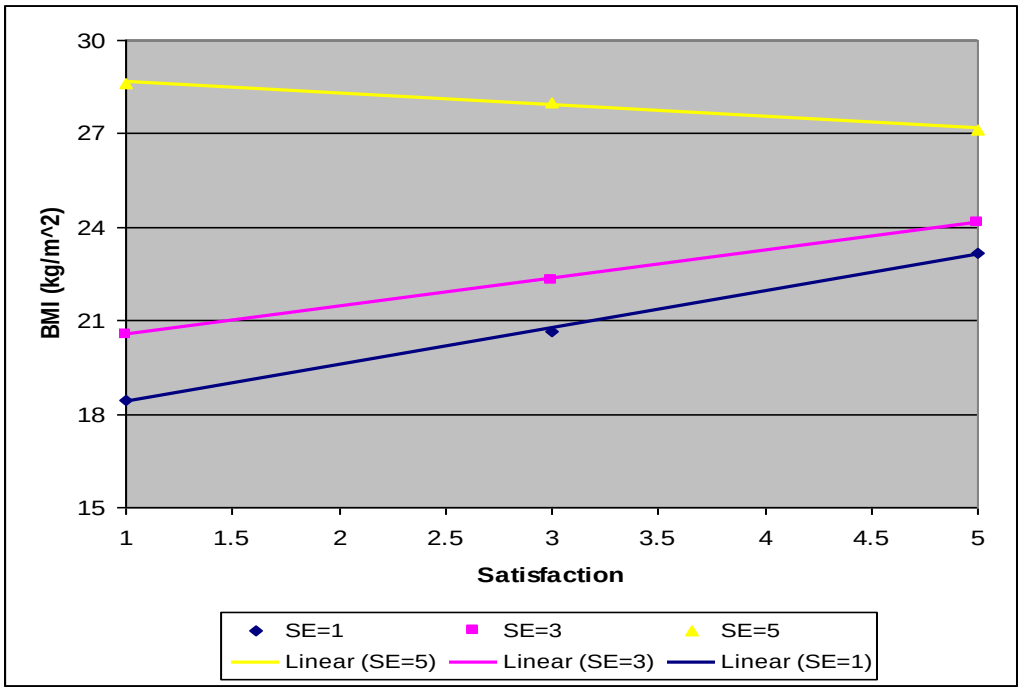


**Figure 2.3 Interaction between participants' satisfaction with their diet and weight and self-efficacy for healthy eating on their body mass index (BMI).**

The analysis for waist circumference revealed similar findings: age, education, self-efficacy for healthy eating all had significant positive associations with WC (p= <.05); (see also Table 2.16). Participants who were younger than the mean age (41 years) were more likely to have smaller waist circumference than the participants who were above the mean age. Larger WC values were significantly associated with lower education levels: participants with less than a high school education were more likely to have larger WC relative to the reference group of participants who had more than a high school education (p=.005) or those who had only a high school education. A significant interaction between self-efficacy for healthy eating and perceived satisfaction of diet and weight, (p = .005) also revealed that participants who had greater satisfaction with diet and weight were more likely to have smaller waist

circumferences when self-efficacy for healthy eating scores were greater than participants with lower psychosocial scores (Figure 2.4).

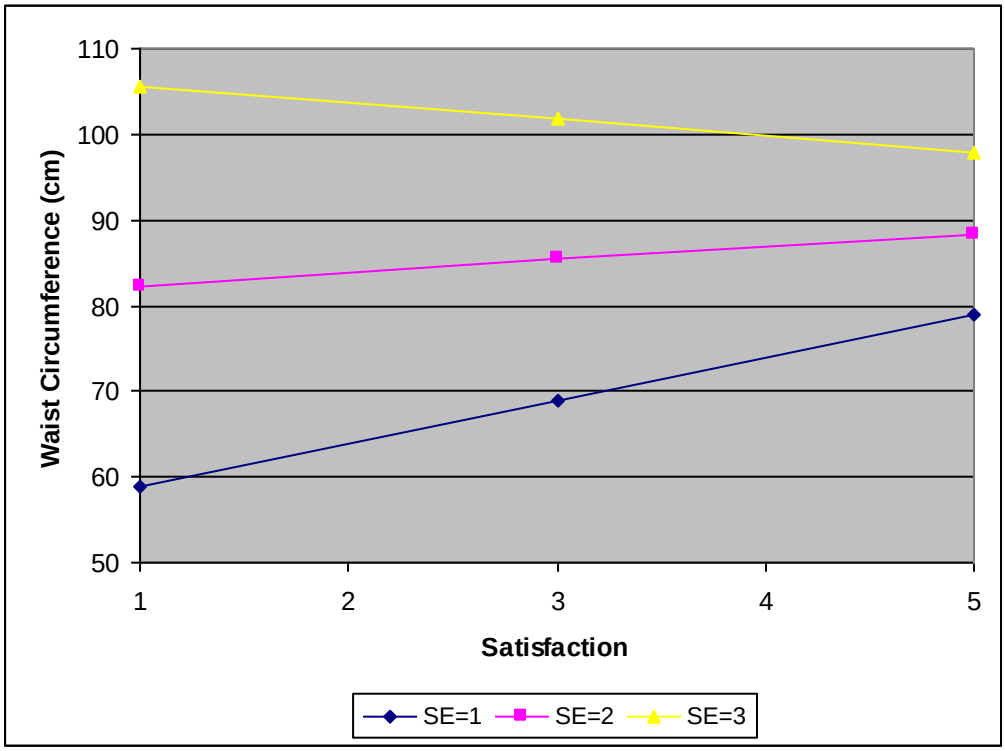


**Figure 2.4. Interaction between participants' satisfaction with their diet and weight and self-efficacy for healthy eating on their waist circumference.**

## DISCUSSION

This study highlights demographic, addiction history, and psychosocial factors that are associated with dietary quality and body composition of men in recovery from substance addiction. These associations have implications for excess weight gain and for diet-related chronic disease risk among men in recovery.

Study participants reported dietary intakes that exceeded recommended levels for saturated fat, cholesterol and sodium and fell below recommended levels for fruits and vegetables and dietary fiber (USDA, 2005). Compared to a national sample of

adult men in similar age groups, these participants reported higher intakes of total energy, percent calories from fat, sweets and desserts, daily servings of fats, oils, sweets and sodas, and lower intakes of fruits and vegetables (USDA, 2008;Casagrande et al., 2007). These dietary patterns  place these men at increased risk for diet-related health conditions including obesity (e.g. Gregg et al., 2005; Healthy People 2010; Nebeling et al., 2007; Casagrande et al., 2007; Ammerman et al., 2002).

Age was an important factor in dietary intake and body composition. Men under 41 years consumed less fat as a percent of calories, but consumed more daily servings of daily fats, oils, sweets and sodas than their older counterparts; these findings are consistent with previous findings on sweets and soda intakes (West, 2006; Bleich et al., 2009). Also younger participants had lower BMI and waist circumference than older participants. Our findings are consistent with previous work, which suggest that men tend to have poor nutrition practices, and may be vulnerable to nutritional problems because they fail to meet recommendations for intake of fats and other important nutrients critical for disease prevention (Melanson, 2008; Wardle, 2004; Baker 2003; Gough, 2007).

The prevalence of adult overweight and obesity increases with age up to age 60 years (Ogden, 2006; Crespo, 2003; McDowell et al., 2006; Simon, 2006). Similarly, the National Center for Health Statistics (2007) found that nearly 40% of men 40-59 years were obese compared only 28% who were between the ages of 20 and 39 years in 2005-2006. Our sample had a similar trend with over two-thirds of the obese participants being 41 years or older. Comparable trends have also been reported for waist circumference among adult men (Ford et al., 2003; Okosun, 2000). Poor dietary practices, excessive weight and larger waist circumferences have all been linked to increased rates of morbidity and mortality (e.g. Flegal, 2005; McDowell, 2006; Healthy People 2010). Attention to these factors is especially critical for older men

who are regarded as an at-risk group for coronary heart disease, cancer and mortality (e.g. Melanson, 2008; Gough, 2007). Though they may be more aware of their enhanced vulnerability to diseases (Melanson, 2008; Gough, 2006) "a healthful diet may be seen by some as unnecessary as long as one is healthy," (Melanson, 2008, 490).

Education was also associated with the participants' BMI and WC. Lower educational levels were associated with higher BMI and WC, which is consistent with previous findings (Crespo 2003; Simon, 2006).

We did not find an association between time in treatment and BMI. Previous studies in this population suggest that some weight gain may be common as people in recovery compensate for the weight loss in active addiction (Cowan & Devine, 2008, Cepik et al., 1995; Hauser et al., 1989; Hatcher, 2004; Hodgkins et al., 2003). Other reports suggest that overeating and obesity may act as protective barriers against addiction because of common neurological mechanisms found in both obesity and addiction (Rapaka et al., 2008; Volkow et al., 2005; Trinko et al., 2007; Wang et al., 2004) as well as the inverse relationship that exists between the two disorders (Warren et al., 2007; Simon et al., 2006; Petry et al., 2008). One study found that as BMI increases, lower rates of alcohol consumption were found (Kliener et al., 2004). Warren and colleague (2005) also found a negative correlation between body mass index and marijuana use supporting the idea that obesity may act as protective barrier thereby reducing drug reward and addiction. Like substance use disorders, some have proposed that obesity may include the same mechanisms of addiction (Simon, 2006; McIntyre, 2007; Wise, 2008 in Blass 2008; Trinko, 2007; Rapaka, 2008), including compulsive overeating of refined foods with high caloric density (Ifland et al., 2009). Both obesity and substance addiction are multifaceted conditions that are strongly reinforced by the exposure to the 'substance of abuse,' whether it is seductive foods or

drugs in the environment. Though the interrelationship between these two disorders is not fully understood, successful treatment approaches can be designed and implemented in treatment facilities to reduce excessive weight gain within this population. One possibility is to understand what other factors besides demographic, neurological, and environmental characteristics are associated with dietary behaviors and body composition among men in recovery from substance addiction. Our study provided new evidence, suggesting that addiction histories and diet-related psychosocial factors may be associated with dietary intake and body composition among men recovering from substance addiction.

We examined theoretically derived psychosocial factors and found that self-efficacy for healthy eating, readiness to change diet in the next 30 days, and satisfaction with diet and weight were associated with dietary intakes and body composition among these men. All three psychosocial factors were positively related to lower intakes of percent calories from fat, and sweets and desserts. Both self-efficacy and satisfaction with diet and weight were positively correlated with higher intakes of vegetables but greater consumption of fruits including juices was associated with satisfaction with diet and weight only. One possible explanation for the lack of association between self-efficacy for healthy eating and fruit intake could be that while the men were satisfied with the inclusion of fruits, primarily fruit juices as part of their diet in recovery, they may not have identified this behavior as being a healthy dietary practice. Further research should study the perceptions of healthy eating practices among men in this population.

As noted previously, younger study participants consumed more fats, oils, sweets, and sodas; however, an inverse relationship was observed between age and dietary intake when younger participants had higher self-efficacy for healthy eating. They consumed fewer daily servings of fats, oils, sweets and sodas than their

counterparts with lower self-efficacy for healthy eating. While younger age was negatively association with daily servings of fats, oils, sweets and sodas, the interaction with self-efficacy for healthy eating may provide a possibly explanation for the importance of perceived confidence in healthy eating practices. Similarly, Hagler and colleague (2007) found that self-efficacy was consistently and independently associated with dietary components that were targeted to increase fiber, fruit and vegetables among overweight and obese men who generally had poor eating practices. Our results are also consistent with other reports of significant associations between positive dietary behaviors and psychosocial factors such as self-efficacy as well as attitude toward manifested health behaviors (Nothwehr, 2008; Brug, 1995; Armitage 1999; French et al., 2005; Ajzen, 2001).

The current results revealed a fascinating relationship among satisfaction with diet and weight, self-efficacy for healthy eating, and body composition. Independently, both psychosocial factors were positively associated with higher BMI as well as larger waist circumferences. However, a significant interaction between self-efficacy for healthy eating and satisfaction with diet and weight revealed an inverse relationship with body composition. Participants with greater self-efficacy for healthy eating and higher satisfaction with diet and weight had lower BMI's and waist circumferences. Though weight gain is generally an expected and positive outcome of recovery (Hauser et al., 1989; Hatcher 2004; Cowan, 2006; Cowan & Devine, 2008), having high self-efficacy for healthy eating may serve as an effective regulatory tool for proper weight management among these men.

The study findings suggest that timing of weight gain is important. The men who had been in the current drug treatment facilities for a shorter time consumed more total calories and percent calories from fat than those who had been in the program longer. Previous work conducted by our group suggests that some substance abusers

described recovery, particularly early in the process, as an opportunity to eat and the means in which to regain the weight lost in active addiction (Cowan, 2006). This desire for weight gain may provide an explanation for the higher BMIs observed among study participants who reported greater satisfaction with their diets and weight. Conversely, the participants with greater self-efficacy for healthy eating had lower BMIs and smaller waist circumference while reporting higher satisfaction with their diets and weight. These diverse attitudes demonstrate the importance of understanding individual addiction history and perceptions about diet and weight before addressing diet quality and healthy weight maintenance among men in recovery.

Although some weight gain in recovery may be necessary, almost two-thirds of our study participants were either overweight or obese at the time of the study, suggesting that many of these men may have overcompensated for the weight lost in active addiction. Alternative explanations for the excessive weight gain may be related to low self-efficacy for healthy eating and/or the unsupportive food environment in the treatment facilities. At the time of the study most participants failed to meet most dietary recommendations; almost sixty percent of the men were diagnosed with diet-related conditions such as diabetes, hypertension, high cholesterol levels, and cardiovascular diseases. These findings are especially disheartening because people in recovery from substance addiction are already at an increased risk for diet-related conditions (Howard et al., 2004; Sutter et al., 1999; Poilkolanen et al., 1998; van de Weil, 2004), and poor dietary patterns and excessive weight gain may further exacerbate their vulnerability to poor health and low overall well-being. These findings emphasized again the need for an urgent call toward more attention to these diet and weight concerns in this understudied population.

Self-efficacy was positively associated with dietary outcomes such as higher vegetable intakes, and lower daily serving of fats, oils, sweets and sodas among young

participants when an interaction with age occurred. Similarly, a significant interaction occurred between self-efficacy and satisfaction with diet and weight with lower body compositions. It is not clear why an increase in calories from fat was observed when self-efficacy interacted with high school educational level. Perhaps higher self-efficacy in these men in recovery may reflect other positive exposures to food not necessarily based in formal education. Further study examining these factors within similar samples would be beneficial. Overall, the self-efficacy findings revealed the need to increase healthy eating skills among men in recovery, perhaps through promotion of cooking skills targeting more fruits, vegetables and lower-fat foods; less sweets and total calories.

Although the present study provides new insights about factors associated with dietary intake and body composition of men in recovery, the study reflects a non-random sample of urban men studied at only one point in time. Generalization of these findings should be limited to men with similar characteristics living in similar residential treatment facilities. The study design precludes making inferences about relationships between demographic, addiction and psychosocial variables with dietary intake and body composition among men who did not have access to treatment facilities.

Food recall issues or reporting bias may be a potential limitation because participants were asked to provide retrospective dietary information within the past year or since recovery. The measures, administered during face-to-face interviews, may have reduced inaccuracies but also increased social desirability bias. However, the consistently high reports of total calories, % kcal from fats, and sweets and sodas, and the consistently low servings of fruits and vegetables reported suggest that this was not the case with our study participants. Participant self-selection might have favored those with interest in nutrition and excluded the emergence of different

associations with dietary intake and body composition among those who did not participate. This is unlikely because almost ninety percent of all the current residents in the six treatment facilities participated in the study. Selection bias by treatment facility may also be considered because of the specific admission criteria in place at each facility; however the study site was controlled for in the multivariate analyses.

This study had several strengths. The findings provide insights about specific factors associated with high quality measures of dietary intake and measured body composition among men in recovery. This study presents new information about an understudied segment of the population. We used theoretically derived psychosocial measures such as self-efficacy, attitude toward diet change, satisfaction with diet and weight to assess these relationships with dietary intakes derived from a well-established food frequency questionnaire. Anthropometric variables were measured by a trained individual and body mass index and waist circumference were calculated from these measurements. Key information revealed about individual characteristics, history of addiction and psychosocial variables will be useful in the design of nutrition intervention in this population.

Further research to examine the associations with dietary intake and body composition among men in recovery from substance addiction is warranted. Longitudinal investigations are also needed to examine long term behavioral and weight patterns in addiction and recovery

**Implications for Research and Practice**

The objective of this analysis was to examine specific demographic, addiction history, and psychosocial factors associated with dietary intakes and body composition among men in residential treatment for substance abuse. These results highlight the importance of nutrition education and dietary counseling in drug treatment facilities, particularly because people in recovery are at an increased risk for obesity and other

diet-related conditions (Hatcher, 2004; Howard et al., 2004; Sutter et al., 1999; Poilkolanen et al., 1998; van de Weil, 2004). Individuals in this sample who had greater self-efficacy for healthy eating consistently demonstrated better diet and weight characteristics than those with less confidence to choose healthy foods. Thus, nutrition interventions may benefit from skill-based learning to promote healthy food choice behaviors, particularly through strategies to increase fruit and vegetable intake and to reduce fats, sweets and total calories tailored to specific age groups and recovery stages as well as the length of time in the treatment program. One example would be to administer a standardized intervention trial to men in early, mid and later recovery then compare the study outcomes. Another example would be to tailor the intervention to men in the treatment program at different length of time, for example, men in the program from 0-6 months vs. longer.

Our intention was also to understand the factors related to dietary intake and weight gain to inform policies concerning nutrition services and food access in recovery facilities. These results suggest that it may be helpful for treatment providers to promote healthy weight by conducting weight and nutritional assessments upon admission and tracking weight while targeting specific nutritional needs throughout the recovery experience in treatment facilities.

Obesity and substance abuse disorders are complicated and costly (McDowell, 2006; Levi et al., 2006; NIDA, 2008; Alexandre et al., 2003; Dewey, 2008) preventable public health problems. It is imperative for treatment providers to do what they can to reduce the prevalence of obesity in treatment facilities in an attempt to eliminate the economic impact and burden of a second adverse health condition among residents. These findings highlight the need for drug treatment facilities to target dietary intake and weight management in recovery.

## APPENDIX

**Table A.1. Association of Total Calories (kcal) with Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| Characteristic | n | Bivariate F | Bivariate p |
|---|---|---|---|
| **Stage of Change:** | | | |
| Readiness to Eat 2 Servings of Fruit | | 0.293 | 0.75 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 0.389 | 0.68 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | | 0.322 | 0.73 |
| Pre-contemplation | 43 | | |
| Contemplation & Preparation | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 1.799 | 0.10 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 0.882 | 0.42 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

**Table A.2. Association of % Kcal from Fat Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 males)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change:** | | | |
| Readiness to Eat 2 Servings of Fruit | | 1.411 | 0.25 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 1.094 | 0.3 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | 43 | 0.358 | 0.70 |
| Pre-contemplation | 52 | | |
| Contemplation & Preparation | 8 | | |
| Action & Maintenance | | | |
| Readiness to Cook with vegetables | | 0.017 | 0.98 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 0.278 | 0.28 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

**Table A.3. Association of % Kcal from Sweet, Dessert with Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change:** | | | |
| Readiness to Eat 2 Servings of Fruit | | 1.489 | 0.23 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 0.134 | 0.87 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | | 5.686 | 0.005 |
| Pre-contemplation† | 43 | | |
| Contemplation & Preparation | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 0.570 | 0.57 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 5.056 | 0.008 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation† | 63 | | |
| Action & Maintenance | 16 | | |

† = Highest mean

**Table A.4. Association of Daily Servings Fat & Oil, Sweets, Sodas with Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change**: | | | |
| Readiness to Eat 2 Servings of Fruit | | 0.114 | 0.89 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 0.138 | 0.87 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | | 1.112 | 0.34 |
| Pre-contemplation | 43 | | |
| Contemplation & Preparation | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 0.291 | 0.75 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 1.368 | 0.26 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

† Highest mean

**Table A.5. Association of Daily Servings of Vegetables with Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change:** | | | |
| Readiness to Eat 2 Servings of Fruit | | 1.422 | 0.25 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 6.832 | 0.002 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance† | 5 | | |
| Readiness to Eat Low-fat Foods | | 1.144 | 0.3 |
| Pre-contemplation | 43 | | |
| Contemplation & Preparation | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 6.630 | 0.002 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance† | 36 | | |
| Readiness to Cook with Low-fat Foods | | 1.736 | 0.18 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

† Highest mean

**Table A.6. Association of Daily Servings of Fruit including Juices with Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change:** | | | |
| Readiness to Eat 2 Servings of Fruit | | 20.681 | <0.0001 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance† | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 0.023 | 0.98 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | | 0.865 | 0.42 |
| Pre-contemplation | 43 | | |
| Contemplation & Preparation | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 1.998 | 0.14 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 0.557 | 0.58 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

† Highest mean

**Table A.7. Association of BMI (kg/m$^2$) with Participants' Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change:** | | | |
| Readiness to Eat 2 Servings of Fruit | | 1.258 | 0.29 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 0.187 | 0.83 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | | 5.401 | 0.006 |
| Pre-contemplation | 43 | | |
| Contemplation & Preparation† | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 0.634 | 0.53 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 0.024 | 0.98 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

† Highest mean

**Table A.8. Association of Waist Circumference (cm) with Participants Readiness to Change Food Choices and Cooking Skills (n= 103 men)**

| | | Bivariate | |
|---|---|---|---|
| **Characteristic** | **n** | **F** | **p** |
| **Stage of Change**: | | | |
| Readiness to Eat 2 Servings of Fruit | | 0.916 | 0.40 |
| Pre-contemplation | 6 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 20 | | |
| Readiness to Eat 3 Servings of Vegetables | | 0.056 | 0.95 |
| Pre-contemplation | 21 | | |
| Contemplation & Preparation | 77 | | |
| Action & Maintenance | 5 | | |
| Readiness to Eat Low-fat Foods | | 3.709 | 0.03 |
| Pre-contemplation | 43 | | |
| Contemplation & Preparation† | 52 | | |
| Action & Maintenance | 8 | | |
| Readiness to Cook with vegetables | | 0.212 | 0.81 |
| Pre-contemplation | 9 | | |
| Contemplation & Preparation | 58 | | |
| Action & Maintenance | 36 | | |
| Readiness to Cook with Low-fat Foods | | 0.065 | 0.94 |
| Pre-contemplation | 24 | | |
| Contemplation & Preparation | 63 | | |
| Action & Maintenance | 16 | | |

† Highest mean

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# CHAPTER 3:

# OUTCOME EVALUATION

## RHEALTH PROGRAM: RESULTS FROM A PILOT INTERVENTION PROMOTING HEALTHY EATING AMONG MEN IN RESIDENTIAL DRUG TREATMENT FACILITIES


## ABSTRACT

People in recovery from substance addiction have poor dietary intakes that put them at risk for diet-related health problems. However, very little research has been conducted in the substance addiction population to promote healthy eating and reduce obesity. We assessed outcomes of the Recovery Healthy Eating and Active Learning in Treatment Houses (RHEALTH) Program, a theory-based pilot educational and environmental intervention designed to promote healthy eating behaviors, increase self-efficacy, and reduce excess weight gain among men in residential substance treatment programs.

The RHEALTH intervention was conducted in 6 residential treatment facilities with 124 men (103 men enrolled before the control period and 21 men enrolled after the control period ended) in recovery from substance addiction following a six week control period in the same facilities using a quasi-experimental design. Baseline, pre-intervention and post-intervention assessments focused on dietary intakes, diet-related psychosocial factors, and measured height, weight from which body mass index was derived, and waist circumference. Self-reported addiction history and physical activity were also assessed.

Of the 124 study enrollees, 43 completed all three assessments and 12 completed only the baseline and post-intervention assessments; these 55 completers were included in the analyses. The mean age for these 55 participants who completed the study was 44.7 years; approximately 64% were members of racial/ethnic minority groups; and over 80% had at least a high school education or higher. The average sobriety period was 8.4 months; the length of time spent in the current drug treatment program was 4.4 months; and the mean years of active addiction was 25.9. Non-completers were younger and had fewer years in active addiction.

Study participants reported significantly greater intake of fruits and vegetables and lower intakes of calories from sweets and desserts following the intervention period, compared to the control period. The intervention was also associated with significant reduction in waist circumference as well as improved self-efficacy for healthy eating and readiness for dietary change. Study findings also confirmed the hypothesized dose effect of the intervention; greater participation in nutrition and cooking classes was associated with better dietary outcomes, greater change in self-efficacy for healthy eating and cooking and satisfaction with diet and weight. Moreover, addiction characteristics such as the length of time in treatment, sobriety and the years spent in active addiction were associated with changes in dietary intake, waist circumference, and readiness to change diet. Specifically, an interaction between greater intervention exposure and longer time in treatment revealed greater reductions in energy intakes, and more improved self-efficacy for healthy food choice behaviors and healthy cooking. However, smaller reductions in waist circumferences were associated with longer time in treatment and greater sobriety time while greater readiness to change diet was associated with longer years in active addiction.

These findings provide preliminary support for the effectiveness of the RHEALTH program in promoting positive dietary behaviors, reduced waist

circumference, and improving key psychosocial characteristics related to the food intake of the men in these six residential treatment facilities. Results of our pilot nutrition intervention underscore the need for a randomized trial to confirm the intervention effects on diet and health outcomes in the substance addiction population. These results also support the need for treatment providers to put in place programs and policies that will address food and nutrition concerns in recovery to increase the capacity for healthy food choice behaviors and healthy weight management among residents of treatment facilities. .

## INTRODUCTION

Poor dietary patterns have been linked to the development of negative health outcomes including obesity, diabetes, cardiovascular disease and some cancer (Healthy People 2010; USDA, 2005; Melanson, 2007; Harnack, 1998). Despite the substantial evidence linking dietary patterns to health outcomes, most Americans fail to meet dietary recommendations to reduce the risks of these chronic conditions (Casagrande et al., 2007; Shaikh et al., 2008). Previous research indicates that people in recovery from substance addiction have poor food choice behaviors as well (Hauser et al., 1989; Hudson et al., 1992; Hatcher, 2004; Cowan et al., 2008), and some evidence suggests their diets may even fall below the dietary quality of the general population (Chapter 2).

Most substance abusers have poor diets during active addiction and are usually malnourished and underweight when they enter treatment (Hauser et al., 1989; Hudson et al., 1992); consequently, some weight gain is necessary in recovery to compensate for the weight loss experienced in active addiction. However, there is a tendency for recovering substance abusers to choose diets that are low in nutrient density and high in calories (Farkas et al., 1984; Hatcher, 2004). There is some evidence suggesting that

carbohydrates, fats, and sweets are substituted for alcohol and cocaine use (Krahn et al., 1992; Gosnell et al., 1998, 2001). This is of concern because people with a history of substance addiction are at an increased risk for these chronic diseases that have been associated with poor nutrition (Sutter et al., 1999; Howard et al., 2004).

Prior research in this population by our research team suggests that poor dietary patterns among men in recovery from substance abuse may be related to lack of nutrition knowledge and lack of food preparation skills as well as treatment facilities that do not support healthy eating behaviors. (Cowan, 2006; Cowan & Devine, 2008).

During recovery the physiological and psychological damages resulting from substance addiction begin to heal, thus good nutrition is paramount as the body rebuilds the organs and tissues damaged during active addiction. It is therefore imperative that treatment facilities provide nutritional support for people seeking treatment for their drug problems. The opportunity is available for these facilities to promote a systematic channel where recovering addicts can learn additional skills including healthy eating behaviors to prepare them for a healthy lifestyle. Treatment facilities may provide a unique environment to deliver interventions messages that promote healthy eating and build food preparation that could be transferred to independent living.

Several studies have examined the role of the food environment in shaping food choice, eating behavior and weight changes (Sorensen et al., 1999; French et al., 2003; Kubik et al., 2003). Behavioral interventions may also alter dietary habits, and a number of on-site and face-to-face programs in various populations have been found to be effective (Jeffery et al., 1994; Beresford et al., 2001; Ammerman et al., 2002; French et. al., 2003; Devine et al., 2005; Pomerleau et al., 2005; Wellman et al., 2007; Greene et al., 2008). For example, in a review of the efficacy of ninety two

independent behavioral interventions to modify dietary intake, the studies were found to be successful in reducing intake of total fat and saturated fat, and increasing fruit and vegetable intake. More than two-thirds of the studies reported an average increase of 0.6 servings per day for fruit and vegetable intake, and an average reduction of 7.3% for calories from fat (Ammerman et al., 2002). Furthermore, an intervention to increase fruit and vegetable consumptions reported a 33% (1.5 servings) increase in daily serving of fruits and vegetables (Beresford et al., 2001) and interventions promoting healthier food environments produced similar outcomes (Jeffery et al., 1994; French et. al., 2003).

While there has been extensive research on the impact of nutrition interventions on food choices and eating behavior in various populations, the same is not true in substance abuse populations. The literature on nutrition interventions in residential treatment facilities to promote healthy eating and reduce weight gain is very sparse. Much of the nutrition services in this population has focused on non-nutrition education services such as meal services, nutrition screening and assessment, and nutrition supplementation (Grant et al., 2004). Only one study investigated the effectiveness of nutrition education and physical activity on body mass index (BMI) in a residential treatment setting, and this was a study among substance-addicted adolescents (Hodgkin 2003)**.** The results indicated a significantly lower average BMI for the intervention group than the control group following the intervention (treatment BMI= 23.97 and control BMI= 24.86). This study supports the need to study the efficacy of nutrition interventions targeting eating behaviors and weight concerns in residential treatment facilities for adults.

We are aware of no study designed to improve dietary patterns through nutrition education and cooking skills in adult male residential treatment facilities. Nor has any research to date evaluated the impact of the food environment, particularly

food-related policies on food choice behaviors and weight gain in recovery. Responding to this gap in knowledge, we developed and implemented the Recovery Healthy Eating and Active Learning in Treatment Houses (RHEALTH) program; a pilot nutrition intervention in residential drug treatment facilities to promote healthy eating in men during recovery from substance addiction**.** The basis of the RHEALTH program was, increasing self-efficacy for healthy eating and food choice skills among men in residential treatment programs may help them to make healthier food choices in recovery. The novelty of this research was the inclusion of addressing personal, behavioral, and environmental factors in promoting healthy food choice behaviors among men in substance treatment facilities.

The primary objective of this paper was to determine the outcomes of the RHEALTH intervention on the participants' dietary intake, psychosocial factors related to diet (self-efficacy related to healthy eating and cooking skills, attitude toward changing diet and cooking skills, attitude toward cooking vegetables, and satisfaction with diet and weight), and body composition (Body Mass Index and waist circumference) by comparing the changes in these measures in treatment and control periods. Our secondary objective was to determine whether there was a dose effect of the intervention on program outcomes. Specifically we hypothesized that men who had participated in four or more class sessions would benefit more from the intervention than men who had attended three or fewer classes. A third objective was to determine how participant characteristics affected the intervention outcomes. Specifically we hypothesized that participants who had been in the treatment program longer, had poorer dietary intake, higher body composition, and lower diet-related psychosocial scores at baseline would benefit more from the intervention than those who had been in the program shorter periods, with better dietary intake, lower body composition, and higher psychosocial values at baseline.

# METHODS

## Theoretical and Analytical Frameworks

The multisite intervention study was guided by prior formative research in this population (Cowan & Devine, 2008) as well as the social ecological framework and social cognitive theory (Green LW et al., 2005; Bandura, 1977). Our prior work in this population suggested that men in recovery had dietary intakes that put them at risk for chronic diseases including low daily servings of fruits and vegetables, and high intakes of energy, fats and sweets. Formative research also showed that men in residential treatment facilities were responsible for preparing evening meals but most lacked the confidence necessary for choosing and preparing healthy meals. Many of these men reported excessive weight gains while in the substance treatment facilities (Cowan, Master Thesis, 2006; Cowan & Devine, 2008).

A social ecological perspective was employed in this intervention because it examines health behaviors among people within their environmental contexts (Greene, 2005). This perspective helped to draw attention to behavioral, interpersonal and environmental factors and the ways in which those factors predispose, reinforce and enable healthy food choice behaviors in the treatment facilities. The social ecological framework (precede/proceed model) consists of a series of planned assessments that help to generate information about the residents' food choice behaviors and the factors in the environment that help to sustain those food choice behaviors. We incorporated the social cognitive theory (SCT) also because of its inclusion of personal, behavioral and environmental influences on health behaviors as well as the focus on self-efficacy (Allison, 1999), which has been linked to dietary change in many studies (e.g. Brug et al., 1995; Baranowski et al., 1999; Roach et al., 2003; Watson et al., 2006; Hagler et al., 2007; Nothwehr, 2008). SCT helped to tailor our multilevel intervention in which personal and behavioral factors were addressed within the treatment facility

environment**.** Environmental health promotions that target lifestyle changes through a combination of efforts to enhance awareness, change behavior as well as create environments that support good health practices can be effective (Glanz et al., 2008), thus SCT and an ecological perspective informed this study because of the inclusion of an environmental component.

The analytical framework for this study (Figure 3.1) illustrates the expected impact of the RHEALTH intervention on the residents' food choice behaviors, self-efficacy for healthy eating, healthy cooking skills, and other diet-related psychosocial factors, and body composition outcomes. We believed that increasing self-efficacy skills for healthy food choice and food preparation through nutrition education and cooking skills will enable the participants in the six halfway houses to: 1) eat more daily servings of fruits and vegetables, 2) reduce total energy intake and percentage calories from sweets and desserts, and 3) choose and prepare more lower-fat foods after the RHEALTH Program compared to before the intervention. Therefore we predicted that higher nutrition class participation would be associated with more positive change in dietary outcomes (more daily servings of fruits and vegetables; greater reduction in total energy and percentage calories from fat and sweets), greater increase in diet-related psychosocial factors, and greater reduction in body weight and waist circumference. We also predicted that healthier dietary intake and higher psychosocial values at baseline would be associated with smaller positive changes. Conversely, longer time in the treatment program and higher body composition at baseline would be associated with greater positive outcomes after the intervention.

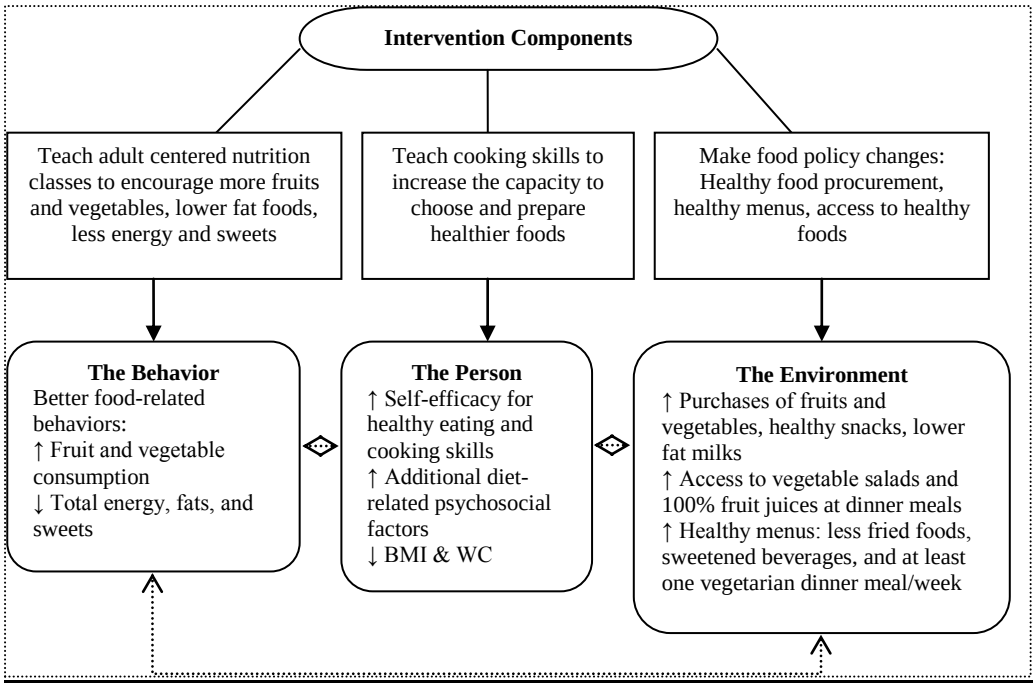


**Figure 3.1. Conceptual Framework: Intervention impact on the interactions between personal, behavioral and environmental factors on food choice behaviors and weight gain.**

### Design, Sample & Recruitment

The intervention study used a quasi-experimental design with a 6 week control period preceding a 6 week treatment period in six study sites (Figure 3.2). Study participants at each site served as their own controls. There were three data collection points: a baseline assessment; a 6 week control period followed by a pre-intervention assessment; then a 6 week treatment period, followed by a post-intervention assessment. At each of the three assessment points, data were collected on socio-demographic characteristics, addiction history, dietary intake, and diet-related psychosocial characteristics. In addition anthropometric measures including height, weight, and weight circumference were taken. Self-reported physical activity behavior was also assessed during each interview.

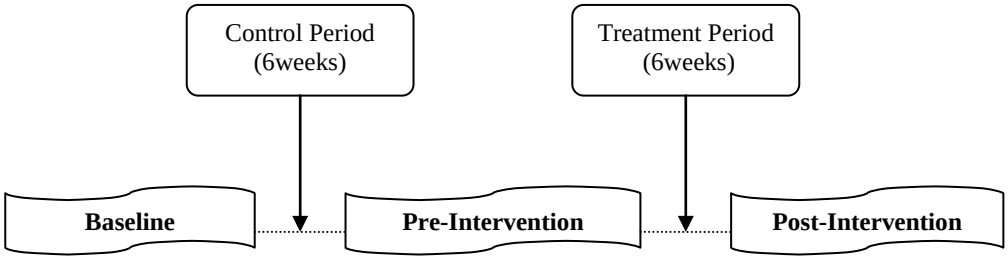


**Figure 3.2. Study Design**

The sample included ethnically diverse men aged 18 years or older, residing in one of six community residential drug-treatment facilities in an urban area in Upstate New York. The six study sites were recruited through prior research connections within the study population (description of the six study sites is presented in the previous chapter). Meetings with the director of each of the six study sites were conducted prior to data collection activities. Discussions with key staff members and residents in each facility were then held to establish the most effective recruitment and retention methods. Participants were recruited through the personal contacts with primary researcher with residents while at the study sites, peer recruiting, fliers posted in common areas, and through weekly community meetings scheduled at the each site. All residents in the six sites were eligible to participate. As part of the recruitment process, interested residents were asked to provide contact information including convenient days and times to be contacted. The study was conducted between June 2007 and June 2008.

## DATA COLLECTION

Data were collected at three periods, baseline, pre-, and post-intervention that allowed each participant to serve as his own control. All three assessments were completed during scheduled private interviews with the primary investigator at the treatment facilities. Pre-intervention assessments were conducted approximately six weeks after the baseline, and the post assessments were completed following the six-week treatment period. Each interview lasted approximately two hours and included questions on socio-demographic characteristics, addiction history, dietary intake (food frequency), diet-related psychosocial measures, and measured height, weight and waist circumference. The primary investigator coded and managed all assessments so that identifying information about participants was maintained separately from their responses. Each participant provided a signed consent following procedures approved by the Cornell University Institutional Review Board.

### Measures

Demographic information including age, ethnicity, education, marital status, and employment status before drug-treatment enrollment was collected. Addiction history was also assessed, including length of time in the current treatment program, primary substance of addiction, total treatment episodes including the current treatment program, and total number of years and months spent habitually using the substance of addiction.

Dietary intake was assessed using the Block 2005 Food Frequency Questionnaire, a 110-item instrument that queried the frequency of consumption and portion size of the following foods: fruits including 100% fruit juices, vegetables, breakfast, lunch and dinner foods, a variety of meats, fish and poultry, breads, snacks items, spreads and dairy products, sweets and beverages. Seasonal use of some foods

and the types of food such as meatless, low-fat and sugar-free foods were also included. Consumption frequency was measured as the number of times per day, week, month or year. The number of pieces of food, glasses of beverages, or cans were assessed, and portion size (small, medium or large) for appropriate food item was asked separately using a pictorial illustration of plate size ranging from ½ cup to 2 cups. Food frequency analysis and scoring was conducted by the developers of the Block Food Frequency questionnaire (BLOCK, 2005).

Self-efficacy for healthy eating and cooking was assessed using modified versions of the self-efficacy scales developed by Sallis and colleagues (1988). We used the 12-item scale and the 6-items scale corresponding to confidence about choosing healthy foods and healthy cooking skills respectively. A 5-point response scale was used for both measures (*5 = I know I can to 1 = I know I cannot*). An overall mean score for each measure was computed with higher scores indicating greater confidence to choose and cook healthy foods.

Attitudes related to participants' readiness to change dietary behavior and cooking techniques in the next 30 days were assessed with two items: 1) How important is it to you that you change your diet habits in the next 30 days? 2) How important is it to you to change your cooking skills in the next 30 days? The two items were adapted from a previous study (Healthy Worksite Study) and were assessed on a 0-10 point response scale (0 = not at all important to10 = very important). We used a modified version of Devine and colleagues (2005) scale to measure community drug treatment participants attitudes toward preparing vegetables (e.g. "I think fresh vegetables are easy to prepare"). The 5-items were measured on a 5-point Likert scale (strongly agree to strongly disagree), and an overall mean score was derived for each participant.

The social support for healthy eating measure was a 14-item modified version of items validated in earlier studies that assessed social support toward healthy eating (Sallis et al., 1988). We modified the measure toward eating behavior of people in drug treatment communities and added four items to evaluate social support for healthy eating in this environment. These items were rated with a 5-point response scale (5 = very often to 1 = none), and the sum of the items was computed. The 3-items scale corresponding to satisfaction with diet and weight was adapted from a previous study (CHANCE Program), and was measured on a 5-point Likert scale (strongly agree to strongly disagree). We computed an overall mean score of the three items, with higher scores associated with greater satisfaction with diet and weight.

Anthropometric measurements of weight, height and waist circumference (WC) were collected on each participants using the standard protocols described in chapter one. Body mass index (BMI) was calculated from weight in kilograms divided by height in meters squared ($kg/m^2$). Physical activity behavior was assessed subjectively by a self-report measure adapted from previous study (BRFSS, 2005)**.** One item assessing self-reported physical activity (Considering a 7-day period, how often do you engage in any regular physical activity long enough to work up a sweat--heart beats rapidly?) was measured on a 4-point scale (often to never), with higher scores indicating higher activity levels.

**Intervention**

Recovery's Healthy Eating and Active Learning in Treatment Houses Program (RHEALTH Program) was a pilot nutrition intervention implemented in six residential drug treatment facilities for men in recovery from substance abuse. RHEALTH had two intervention components: 1) weekly nutrition education and cooking classes for residents to modify dietary intake, and increase self-efficacy and skills for healthy

eating and cooking, and 2) policy changes in the house food environments to increase opportunities for healthy food choices. The latter were made in collaboration with house staff at each site. The RHEALTH intervention focused on increasing the consumption of fruits and vegetables, and reducing the consumption of total energy, total fat, and added sweets among men in recovery from drug and alcohol addictions. The primary researcher selected program sites, recruited participants, and implemented the intervention in all the study sites.

**RHEALTH Classes**

The RHEALTH classes were presented through approximately 2-hour weekly meetings for six consecutive weeks at each site. The intervention was designed to engage residents in active learning, practice and sharing of food preparation knowledge, skills and strategies, and included tasting delicious and easy to make healthy foods. The program was modified from teaching materials adapted from: "Sisters in Health" (Devine et al., 2005), "Eating Right is Basic—Enhanced" (Coleman, 2001 and "Side By Side" (2001), and was guided by a learner-centered approach to adult learning (Norris, 2003).

The RHEALTH program materials covered the following six weekly topics: Getting Started: Food for Taste and Health, Portion Distortion: What's a Healthy Serving? Color Me Healthy: Choosing Vegetables by the Colors, Fruit: A Natural Sweet, Sugar Blues, and Fats of Life. The Food Guide Pyramid (USDA, 2005) was incorporated in each meeting as a teaching tool to illustrate basic nutrition messages. Examples of covered nutrition topics were caloric, fat and fiber content of foods as well as the energy density of common foods, increasing fruits and vegetables, reducing portion size, fats and sweets intake including sweetened beverages, food labels and diet-related weight control techniques.

The classes were held in the community room of each treatment facility; each was equipped with tables and chairs and located within close proximity to the kitchen. Each class meeting consisted of the following components: the class meeting objectives, welcome and warm-up activities, key food and nutrition messages with food props, handouts and posters, group activities designed to reinforce key concepts, and cooking activities that emphasized healthy food preparation consistent with key messages, and tasting. Class discussions and group activities were learner centered as participants were encouraged to share experiences and insights on the nutrition topics covered. A weekly challenge was also included at the end of each session for participants to track food choice behaviors or to try new dietary behaviors related to key messages and report back at the next class. The primary researcher gave $20, $15, and $10 gift cards from a local supermarket to the top three winners of each weekly challenge as incentives to buy healthier snack foods including fruits.

The recipes chosen met dietary guidelines for healthy recipes developed for Cornell Cooperative Extension (CCE, 2007); they were simple, easy to modify, and generally inexpensive. They were selected with the lifestyle of independent, low-income, adult men in recovery in mind. The primary investigator facilitated the in-class cooking activities with study participants at the end of each nutrition discussion. A printed copy of each recipe was provided to all participants. Conversations about the recipes were encouraged and participants provided feedback on the nutrition discussions and cooking activity at the end of each meeting.

**Food Environment Component**

For the environmental component, key staff members, including the food coordinators in each study site, met with the investigator to discuss targeted small changes in the food-related policies to provide more healthy guidelines for menu

development, food procurement, food availability, and food access. These changes were based on prior formative research (Cowan & Devine, 2008) in treatment facilities similar to these. Each treatment site was asked to: limit fried foods and encourage menus with more non-meat dishes and other healthy recipes: purchase lower-fat milk (2%, 1% and skim milk) instead of whole fat milk; substitute water and 100% fruit juices for sweetened drinks at each dinner meal; provide more daily servings of fruits and vegetables, including at least one vegetable or fruit salad daily with low-fat dressings at each dinner meal; and purchase fewer sugary and sweetened snack foods, and more healthy snacks such as pretzels, popcorn and fruits. The environmental food-related policy component of the intervention will be discussed in detail in a subsequent paper (Chapter 4).

## STATISTICAL ANALYSIS

Data analysis was conducted using the Statistical Package for the Social Science (SPSS for Windows Version 16, SPSS, Inc.). Descriptive statistical analyses were performed including frequencies and distributions. Pearson's correlation analysis was carried out to examine relationships between key outcome variables and socio-demographic and addiction history variables. ANOVA was used to compare mean differences in baseline, pre-intervention and post-intervention of the following outcome variables: dietary intakes (energy, percentage calories from fat and sweets and desserts, daily servings of fats, oils, sweets, and sodas, daily servings of fruits and vegetables); body composition (BMI and WC); and diet-related psychosocial variables (self-efficacy for healthy eating and cooking, readiness to change diet and cooking skills in the next 30 days, attitude toward cooking vegetables, and satisfaction with diet and weight**).** Following bivariate analyses, key independent variables were retained for subsequent analyses if they demonstrated a significant relationship

(p=<0.05) with outcome variables, and theoretical relevance to the study objectives (see Chapter 2 for more details).

To test for program effect we compared the mean changes in dietary intake, body composition, and psychosocial factors between the control (change between baseline and pre-intervention) and the treatment period (change between pre- and post-intervention). We used the 2-sided t tests for paired samples (George and Mallery, 2008) for the participants who completed all three assessments. Program effect size on each outcome variable was then calculated from the difference between the change in the intervention and the control period divided by the standard deviation. We used t and Chi square tests to assess differences between participants who completed the program and those who did not.

Following the t test analysis, we created change variables for the outcome variables that demonstrated statistical significance ($p<0.05$) or theoretical relevance to the study for the participants who completed both baseline and post assessments. The intervention was delivered to individuals within six treatment facilities, therefore a mixed model regression analysis (repeated measures) was then conducted to test the dose effect and characteristics of participants on changes in dietary intakes (energy, percentage calories from sweets and desserts, daily servings of fruits and vegetables), body composition (BMI and WC), and psychosocial variables (self-efficacy for healthy eating and cooking, readiness to change diet in 30 days, and satisfaction with diet and weight). Models were built separately for each outcome, and the study sites were controlled for in all multivariate analyses. Nutrition class attendance and addiction history such as time in treatment program were included in all the multivariable models except for the change in body composition, and daily serving of fruits and vegetables respectively because no significant relationships were found in

the bivariate analyses. All statistical tests were considered to be statistically significant at a p-value of $< 0.05$.

## RESULTS

Among the 124 men who enrolled in the RHEALTH program in the 6 drug treatment facilities, 76 completed the treatment phase. Of the group that completed the program, only 43 participants completed all three assessments that is, baseline, pre-intervention and post-intervention evaluations (Table 3.1). Twelve participants who had entered the drug treatment facilities during the control period completed only the pre-intervention (served as and referred to hereafter as the baseline for this group) and post-intervention assessments. This group of men, who had no control period, was not included in the testing of the first hypothesis assessing the intervention vs. control effect. Twenty-one men, who entered the drug treatment program and the RHEALTH intervention after the control period had ended, completed only the post-intervention evaluations. This last group was not included in the analyses reported here.

The retention rate across the entire program (approximately 4 months per treatment site) was 61.3%. Participants with incomplete evaluations such as those with only one assessment or those who graduated from the drug treatment program or dropped out due to drug or alcohol relapse during the six-week intervention period were not included in the current analysis.

**Table 3.1 Recovery Healthy Eating and Active Learning in Treatment Houses (RHEALTH) Program Participation**

| Completed Assessments: | Number of Participants |
|---|---|
| All 3 assessments: Baseline, pre- and post-intervention | 43 |
| Baseline and post-intervention assessment only | 12 |
| Post-intervention assessment only | 21 |
| *Total completers (received treatment)* | *76* |
| **Graduated or dropped out of drug treatment due to relapse:** | |
| Baseline assessment only | 24 |
| Baseline and pre-intervention assessment only | 24 |
| *Total non-completers (no treatment)* | *48* |
| **Overall total** | **124** |

**Completers vs. Non-completers**[1]

There were no significant differences among the 55 "completers," those participants who completed the post evaluation, between the 43 men who completed all three assessments, and the 12 men who completed only baseline and post-intervention assessments in socio-demographics, addiction history (primary drug of choice, treatment episodes, and years spent in active addiction), and key outcome variables.

The non-completers, enrollees who dropped out due to drug use relapse or graduation from the drug treatment facilities were younger (Mean age = 39.0 years, SE= 2.0) than the completers (Mean age = 45.0 years, SE= 1.9), and were in active addiction a shorter period (Mean =18.7 years, SE= 1.9) than their counterparts (Mean =24.5 years, SD=1.8) who completed the RHEALTH program (p= <0.05). The

[1] Glossary:

- Enrollees. Men in the six treatment programs who enrolled in the RHEALTH program.
- Completers. Enrollees who completed the intervention period--participants who received the treatment.
- Non-completers: Enrollees who dropped out due to substance use relapse or graduation from the treatment program during the control and treatment period.

percentages of enrollees who dropped out of the treatment program due to substance use relapses and treatment completion/graduation were 25.8% and 12.9% respectively.

Among the key outcome variables, one statistically significant difference (p= <0.05) was found between the 55 participants who received the intervention treatment and those who dropped out of the drug treatment program due to relapse or graduation following the control period. Those participants who dropped out had more positive attitudes at baseline toward cooking vegetables (M= 4.2, SE= .11) than their counterparts who completed the RHEALTH program (M= 3.8, SE= .11). There was a non-significant trend for higher self-efficacy for healthy cooking for enrollees who dropped out (M=3.8, SE= .11) than those who completed (M= 3.6, SE= .11) the intervention program (p = .057).

*Objective 1: To assess the RHEALTH intervention effects on dietary intake, body composition, and diet-related psychosocial factors (Treatment effect)*

Only the 43 completers, those who had completed all three evaluations (baseline, pre- and post intervention) were included in testing this hypothesis, which compared changes in key outcome variables in treatment and control periods. The mean age of the 43 completers with all three assessments was 44.9 years, 44% were African Americans, 35% were white of European decent, and about 12% self-identified as being of Hispanic origin (Table 3.2). More than half had a high school education or less; most were single, and more than two-thirds were unemployed before entering the drug treatment program.

The addiction characteristics for these 43 participants are presented in Table 3.3. About 40% reported alcohol, one-third crack or cocaine, and 27% heroin or other opiates as primary substance of addiction. These participants reported an average of 8.7(10.3) months of sobriety and 4.6(3.6) months in the current treatment program.

The average drug treatment episodes was 5.7(4.9) and the mean years spent in active addiction was 24.6(9.8).

Among the 43 RHEALTH participants who provided complete data we found statistically significant ($p = < 0.05$) differences in mean estimates for key outcome variables between the control and the treatment period. Following the treatment period (compared to the control period), study participants reported significantly lower mean percentage of calories from sweets and desserts, and significantly higher daily servings of fruits and vegetables. In addition, we found significantly smaller waist circumference after the treatment period in this group. There were significant increases in psychosocial readiness for diet change and self-efficacy for healthy eating (Table 3.4). There were no significant differences in these measures during the control period except for total energy intake; participants consumed significantly more total calories at baseline than at the pre-intervention evaluation (end of the control period) ($p = .011$).

We grouped participants as high and low scorers (based on the median for each variable) on key dietary and body composition variables in the control period to assess a possible effect of "regression to the mean" on the changes in the control period (Conroy, 1996). We found significant mean differences between high and low scorers at baseline ($p = <0.05$) for changes in percent of calories from sweets, daily servings of vegetables and fruits during the control period (High = -4.7 ± 7.0 %, Low = 5.3 ± 6.9 %; High = -0.73 ± .95 servings, Low = 0.22 ± 1.3 servings; High = -0.44 ± 1.0 servings, Low = 0.20 ± .61 servings respectively) but no significant differences between high and low scorers for total energy and body composition. We subsequently included baseline values in all multivariate analyses of intervention outcomes.

We found no evidence of a treatment effect on energy consumption or percentage calories from fat, daily servings of fats, oils, sweets and sodas. We found

no change in readiness for changing cooking skills, social support for healthy eating, self-efficacy for healthy cooking, attitude toward cooking vegetables or satisfaction with diet and weight. There was an overall change in BMI at the end of the program. There was a non-significant trend for a greater increase in BMI in the control period than during the treatment period, but the difference was not statistically significant (p= .582); (see also Table 3.4). There was also a non-significant trend in the shift across BMI and waist circumference categories during the intervention period. Three study participants moved from the obese to the overweight category (p= .995), and 4 participants moved from the above WC cutoff (≥102 cm) to the below category (p= .678).

**Table 3.2 Characteristics of Participants who Completed RHEALTH Program (n=43 men)**

| | Mean (SD) | Range | N | Percent |
|---|---|---|---|---|
| Age (years) | 44.9 (8.1) | 24-59 | | |
| Race/ethnicity: | | | | |
| African-American | | | 19 | 44.2 |
| White | | | 15 | 34.9 |
| Hispanics | | | 4 | 9.3 |
| Other | | | 5 | 11.6 |
| Single | | | 28 | 65.1 |
| Married | | | 6 | 14.0 |
| Separated/Divorced | | | 9 | 20.9 |
| Education: | | | | |
| < High school | | | 5 | 11.6 |
| High School or GED | | | 24 | 55.8 |
| >High School Diploma | | | 14 | 32.6 |
| Employed before Treatment: | | | | |
| No | | | 33 | 76.7 |
| Yes | | | 10 | 23.3 |

**Table 3.3 Substance Addiction/Recovery Characteristics of Participants who Completed RHEALTH Program (n=43 men)**

| | Mean (SD) | Range | N | Percent |
|---|---|---|---|---|
| Primary Drug of Choice: | | | | |
| Alcohol | | | 17 | 39.5 |
| Crack/Cocaine | | | 15 | 34.9 |
| Heroin/Opiates | | | 11 | 25.6 |
| Current Sobriety (months)* | 8.7 (10.3) | 0.5-48 | | |
| Time in Current Program (months)* | 4.6 (3.6) | 3-19 | | |
| Treatment Episodes (n) | 5.7 (4.9) | 1-20 | | |
| Active Addiction (years)* | 24.6 (9.8) | 4-43 | | |

* Variables included in mixed models

*Objectives 2&3: To assess dose response to the intervention and associations between participant characteristics and study outcomes (dietary intake, body composition, and diet-related psychosocial factors)*

Fifty five men were included in the analysis to test the dose response and associations between participant characteristics and the intervention outcomes. This included the 43 who had completed all three assessments as well as the 12 men who had completed only baseline and post-intervention assessments (no control period). We combined the two because there were no statistically significant differences found in socio-demographic characteristics, addiction history or baseline and post intervention values in key outcome variables in these two groups. The 55 participants' socio-demographic and addiction characteristics are presented in Tables 3.5 & 3.6. For this analysis we calculated the change between post intervention and baseline in key outcome variables that demonstrated program impact ($p = < .05$) of relevance to our hypotheses.

Bivariate correlation analyses revealed no statistically significant correlations between socio-demographic characteristics such as age, race and ethnicity, education, and marital status and changes in the key outcome variables or with addiction history such as primary drug of choice and treatment episodes; therefore these were not

**Table 3.4 Mean (SD) Change in Dietary Intake, Body Composition and Psychosocial Variable Within the Study Participants (n= 43): Control vs. Intervention Period**

| Dietary Intake | Baseline ($T_1$) | Pre-Intervention ($T_2$) | Post-Intervention ($T_3$) | Control ($\Delta^1$) | Intervention ($\Delta^2$) | Mean Difference ($\Delta^2 - \Delta^1$) | t | P-Value | Effect Size |
|---|---|---|---|---|---|---|---|---|---|
| Energy | 3358.75 (1311.80) | 2994.61 (1425.70) | 2689.46 (1293.37) | -364.14 (851.57) | -305.15 (937.10) | 58.99 (1570.61) | 0.246 | .807 | .04 |
| % kcal Fat | 38.19 (4.10) | 36.91 (5.29) | 36.75 (4.43) | -1.27 (5.24) | -0.17 (5.23) | -1.11 (9.25) | 0.784 | .437 | .12 |
| % kcal Sweets* | 21.70 (10.09) | 22.13 (7.79) | 18.36 (9.05) | 0.42 (8.51) | -3.77 (9.43) | 4.19 (13.23) | -.079 | **.044** | .32 |
| Daily Servings Fats, Oils, Sweets, Sodas | 5.95 (2.80) | 5.43 (2.63) | 4.86 (2.67) | -0.52 (1.60) | -0.58 (2.01) | -0.06 (2.80) | -.142 | .888 | .02 |
| Daily Servings Vegetables* | 2.66 (1.45) | 2.49 (1.57) | 3.52 (2.57) | -0.17 (1.25) | 1.03 (2.50) | 1.20 (3.25) | 2.428 | **.020** | .37 |
| Daily Servings Fruits* | 1.19 (0.74) | 1.11 (0.70) | 1.89 (1.13) | -0.08 (0.87) | 0.79 (1.21) | 0.87 (1.80) | 3.172 | **.003** | .48 |
| **Body Composition** | | | | | | | | | |
| BMI | 29.79 (7.17) | 29.98 (7.15) | 30.07 (7.48) | 0.19 (0.77) | 0.09 (1.09) | -0.10 (1.16) | -.554 | .582 | .09 |
| Waist Circumference* | 103.68 (17.69) | 103.94 (17.34) | 101.80 (18.03) | 0.26 (4.12) | -2.14 (4.85) | -2.14 (7.37) | -.140 | **.038** | .33 |
| **Psychosocial** | | | | | | | | | |
| Readiness to change diet* | 6.65 (3.04) | 5.95 (2.96) | 6.67 (3.09) | -0.70 (2.27) | 0.72 (2.94) | 1.42 (4.41) | 2.110 | **.041** | .32 |
| Readiness to change cooking skills | 5.88 (3.22) | 5.49 (2.82) | 6.16 (3.24) | -0.40 (3.16) | 0.67 (3.39) | 1.07 (5.52) | 1.271 | .211 | .19 |
| Social Support | 23.26 (5.94) | 23.51 (6.06) | 25.44 (5.49) | 0.26 (6.17) | 1.93 (6.27) | 1.67 (10.75) | 1.021 | .313 | .16 |
| Self-efficacy Healthy Eating* | 3.81 (0.65) | 3.84 (0.66) | 4.25 (0.56) | 0.03 (0.62) | 0.40 (0.67) | 0.38 (1.13) | 2.192 | **.034** | .33 |
| Self-efficacy healthy cooking* | 3.63 (0.69) | 3.71 (0.80) | 3.98 (0.82) | 0.07 (0.84) | 0.27 (0.69) | 0.20 (1.25) | 1.064 | .293 | .04 |
| Attitude toward Cook Vegetables | 3.89 (0.82) | 3.91 (0.70) | 4.00 (0.74) | 0.04 (0.74) | 0.09 (0.77) | 0.05 (1.30) | 0.264 | .793 | .04 |
| Satisfaction with Diet & Weight* | 2.85 (0.98) | 2.88 (0.92) | 3.19 (0.90) | 0.02 (0.85) | 0.31 (1.03) | 0.29 (1.61) | 1.169 | .249 | .18 |

*Mean differences in Pre-intervention and Post-intervention significant at P = ≤ .05 but not significant in Baseline and Pre-intervention.
$\Delta^1 = T_2 - T_1$; $\Delta^2 = T_3 - T_2$

included in the mixed model analysis. A smaller waist circumference was correlated with less time in treatment program (r = -.34, p = .01), shorter sobriety time (r = -.21, p = .02), and longer years in active addiction (r = .19, p = .05). Change in readiness for dietary change was also associated significantly with longer years in active addiction (r = .21, p = .03), therefore these addiction variables were retained in subsequent analyses.

**Table 3.5 Characteristics of the 55 Participants who Completed RHEALTH Program**

| | Mean (SD) | Range | N | Percent |
|---|---|---|---|---|
| Age (years) | 44.7 (8.0) | 24-59 | | |
| Race/ethnicity: | | | | |
| African-American | | | 25 | 45.5 |
| White | | | 20 | 36.4 |
| Hispanics | | | 5 | 9.1 |
| Other | | | 5 | 9.1 |
| Single | | | 37 | 67.3 |
| Married | | | 4 | 7.3 |
| Separated/Divorced | | | 14 | 25.5 |
| Education: | | | | |
| < High school | | | 9 | 16.4 |
| High School or GED | | | 30 | 54.5 |
| >High School Diploma | | | 16 | 29.1 |
| Employed before Treatment: | | | | |
| No | | | 41 | 74.5 |
| Yes | | | 14 | 25.5 |

**Table 3.6 Substance Addiction/Recovery Characteristics of Participants who Completed RHEALTH Program (n=55 men)**

| | Mean (SD) | Range | N | Percent |
|---|---|---|---|---|
| Primary Drug of Choice: | | | | |
| Alcohol | | | 22 | 40.0 |
| Crack/Cocaine | | | 18 | 32.7 |
| Heroin/Opiates | | | 15 | 27.3 |
| Current Sobriety (months)* | 8.4 (7.5) | 0.5-48 | | |
| Time in Current Program (months)* | 4.4 (3.2) | 2-19 | | |
| Treatment Episodes (n) | 6.3 (5.1) | 1-20 | | |
| Active Addiction (years)* | 25.9 (9.7) | 3-43 | | |

* Variables included in mixed models

A mixed model regression of the following change variables were built and analyzed separately: Change in energy intake, percentage kcal from sweets and desserts, daily servings of vegetables and fruits; the change in body composition (BMI and WC); and the change in psychosocial variables such as self-efficacy for healthy eating and cooking skills, readiness for diet change in the next 30 days, and satisfaction with diet and weight.

The mixed model analysis with change in energy intake as the dependent variable is presented in model one (Table 3.7) and the following as independent variables: Class attendance, baseline energy intake, time in treatment program, baseline's attitude toward diet change in the next 30 days, satisfaction with diet and weight, and regular weekly exercise. The regression analysis showed that greater readiness for diet change in 30 days at baseline ($\beta = 127$, $p<.05$) and greater satisfaction with diet and weight at baseline ($\beta = 323$, $p <.05$) were significantly associated with a larger reduction in energy intake in the treatment period while a smaller reduction in energy intake was associated with higher energy intake at baseline ($\beta = -.225$, $p<.05$).

An interaction between nutrition class attendance and time in treatment program revealed that longer time in the treatment program and attendance at four or more nutrition classes was associated with a greater reduction in energy intake compared to attendance at three or fewer nutrition classes ($\beta = 170$, $p <.05$); see also Figure 3.3.

We computed a similar regression model with change in percentage calories from sweets and desserts as the outcome variable, which is presented in model two (Table 4.1). The results showed that smaller reduction in percentage calories from sweets and desserts was associated with higher baseline consumption of sweets and

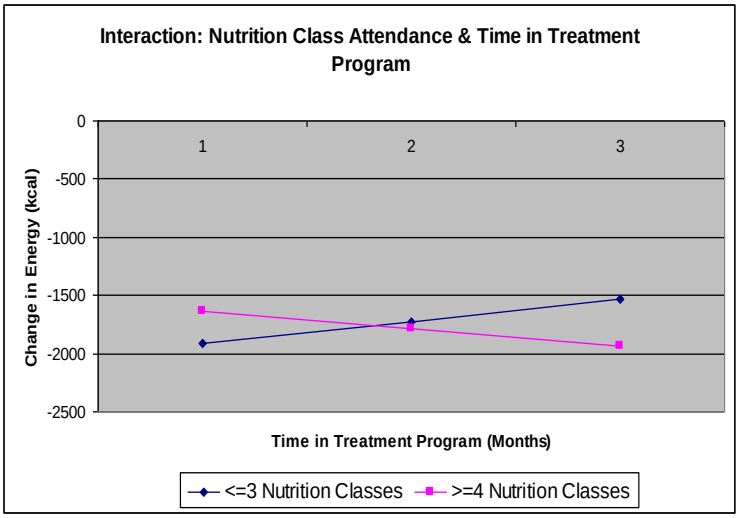


**Figure 3.3 Interaction between the participants' attendance at nutrition class and time spent in treatment program (additional months beyond mean= 4.4 months) for the reduction in energy consumption from baseline to the end of the RHEALTH program.**

desserts (β = - .782, p <.0001), and more regular physical activity at baseline (β = -2.83, p <.05).

We did not include any addiction history variables in the models for the change in vegetable and fruit intakes because there were no statistically significance relationships found in the bivariate analyses. The multivariate models for change in vegetable and fruit intake are presented in Table 3.8. As predicted, greater increases in vegetable and fruit consumption were significantly associated with higher nutrition class attendance (β = -1.22, p <.05 and β = -.765, p <.05 respectively). Surprisingly, our results revealed a trend for smaller increase in fruit intake with greater improvement in self-efficacy for healthy eating at post-intervention.

**Table 3.7 Parameter Estimates of Mixed Model for the Change in Energy and Percentage Calories from Sweets and Desserts by Nutrition Class Attendance, Addiction History, Regular Exercise and Key Psychosocial Factors: Before and After the RHEALTH Program**

| **Change in Energy:** | **β** | **95% CI** | **p-value** |
|---|---|---|---|
| Intercept | -1556.11 | - 2921.63, 190.60 | **.026** |
| Nutrition class attendance (NCA): ≤ 3 | -455.71 | -938.50, 27.09 | *.064* |
| ≥ 4 | 0[a] | . | **.** |
| Baseline Energy | -.225 | -.399, .050 | **.013** |
| Time in treatment program[§] (TITP) | -74.63 | -194.24, 44.98 | .216 |
| Baseline readiness to change diet in 30 day | 127.29 | 42.04, 212.55 | **.004** |
| Baseline satisfaction with diet and weight | 323.02 | 65.19, 580.86 | **.015** |
| Regular weekly exercise at baseline | 17.27 | -186.59, 221.12 | .865 |
| NCA: ≤ 3*TITP | 170.32 | 21.64, 319.00 | **.026** |
| NCA: ≥ 4*TITP | 0[a] | **.** | **.** |
| **Change in % kcal from sweets & desserts:** | | | |
| Intercept | 14.73 | .199, 29.65 | *.053* |
| NCA: ≤ 3 | 3.31 | -1.64, 8.25 | .185 |
| ≥ 4 | 0[a] | . | . |
| Baseline % kcal from sweets & desserts | -.782 | -1.02, .544, | **.000** |
| Time in treatment program[§] | .066 | -.689, .822 | .860 |
| Baseline readiness to change diet in 30 day | .314 | -.619, 1.25 | .502 |
| Baseline satisfaction with diet and weight | 1.21 | -1.45, 3.86 | .365 |
| Regular weekly exercise at baseline | -2.83 | -4.88, .778 | **.008** |

0[a] Reference group; § Centered to Mean = 4.4 months; * Interaction term

We included the following independent variables in the mixed model analysis with body composition (BMI and WC) as dependent variable: baseline body composition variables respectively, time in treatment program, sobriety time, years in active addiction, baseline physical activity, and change in satisfaction with diet and weight. Mean estimates results showed a trend for an increase in body mass index at the end of the program (Table 3.4) but none of the independent variables made a significant contribution to the change observed. However, there was a trend for the increase in BMI (Table 3.9) to be positively associated with regular exercise at baseline ($\beta = .519$, $p = .079$) and negatively associated with greater increases in satisfaction with diet and weight at the end of the program ($\beta = -.624$, $p = .075$).

**Table 3.8 Parameter Estimates of Mixed Model for the Change in Daily Servings of Fruit and Vegetable Intakes by Nutrition Class Attendance and Key Psychosocial Factors: Before and After the RHEALTH Program**

| **Change in daily servings of vegetables:** | **β** | **95% CI** | **p-value** |
|---|---|---|---|
| Intercept | 1.33 | -.765, 3.42 | .208 |
| Nutrition class attendance (NCA): ≤ 3 | -1.22 | -2.36, -.065 | **.039** |
| ≥ 4 | 0[a] | . | . |
| Baseline daily servings of Vegetables | -.180 | -.585, .226 | .379 |
| Change in self-efficacy healthy eating | -.096 | -.988, .796 | .829 |
| Change in readiness to change diet in 30 day | .107 | -.094, .309 | .291 |
| **Change in daily servings of fruits:** | | | |
| Intercept | 1.35 | .402, 2.31 | **.006** |
| NCA: ≤ 3 | -.765 | -1.34, -.193 | **.010** |
| ≥ 4 | 0[a] | . | . |
| Baseline daily servings of fruits | -.266 | -.664,.133 | .186 |
| Change in self-efficacy healthy eating | -.392 | -.825,.042 | *.075* |
| Change in readiness to change diet in 30 day | .033 | -.065, .131 | .505 |

0[a] Reference group

**Table 3.9 Parameter Estimates of Mixed Model for the Change in Body Composition by Addiction History and Key Psychosocial Factors: Before and After the RHEALTH Program**

| **Body Mass Index:** | **β** | **95% CI** | **p-value** |
|---|---|---|---|
| Intercept | -1.68 | -5.21, 1.86 | .345 |
| Baseline Body Mass Index (BMI) | -.004 | -.095, .087 | .936 |
| Time in treatment program§ (TITP) | -.156 | -.362, .051 | .137 |
| Sobriety time (months) | -.048 | -131, .036 | .255 |
| Years in active addiction | .043 | -.026, .112 | .215 |
| Regular weekly exercise at baseline | .519 | -.062, 1.10 | *.079* |
| Change in satisfaction with diet and weight | -.624 | -1.31, .065 | *.075* |
| **Waist Circumference:** | | | |
| Intercept | -8.61 | -17.0, -.215 | **.045** |
| Baseline waist circumference | .024 | -.044, .093 | .479 |
| Time in treatment program§ | -.594 | -974, -.215 | **.003** |
| Sobriety time (months) | -.188 | -.341, -.035 | **.017** |
| Years in active addiction | .121 | -.009, .252 | *.067* |
| Regular weekly exercise at baseline | 1.10 | -.070, -2.28 | *.065* |
| Change in satisfaction with diet and weight | -1.27 | -2.61, .084 | *.065* |

§ Centered to Mean =4.4 months

The body composition analysis also revealed that longer sobriety and time in the treatment program were significantly and associated with smaller reductions in waist circumference at the end of the program ($\beta = -.188$, $p < .05$ and $\beta = -.594$, $p < .05$ respectively), as well as a smaller trend for greater positive change in satisfaction with diet and weight after the program ($\beta = -1.27$, $p = .065$). Longer time spent in active addiction ($\beta = .121$, $p = .067$) and greater physical activity levels ($\beta = 1.10$, $p = .065$) at baseline showed greater trends in waist circumference reduction at the end of the program.

**Table 3.10 Parameter Estimates of Mixed Model for the Change in Self-efficacy by Nutrition Class Attendance and Addiction History: Before and After the RHEALTH Program**

| **Change in self-efficacy for healthy eating:** | **β** | **95% CI** | **p-value** |
|---|---|---|---|
| Intercept | 3.36 | 2.52, 4.19 | **.000** |
| Nutrition class attendance (NCA): ≤ 3 | .037 | -.248, .321 | .796 |
| ≥ 4 | 0[a] | . | **.** |
| Baseline self-efficacy for healthy eating | -.763 | -.980, -.545 | **.000** |
| Time in treatment program[§] | .073 | -.001, .146 | *.054* |
| NCA: ≤ 3*TITP | -.125 | -.220, -.030 | **.011** |
| NCA: ≥ 4*TITP | 0[a] | . | **.** |
| **Change in self-efficacy for healthy cooking:** | | | |
| Intercept | 3.30 | 2.30, 4.30 | **.000** |
| Nutrition class attendance (NCA): ≤ 3 | .189 | -.204, .582 | .338 |
| ≥ 4 | 0[a] | . | **.** |
| Baseline self-efficacy for healthy cooking | -.813 | -1.09, -.537 | **.000** |
| Time in treatment program[§] | .086 | -.013, .185 | .089 |
| NCA: ≤ 3*TITP | -.260 | -.385, -.135 | **.000** |
| NCA: ≥ 4*TITP | 0[a] | . | . |

0[a] Reference group
[§] Centered to Mean = 4.4 months
* Interaction term

We computed similar mixed models for the psychosocial variables that demonstrated statistically significant changes at the end of the program or if deemed relevant to our hypotheses. The resulting psychosocial models are presented in Tables 3.10 & 3.11). Analyses with the change in self-efficacy for healthy eating and cooking as dependent variables revealed a two-way interaction between time in the treatment program and nutrition class attendance categories (Table 3.10, Figures 3.4 & 3.5). Participants who had been in the treatment program longer and attended four or more nutrition classes experienced a greater increase in both self-efficacy for healthy eating

and cooking skills than their counterparts who had been in the treatment longer but attended three or fewer classes ($\beta = -.125$, $p < .05$ and $\beta = -.260$, $p < .0001$). Smaller increases in self-efficacy for healthy eating and cooking skills were associated with higher self-efficacy at baseline (($\beta = -.763$, $p < .0001$ and $\beta = -.813$, $p < .0001$ respectively).

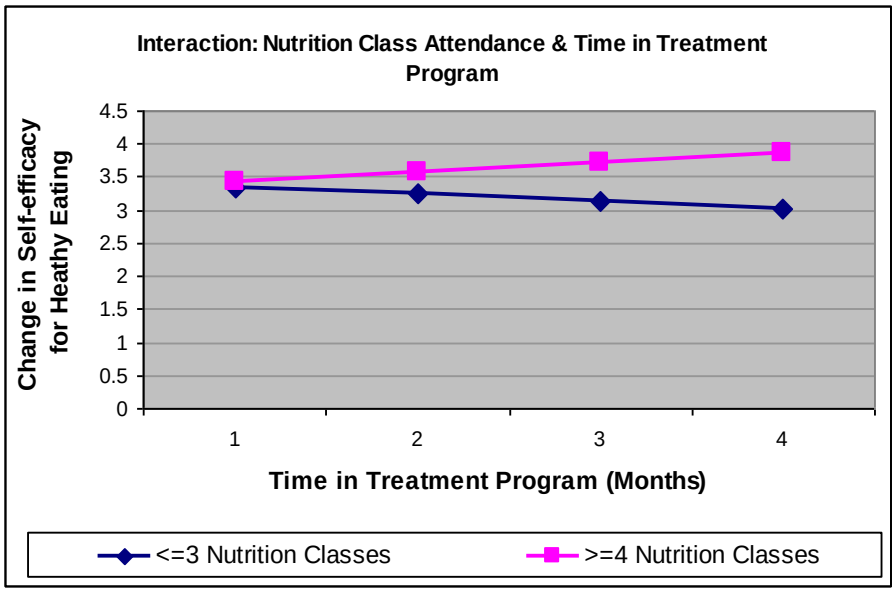


**Figure 3.4 Interaction between the participants' attendance at the nutrition class and the length of time spent in the current treatment program (additional months beyond mean =4.4 months) for the increase in self-efficacy for healthy eating from baseline to the end of the RHEALTH program.**

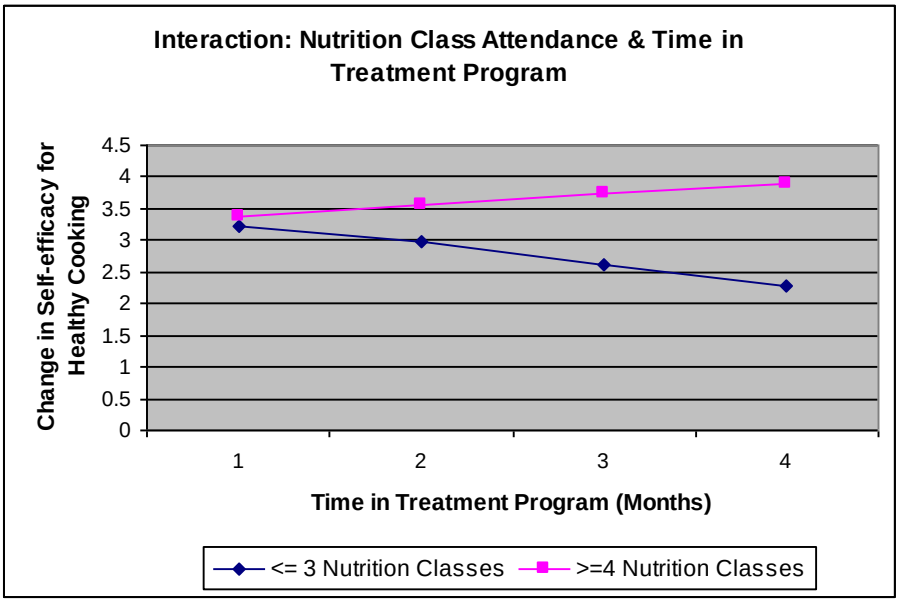


**Figure 3.5 Interaction between the participants' attendance at the nutrition class and the length of time spent in the current treatment program (additional months beyond mean =4.4 months) for the increase in self-efficacy for healthy cooking from baseline to the end of the RHEALTH program**

We tested for predictors of readiness for dietary change as the dependent variable (Table 3.11) and found that longer time in active addiction was associated with a greater increase in readiness for dietary change at the end of the program ($\beta$ = .101, $p < .05$). The results showed that readiness to change at baseline was associated with smaller improvements in readiness for dietary change at the post evaluation. Similarly, there was a trend for longer time in the treatment program to be associated with decreased in readiness for change at treatment end ($\beta$ = -.225, $p = .072$).

**Table 3.11 Parameter Estimates of Mixed Model for the Change in Attitude toward Diet Change and Satisfaction with Diet and Weight by Nutrition Class Attendance, Addiction History, Regular Exercise and Key Psychosocial Factors: Before and After the RHEALTH Program**

| **Change in readiness to change diet in 30 days:** | **β** | **95% CI** | **p-value** |
|---|---|---|---|
| Intercept | .466 | -2.97, 3.90 | .786 |
| Baseline readiness to change diet in 30 days | -.430 | -.674, -.186 | **.001** |
| Time in treatment program§ | -.225 | -.470, .021 | *.072* |
| Years in active addiction | .101 | .023, .180 | **.013** |
| Nutrition class attendance (NCA): ≤ 3 | .285 | -1.15, 1.72 | .692 |
| ≥ 4 | 0[a] | . | . |
| Change in self-efficacy for healthy eating | -.596 | -1.71, .521 | .289 |
| Change in waist circumference | -.061 | -.220, .521 | .439 |
| Regular Exercise at Baseline | -.012 | -.665, .642 | .972 |
| **Change in Satisfaction with diet & weight:** | | | |
| Intercept | 1.57 | .602, 2.54 | **.002** |
| Baseline satisfaction with diet and weight | -.458 | -.694, -.223 | **.000** |
| Time in treatment program§ | -.059 | -.133, .016 | .119 |
| Years in active addiction | .007 | -.030, .016 | .562 |
| NCA: ≤ 3 | -.469 | -.927, -.011 | **.045** |
| ≥ 4 | 0[a] | . | . |
| Change in self-efficacy for healthy eating | .261 | -.077, .599 | .127 |
| Change in waist circumference | -.040 | -.085, .005 | *.078* |
| Regular Exercise at Baseline | .113 | -.083, .310 | .252 |

0[a] Reference group
§ Centered to Mean = 4.4 months

The regression analysis for the change in satisfaction with diet and weight revealed that attendance at four or more nutrition classes was significantly and positively associated with greater increases in satisfaction with diet and weight at the end of the program than class attendance at three or fewer classes ($\beta = -.469$, $p < .05$). Our results also revealed that more satisfaction with diet and weight at baseline was

significantly associated with smaller increase in satisfaction at the end of the program ((β = -.458, p < .0001). Surprisingly, a negative trend was observed in the change in satisfaction with diet and weight for participants who had experienced greater reductions in waist circumference (β =-.040, p = .078) at the end of the program than their counterparts who had smaller reductions (Table 3.11).

## DISCUSSION

This study examined the effects of the RHEALTH program on dietary intake, body composition and diet-related psychosocial factors of men in drug treatment facilities. There is some evidence suggesting that our pilot intervention had a positive impact on these outcome variables. Specifically the RHEALTH intervention was associated with significant increases of fruit and vegetable consumption, self-efficacy for healthy eating as well as reduced percentage calories from sweets and desserts, and waist circumference with medium to large effect sizes. The increases in fruit and vegetable consumption (≥ 0.5 servings of fruits and vegetables translate to ≥ medium effect size) are especially meaningful because empirical data have shown protective effects of fruits and vegetables intake against CVD events, blood pressure and some cancers (Ammerman et al., 2002b), deleterious conditions for which intervention participants are at an increased risk (Sutter et al., 1999; Howard et al., 2004). The medium effect of the intervention on waist circumference is of clinical importance because reduction in WC centimeters was consistent with the finding that four participants moved from the at-risk category to below the at-risk cut off point for obesity and other cardio-metabolic diseases (Ford et al., 2003). Because WC is a good predictor of future risk of metabolic syndrome (Ford et al., 2003) the intervention effect on waist circumference is a step in the right direction toward better health.

The results also demonstrated a dose effect of the intervention as hypothesized. The men who attended four or more nutrition classes had greater increases in vegetable and fruit intakes, self-efficacy for healthy eating, and satisfaction with diet and weight than those who attended fewer classes. These findings, for the first time, extend to the population of adults in recovery from substance abuse. The results lend support to previous findings in general populations that indicate that dietary interventions including those that teach internal skills tailored to increase of dietary components (Hagler et al., 2007) and delivered to individuals in various settings can have a positive impact on dietary behaviors particularly those associated with chronic disease risk reduction (Ammerman et al., 2002; Finkelstein et al., 2004).

The findings related to relationships hypothesized between the participants' individual characteristics (including addiction history and psychosocial factors) and the intervention outcomes were generally mixed. Greater reduction in energy intake was associated with greater readiness for diet change in 30 days and greater satisfaction with diet and weight at baseline but inversely associated with higher baseline energy intake. Similarly, greater reductions in percent of calories from sweets and desserts were associated with lower baseline values but not higher baseline values. One possible explanation for this result may be that participants who consumed more energy and sweets at baseline may have had greater barriers for dietary change. This is consistent with the fact that they were worse off at baseline and may have had more room for improvement. These findings are in concurrence with a previous study that suggests that it is easier to increase the intake of healthy foods such as fruits and vegetables, than to decrease unhealthy foods such as high fat foods (Hagler et al., 2007). This result may also provide some support for ruling out the potential bias from regression to the mean (Conroy, 1996). Our study participants with very high baseline values did not demonstrate a greater magnitude of change in the outcome assessments

following exposure to the treatment. Instead the opposite was observed and contrary to what was indicated in regression analyses especially for self-efficacy as presented in chapter one. Those with higher baseline values experienced a more modest change in all the outcome variables at post intervention.

An interaction between class attendance and time spent in the treatment program for the change in energy, self-efficacy for healthy eating and cooking suggests that those who were in the treatment program longer and had a greater exposure to the intervention treatment (attendance to four or more nutrition classes) fared better than their counterparts with less exposure. This finding confirms the hypothesized relationship between the change in self-efficacy and the RHEALTH program: the intervention would increase self-efficacy for healthy eating and cooking among these men. The need to provide continuing nutrition education in treatment facilities that tailored to the specific needs and stages of recovery is also highlighted by this finding as well as concurs with a previous study in this population that suggests the need for a systematic recovery-stage approach in addressing dietary concerns and weight gain in treatment facilities (Cowan et al., 2007).

While there were no significant treatment effects found for changes in BMI during the intervention period, greater reductions in waist circumference were positively associated with longer time in active addiction, but not with longer time in the treatment program or longer sobriety or clean time. It is not immediately clear why a smaller change in waist circumference was found with longer treatment time when a growing body of evidence suggests that length of stay in treatment is one of the strongest predictors of positive substance treatment outcomes (e.g. SAMHSA, 2009b; Cacciola et al., 2005; Hser et al., 1999, 1999b; Grella et al., 1999). However, a previous qualitative study conducted by our research team with a similar sample found that excessive weight gain occurred with longer sobriety and time in recovery

especially in residential treatment communities that were unsupportive of healthy food choice behaviors (Cowan et al., 2007). Thus, excessive weight gain particularly in abdominal fat with longer sustained recovery may inadvertently impede motivation for change especially if it is seen as unattainable.

On the other hand, the decline in waist circumference with longer time in active addiction may be associated with readiness for change. While the reduction in waist circumference was modest, the change may be more meaningful for those participants who were at or above the cut-point (≥ 103 cm) corresponding to obesity in men and other health risks such as cardiovascular disease, diabetes, hypertension and dyslipidemias (Ford et al., 2003). Although we found no significant age-related differences in our study, more years of regular drug use is postulated to be associated with older adults (Grella et al., 1999). Older adults are more inclined to have longer treatment "careers", greater recognition of their drug problems, stronger desire for help and readiness for change in treatment (Hser et al., 1999). Additional research is needed to understand how addiction history and the drug treatment processes in residential programs may effect changes in body composition primarily because abdominal obesity is associated with alcohol consumption (Vadstrup et al., 2003) as well as increased health risks (Kahn et al., 1997; Koh-Banerjee et. al., 2003; Halkjaer et al., 2009).

The RHEALTH results also revealed that baseline self-efficacy for healthy eating and readiness for diet change in the next 30 days had increased significantly at the end of the intervention period. This is important because positive changes in self-efficacy scores were associated with greater nutrition class participation, which confirms our hypothesis, and concurs with previous studies that found that nutrition education enhanced self-efficacy for healthy eating behaviors (Rinderknecht et. al, 2004; Nitzke et al., 2007; Greene et al., 2008). However, we found no significant

associations between enhanced self-efficacy and improvements in dietary intakes; however self-efficacy has been shown to be related to dietary changes in a plethora of studies (e.g. Brug et al., 1995; Schnoll et a., 2001; Hagler et al., 2007; Nothwehr, 2008; Shaikh et al., 2008). Perhaps a larger sample would better able to explicate the relationships among these variables.

There were no significant differences found between the control and treatment periods for changes in self-efficacy for healthy cooking and satisfaction with diet and weight. However, the regression analysis revealed that trends for improvements in these diet-related psychosocial variables at the end of the intervention were positively associated with more nutrition class attendance. One plausible explanation for a dose effect but not an overall treatment effect may be that we used a larger sample in the regression models for the determinants of change in the outcome variables and included only the forty three participants who completed all three assessments in the analyses to determine the RHEALTH program impact on dietary intake, body composition, and diet-related psychosocial previously mentioned.

A few limitations should be considered when interpreting the findings from this pilot intervention. The study was conducted among a non-random sample of men in a small number of residential treatment facilities in an urban area. Consequently findings may not generalize to other drug treatment groups. Given the strength and consistency of the relationships found among variables one could conjecture that similar or even stronger associations may be found in larger intervention samples. The nonrandom nature of the treatment implementation or participation into the RHEALTH program should also be considered. Randomization within these treatment facilities may be viewed by some as inequitable and thereby increasing the potential for social interaction threats. Also a post-test difference between randomized treatment facilities may be explained by a program-versus-comparison group due to non-

comparable study sites (Trochim, 1999). However our quasi-experimental design, which allowed the participants to serve as their own controls may address some of these validity issues. Memory recall issues and random error in reporting food consumption as well as social desirability issues should also be considered particularly because the primary investigator conducted all aspects of the intervention and evaluation. There was some indication of regression to the mean in some dietary variables during the control period; inclusion of baseline values in tests of treatment effects may have partially but not fully compensated for this effect. It is also possible that there was a testing effect because the control periods preceded the intervention period. We included an "expanding across time" design, which may have reduced some of the potential maturation or testing threats (Trochim, 1999). For instance, if changes in the outcomes occurred between baseline and pre-intervention period, one would expect similar changes between the pre- and post- intervention assessments. However, if there was no change between the baseline and pre-intervention but a change was found between the pre- and post-intervention period, as shown by our results, then one could assume that maturation or testing effect is not likely the explanation for the changes in the study outcomes following the intervention. However, a randomized control trial would more fittingly address these testing issues.

Additionally, it is likely that participants may have more interest in nutrition and higher motivation for change than non-participants, and thereby the potential for greater program success. However the high enrollment rate in the intervention among the study sites (approximately 90%) may address these selection biases. The attrition rate from baseline to the post intervention period was 38.7%, which is similar to the national attrition rate (40%) for long-term residential substance abuse treatment (SAMHSA, 2009). High numbers of unplanned treatment discharges due to substance

relapses and drug treatment completion/graduation were the causes of the high drop out rate from the intervention.

Comparison analysis between the RHEALTH program completers and non-completers revealed some differences. Those who dropped out of the drug treatment programs and by default from the intervention were younger and had shorter addiction histories. Baseline comparisons revealed that they also scored higher, on average, on the self-efficacy for healthy cooking and attitude toward cooking vegetables scales. As previously mentioned, age and length of addiction careers are associated with substance treatment outcomes. Specifically, being over 40 years at admission, which is older than the average age of the intervention non-completers, is a strong predictor of substance treatment completion (SAMHSA, 2008). Additionally, older substance abusers tend to have longer addiction histories (Grella et al., 1999), it is not surprising then that our non-completers were younger and had shorter addiction "careers." Age has been revealed to be a reliable predictor of treatment retention, with time in treatment for substance abuse increasing with age (Grella et al., 1999). There is some evidence suggesting that unskilled people generally have difficulties recognizing their incompetence, which may lead to inflated self-assessments and inaccurate judgments about performance (Dunning et al., 2004; Kruger et al., 1999; Ehrlinger et al., 2003). It is then plausible to suggest that the higher scores for these substance 'relapsers' may be related to over-confidence in judgment particularly because they were unsuccessful in completing the drug treatment.

The high attrition rate in the drug treatment facilities and the open nature of the intervention meant that some participants enrolled in and left the RHEALTH program on different timelines. However, individual who completed only post-intervention assessments were not included in any of the analyses even though they did not differ

in major ways from those who completed the study. Further study assessing the long term sustainability of these post intervention changes is necessary.

To our knowledge, this is the first dietary intervention study of a sample comprised of all adult men in residential drug treatment facilities, an understudied segment of the population, regarding dietary behavioral change, body composition, and diet-related psychosocial factors. Findings from a preliminary formative study in a similar recovery sample help shaped the study design as well as the use of effective frameworks (the ecological perspective and Social Cognitive Theory) from which to explore significant constructs of health behaviors beyond the individual level. The study incorporated multiple assessments including measured height, weight and waist circumference conducted during face-to-face interviews to reduce inaccuracy. Each participant served as his own control, which adds to the validity of the study. The inclusion of a highly validated and comprehensive food frequency questionnaire as well as measures derived from several theoretical constructs thought to be important determinants of food choice behaviors also add to the strengths of this pilot intervention.

## RESEARCH AND PRACTICE IMPLICATIONS

The results of this study have a number of implications for research and treatment service providers. Because people in recovery from substance addiction tend to have poor dietary patterns (Hauser et al., 1989; Hudson et al., 1992; Hatcher, 2004; Cowan et al., 2007) and are at an increased risk for adverse health conditions such as obesity, diabetes, hypertension, cardiovascular diseases and some cancers (Sutter et al., 1999; Howard et al., 2004), additional studies are warranted to address dietary concerns in the recovery population. Our study lends support to the proposition that dietary intervention for men in residential treatment facilities may benefit from

targeting specific dietary intakes, especially sweets and desserts, fruits and vegetable intakes, waist circumference and psychosocial factors such as self-efficacy for healthy eating and readiness to change diet. Efforts to increase fruits and vegetables consumption while lowering total energy and sweets intakes need to focus on nutrition education tailored to specific addiction histories such as sobriety, the length of time in treatment and years in active addiction. Further research is necessary to determine if improvements in self-efficacy for healthy eating among men in recovery from substance addiction translate into healthful dietary changes. Information from such investigations is particularly salient given the increased health risk associated with substance addiction. Also follow up studies are needed to assess the sustainability of these behavioral changes.

The pilot intervention was associated with increased fruit and vegetable intake. Given the importance of fruits and vegetable in reducing chronic disease risk the need for supportive food-related policies in treatment facilities is paramount. The opportunity is also available for treatment programs to provide ongoing nutrition education that focus on increasing self-efficacy for healthy food choice behavior at different stage in the treatment facility. Our study provide some support for a programmatic approach in residential substance treatment facilities to address dietary concerns, body composition particularly abdominal obesity, and self-efficacy related to healthy behavior change.

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# CHAPTER 4:

# PROCESS EVALUATION

## RHEALTH PROCESS EVALUATION RESULTS: A PILOT INTERVENTION TO PROMOTE HEALTHY DIETARY INTAKE AND FOOD ENVIRONMENTS IN RESIDENTIAL DRUG TREATMENT FACILITIES


## ABSTRACT

RHEALTH was a multisite pilot behavioral and environmental nutrition intervention designed to improve dietary intake and body composition of men in residential drug treatment facilities. At the six intervention sites process evaluation data were collected to assess program participation, dose, fidelity and implementation of the nutrition education and food service components as well as contextual factors using multiple process assessment tools. The process evaluation revealed that study participants were exposed to 94% and 69% of the nutrition education and food service components respectively. RHEALTH intervention sites were categorized into high (4 sites) and low (2 sites) class participation and intervention implementation groups, and compared on nine essential food service elements. The Wilcoxon rank scores test indicated that lower- and higher-implementing intervention sites differed significantly on four of nine food service elements examined. Higher implementing sites scored higher than lower implementing sites on providing water and 100% juices daily, offering fruit or vegetable salad option at dinner meals, offering choices of fruits and vegetables daily, and limiting fried foods on the weekly menus.

Mixed model analysis of covariance revealed that participants living in the high class participation and intervention implementation sites reported greater

reductions in total energy, percent calories from sweets, daily servings of fats, oils, and sweets, and body mass index over the course of the intervention. Participants in sites with low nutrition education class participation and intervention implementation reported greater reductions in percent calories from fat to high implementing sites with high class participation. Process evaluation can be a useful tool for understanding the relationship between intervention participation, dose, fidelity, and study outcomes. These findings can inform the development and implementation of effective dietary interventions in drug treatment facilities.

## INTRODUCTION

Increasing emphasis has been placed on the use of process evaluations to determine the success of field-based research, particularly health behavior change interventions. There are a myriad of potential problems in implementing an intervention in the real world, especially in multiple community settings, and thus careful planning, monitoring, and the development of efficient and effective resolutions is crucial. Adherence to the study protocols and guidelines is an essential part of successful implementation of any behavioral change intervention (Johnson et al., 2010), and is also critical for preventing type III errors, measuring an intervention effect when the intervention was not delivered (Dobson & Cook, 1980) as well as keeping researchers from making erroneous conclusions that a program was ineffective because it was not implemented effectively (Saunders et al., 2006). When employed appropriately, process evaluation can capture the variability in program implementation, and thereby can be an effective set of tools for understanding why a program succeeded or failed (Baranowski & Stables, 2000; Saunder et. al., 2005).

In recent years, there have been significant advancements in the methodology and models used to guide the development of comprehensive process evaluations in

order to more effectively rule out alternative interpretations of data and explanations of study outcomes (Dobson & Cook, 1980; Saunder et. al., 2005). Components of process evaluation encompass factors that reflect the description of the intervention, where and how the intervention was conducted and received, the quality of the program delivered, and examination of relationships between specific program elements and program outcomes (Baranowski & Stables, 2000; Steckler et al., 2003; Saunder et. al., 2005).

A plethora of published reports on health promotions employ process evaluations that served both formative and summative purposes. Primarily, formative evaluation data are used to improve the suitability and quality of programs and summative evaluations are used to examine the program's completeness and fidelity, and the intended target audience participated in the program (Durlak, 1998; Helitzer et al., 1999, 2000; Dusenbury et al., 2003; Saunder et. al., 2005; Holiday et al., 2009; Wilson et al., 2009) as well as other factors such as participants' receptivity and satisfaction, contextual factors that may influence outcomes, among other aspects (Sanders et al., 2005; Johnson et al., 2010).

Recovery healthy eating and active learning in treatment houses (RHEALTH) program, a behavioral and environmental nutrition intervention, was designed for the purpose of promoting healthy eating among men in residential substance abuse treatment facilities. The process evaluation was planned and developed a priori, and served as an integral part of the implementation of the intervention protocols. The purpose of this analysis was to learn to what extent RHEALTH was implemented in the six study sites and to determine how study outcomes differed by the intensity and fidelity of the intervention implementation. Specifically, the investigators assessed the dose delivered and received (satisfaction), nutrition class participation, the intervention implementation, and fidelity across the six sites. Relationships between

treatment facility type (high and low class participation and intervention implementation sites) and the primary study outcomes were also examined. Contextual aspects of the treatment facility environment that may have influenced implementation and the study outcomes were also examined. We hypothesized that sites with high participation and implementation would report more beneficial changes in diet quality and anthropometric measures of study participants.

## METHODS

### Overview of the RHEALTH Study Design

Details of the study design, methods and outcomes of the RHEALTH intervention are reported in chapters 2 and 3. RHEALTH used a quasi-experimental design with a six week control period followed by a 6 week treatment period in six residential drug treatment facilities in an urban area in Upstate New York. The participants, ethnically diverse men aged 18 years or older residing in each of six drug treatment facility, served as their own controls.

The intervention sites, certified by the New York State Office of Alcoholism and Substance Addiction Services (OASAS), were residential community treatment facilities that provided 24-hour rehabilitative services for men recovering from substance addiction. Three study sites (4, 5 and 6) were located in an inner-city neighborhood; one treatment facility (site 2) was in a historical and more affluent community, and the two final facilities (sites 1 and 3) were located in urban residential communities. All facilities were non-profit organizations except for site number one, which was a government funded program. Residents were screened and admitted to the treatment programs based on specific treatment criteria in each facility. All six intervention sites were non-mandatory treatment facilities, that is, residents entered and left treatment voluntarily except in the case of a substance abuse relapse, resulting

in a staff-initiated discharge from the treatment program. The six study sites were recruited through referrals and prior research connections within the study population, and all six sites agreed to participate in the study when approached. Residents in intervention sites 1-5 were assigned to cook teams that were responsible for preparing the evening meals five days per week. In site number six, hired cooks were responsible for all food service.

**Intervention Outcome Measures**

Residents of each of the six treatment facilities were recruited into the study by house meeting, signs, and individual interactions. The main intervention outcomes were dietary intake and anthropometrics. Dietary intake was assessed using the Block 2005 Food Frequency Questionnaire (Block 2005), a 110-item instrument that asked about the type, frequency and portions of food consumed, during three successive face-to-face interviews: baseline, followed in 6 weeks by a pre-intervention assessment, then a 6 week treatment period, followed by a post intervention assessment. At each of the three assessment points, data were also collected on participants' socio-demographic characteristics, addiction history, and anthropometric measurement including height, weight, and weight circumference were measured. Body mass index (BMI) was derived from weight in kilograms divided by height in meters squared ($kg/m^2$). Physical activity behavior was evaluated by a self-report measure adapted from previous study (BRFSS, 2005)**.** The primary researcher conducted the intervention as well as collecting, coding and managing all assessments including the process evaluation data. All identifiable information about participants was maintained separately from their responses. The study was approved by the Cornell University Institutional Review Board, and was conducted between June 2007 and June 2008.

The intervention aim was to improve dietary patterns of men in residential treatment facilities through nutrition education classes that included hands-on cooking skills, and by changing the residential food environments to promote healthy eating. The primary outcome variables were changes in dietary intake (total calories, % calories from fat, % calories from sweets, daily servings of fats, oils and sweets, daily servings of fruits and vegetables) and body composition (body mass index and waist circumference).

**Overview of the RHEALTH Intervention**

The RHEALTH intervention targeted eating behavior, cooking skill and the food environment in six residential drug treatment facilities for men in recovery from substance abuse. The social ecological framework (Green et al., 2005) and Bandura (1977) social cognitive theory guided this study. The use of these theories helped to draw attention to behavioral, interpersonal and environmental factors and ways in which these factors may affect eating behaviors in residential drug treatment facilities.

Prior formative research in this population (Cowan & Devine, 2008) suggests that men in recovery have dietary intakes that put them at risk for chronic diseases including low daily servings of fruits and vegetables, and high intakes of energy, fats and sweets, and thereby was the basis of the RHEALTH intervention. Formative research also indicated that most men in the residential treatment facilities lacked the confidence necessary for choosing and preparing healthy meals, and more often than not, were responsible for preparing evening meals. The results from this formative study also revealed that the food environment in residential treatment facilities were unsupportive of healthy eating behaviors (Cowan, 2006; Cowan & Devine, 2008).

The RHEALTH intervention, which aimed at increasing the consumption of fruits and vegetables while reducing the consumption of total energy, total fat, and

added sweets among men in residential drug treatment facilities, had two components, designed to work together to address behavioral and environmental factors related to the residents' dietary behaviors. The intervention components were (1) a nutrition education component consisting of weekly nutrition and cooking classes for residents to modify dietary intake and increase cooking skills, and (2) a food service component consisting of policy changes in the residential food environment to increase opportunities for healthy food choices.

The nutrition education component included a series of food and nutrition classes that covered the following topics in six consecutive weeks: Getting Started: Food for Taste and Health, Portion Distortion: What's a Healthy Serving? Color Me Healthy: Choosing Vegetables by the Colors, Fruit: A Natural Sweet, Sugar Blues, and Fats of Life. Each weekly nutrition class included: weekly handouts with related nutrition concepts, the Food Guide Pyramid (USDA, 2005) poster in a conspicuous location in each residential treatment facility, classroom and cooking activities that incorporated recipe tasting to reinforce key messages, and "take home" challenges to emphasis the key nutrition concepts covered in each class. The classes were held in the community room or dining hall in each treatment facility, which was equipped with tables and chairs, and located close to the kitchen.

For the food service component, key staff members including the food coordinators in each study site met initially with the primary investigator to discuss targeted small changes in the food-related policies to provide more healthy guidelines for menu development, food procurement, food availability, and food access. The staff food service coordinator in each treatment site was asked to incorporate nine food service elements. Each site agreed to implement all of the nine food service components during the six-week intervention period: provide lower fat milks (1%, 2% and skim); refrain from serving Kool-Aid and other sugary drinks; provide water and

100% juices daily; offer fruit and/or vegetable salads at each dinner meal; offer choices of fruits and vegetables daily; offer a vegetarian or meatless dish at least once a week; offer lower-fat snacks such as pretzels, popcorn and fruits; limit the amount of sweetened and sugary foods; and limit the amount of fried foods on the menus. These food service changes were based on prior formative research (Cowan, 2006) in treatment facilities similar to these six study sites.

**Process Evaluation**

Strategies for documenting the implementation of the intervention were developed a priori using theory to inform the process evaluation activity, which ensured that key variables and constructs were measured and documented appropriately (Steckler & Linnan, 2002). Key constructs were organized into three major themes or "essential elements," class attendance, nutrition education class delivery, and implementation of food service elements, described in Tables 1 and 2. The primary investigator implemented and assessed all the nutrition education elements including class attendance while the residential treatment staff members, particularly the food service coordinator in each site was responsible for implementing all of the food service elements in his/her site. The primary investigator met with staff members and residents at each site during a community meeting before the start of the intervention. All treatment facilities were strongly encouraged to implement all the food service elements. Management in each site approved the intervention. The staff food coordinators and key participant informants in each site were also asked to meet with the primary investigator during three process evaluation interviews as part of the process evaluation activity to provide 'snapshots' at different points throughout the study.

The RHEALTH process evaluation included the following components: (1) documenting nutrition class participation (class attendance); (2) documenting dose delivered and received (nutrition education and food service elements activities) in all sites; (3) participant feedback on nutrition classes and cooking activities; and (4) monitoring fidelity and completeness of the RHEALTH implementation (data from direct observations and interviews with key staff and residents). This comprehensive approach enabled us to triangulate the data in assessing the fidelity and implementation on the key outcome variables. Contextual factors may also influence the completeness of RHEALTH implementation and the quality of the program implemented, and thereby the interpretation of the study outcomes. Consequently, activities or events occurring in the facilities unrelated to the RHEALTH intervention were documented in order to appropriately interpret the findings (Steckler & Linnan, 2002).

**Measurement Instruments**

As shown in Tables 4.1 and 4.2., a total of 10 instruments were used to collect the process evaluation data for RHEALTH intervention. Presented in the tables are the process evaluation components that each instrument was designed to measure. Several different types of process data were collected for the intervention components described below.

**Table 4.1. Class attendance and nutrition education elements of the RHEALTH intervention and process evaluation data collection tools**

| Essential Elements | Data collection tools | Time collected | Process evaluation components | Rating scale |
|---|---|---|---|---|
| ***Class Attendance*** | Attendance Log, program & admission information | End of each class | Participation | Number of participants, RHEALTH enrollment (n, %)<br>Facility occupancy |
| ***Nutrition Education:*** | | | | |
| 6 Weekly Nutrition Classes | Class check list, field notes | End of each class | Dose Delivered | 3=All, 2=Most, 1=Some, 0= No/None |
| Handouts with key nutrition concepts | Class check list, field notes | End of each class | Dose Delivered | 3=All of the time, 2=Most of the time, 1= Sometimes, 0= No/None |
| Class Activities | Class check list, field notes | End of each class | Dose Delivered | 3=All of the time, 2=Most of the time, 1= Sometimes, 0= No/None |
| Cooking activities including all recipes | Recipe check list, field notes | End of each class | Dose Delivered | 3=All of the time, 2=Most of the time, 1= Sometimes, 0= No/None |
| Tasting | Recipe check list, field notes | End of each class | Dose Delivered | 3=All of the time, 2=Most of the time, 1= Sometimes, 0= No/None |
| Food Guide Pyramid Poster displayed | Direct Observation | During intervention | Dose Delivered | 3=All of the time, 2=Most of the time, 1= Sometimes, 0= No/None |
| Participants' Receptiveness | Class feedback questionnaire | End of each class | Exposure (Dose Received) | 2= Class fun & interesting, recipes great , 1= Class & recipes Ok, not bad, 0= Class boring, recipes not liked |

**Table 4.2. Food service elements of the RHEALTH intervention and process evaluation data collection tools used for assessment**

| Food Service Elements: | Data collection tools | Time collected | Process evaluation components | Rating scale |
|---|---|---|---|---|
| 1) Provide low-fat milks (1&2%,skim) | Shopping list, direct observation, food inventory, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 2) No Kool-Aid or sugary drinks | Shopping list, direct observation, food inventory, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 3) Provide water and 100% juices | Shopping list, direct observation, food inventory, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 4) Offer fruit and/or vegetable salad @ dinner | Interview with staff & key resident participants | Before, during & at end of the six-week intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 5) Offer choices of fruits and vegetables | Shopping list, direct observation, food inventory, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 6)Vegetarian/meatless dish at least 1 per week | Review menus, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 7) Offer lower-fat snacks: e.g. pretzels, popcorn, fruits | Shopping list, direct observation, food inventory, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |

**Table 4.2. (Continued)**

| | | | | |
|---|---|---|---|---|
| 8) Limit sweetened foods & sugary snacks | Shopping list, direct observation, food inventory, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during & at end of the six-week Intervention period | Dose & Fidelity | 3= Yes, completely 2=Most of the time; 1= Sometimes; 0=No/None |
| 9) Limit fried foods on menus | Review menus, interviews with staff food coordinator & key residents participants | Weekly (six-week), before, during &at end of the six-week intervention period | Dose & Fidelity | 3=Yes, completely; 2=Most of the time; 1= Sometimes; 0=No/None |
| 10) Initial meeting with food service staff | Implementer's self-report | Before the six-week intervention | Dose | 1= Yes, 0= No |
| 11) 3 Follow up meetings with food service staff | Implementer's self-report | Before, during & at the end of the six-week intervention | Fidelity | 1= Yes for each meeting; 0= No |

Two types of process evaluation data were collected for the nutrition education class attendance. Attendance at each of the six weekly nutrition classes was recorded for the purpose of documenting class participation. Also treatment program admission records from each study site were acquired to assess treatment facility occupancy, and thus nutrition class participation rate within each site. A nutrition education checklist, which involved a check mark when each planned class activity was completed, was designed specifically to ensure that all the key nutrition education activities were carried out in each site (dose delivered).

The class participation feedback survey was developed to obtain information about the level of exposure to the curriculum elements and participants' receptiveness toward the nutrition class and cooking activity (dose received and satisfaction). The participation feedback was a brief one page self report that was administered to all participants in each study site at the end of each nutrition education class. For example, each participant was asked to select one of the three options to describe each

nutrition class: “fun and interesting,” “Ok, not bad,” or “so boring I almost fell asleep (yawn),” and to indicate how they felt about the recipes used in each cooking activity: “Great, I’ll make it again,” “Ok, not bad,” and “not something I care for.”

The primary investigator, skilled in qualitative methods, conducted direct observations (field notes), reviewed all the food service records including shopping lists, weekly menus and food inventories in each of the six facilities to assess with the completeness of the food service implementation; and conducted the three follow interviews with key staff and participants. The interviews were conducted at three different points: at the beginning of the intervention, at mid point, and at the end of the six-week intervention period (Figure 4.1). The key staff and participant informants were selected because of their food service responsibilities in each treatment facility.

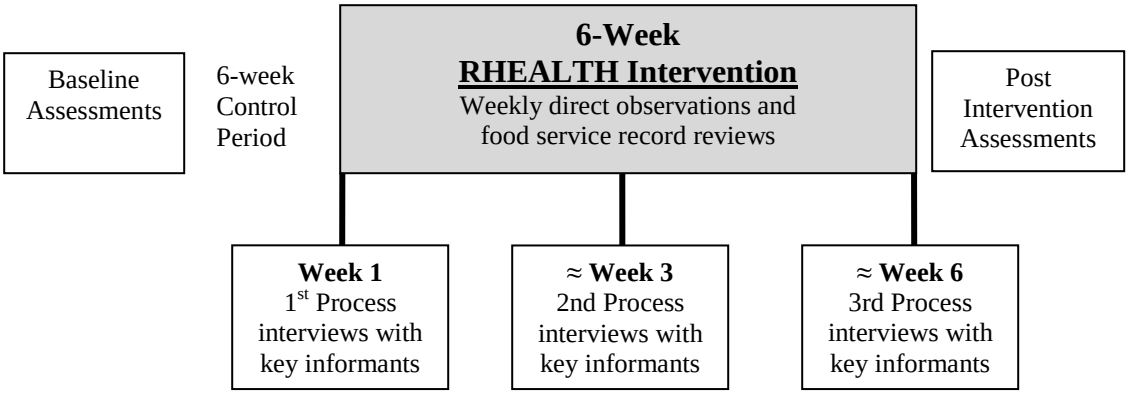


**Figure 4.1. RHEALTH intervention process evaluation timeline**

During semi-structured interviews, staff food service coordinators and key participant informants were asked to share their perspectives on the changes made in the food environment including the shopping lists and menus as well as changes observed in the residents’ eating behaviors. Examples of the open-ended questions regarding the changes in the food environment were, “Tell me in your own words

what kinds of things you have noticed regarding food and eating here since the program started?" "What has changed?" "What changes have you noticed in the menus, shopping lists and/or the residents' eating patterns since the program began?" Interviewees were also asked to talk about activities and events, unrelated to the RHEALTH program, occurring in the treatment facilities that could directly or indirectly affect the intervention. This information provided additional contextual data. As illustrated in Tables 4.1 and 4.2, all instruments, except those used to assess items (10) and (11) in the food service elements, had either a 3- or 4-point response formats, and were considered ordinal level measurement.

## DATA ANALYSIS

Descriptive analyses of study participants' socio-demographic characteristics and addiction histories in all six sites were conducted, and ANOVA and Chi-square analyses were used to compare mean differences among the six sites. Data obtained at the beginning, mid point and at the end of the six-week intervention were used for the process evaluation analysis. The data were logged, summarized and analyzed by key process evaluation components described below.

Nutrition education class participation was calculated by dividing the total number of participants who attended each class by the treatment facility occupancy at the start of the study recruitment process. The mean class participation rate across the six sites was also derived, and the sites were categorized into higher and lower class participation sites based on their scores. Only the participants who had at least two assessments (before and after the intervention) were included in descriptive and the mixed model analyses to assess the intervention implementation on key study outcomes. Dose delivered and the completeness of RHEALTH implementation was calculated by adding the scores for each of the essential elements at each site. Fidelity

for each individual treatment facility was determined by dividing the implementation score in each site by the total possible implementation score from the eleven food service elements; the mean percent across the six sites was also calculated. Treatment program facilities were categorized into higher- and lower-implementation sites based on percentile rank of the implementation scores. High and low implementing sites were compared on the nine essential food service elements (Table 4.2) using the non-parametric Wilcoxon rank scores test. A significance level of $\leq .05$ was accepted for all tests.

A mixed-model analysis of covariance (ANCOVA) was used to investigate the relationship between the two groups (higher- and lower- participation and implementing sites) and the primary study outcomes (changes in dietary intake: total energy, percentage calories from fat and sweets, daily servings of fats, oils and sweets, daily servings of fruits and vegetables; and body composition such as body mass index and waist circumference). The implementation level was the independent variable while the primary study outcomes were the dependent variables. Analyses were adjusted for the related baseline variables and time in treatment program for the dietary outcome variables; and age, education and baseline physical activity were included in the adjusted analysis for body composition outcomes. A significance level of $p= \leq .05$ was accepted for all tests. The quantitative data were analyzed using the Statistical Package for the Social Science (SPSS for Windows Version 16, SPSS, Inc.). Qualitative data analysis (Denzin & Lincoln, 2003) was used to assess information about the contextual factors obtained during the interviews with key staff members and participants.

# RESULTS

## Socio-demographics and addiction history

**Table 4.3. RHEALTH participants' demographic characteristics and addiction histories**

| n=55 *Mean (SD)* | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 |
|---|---|---|---|---|---|---|
| **Age (years)[1]** | 47.7 (7.1) | 41.7 (11) | 45.3 (5.7) | 39.6 (6.0) | 43.4 (7.8) | 50.6 (2.9) |
| **Time in treatment program (months)[2]** | 5.8 (5.0) | 5.7 (4.0) | 3.6 (2.2) | 2.2 (.98) | 2.8 (1.3) | 6.4 (1.8) |
| **Drug treatments** | 5.4 (5.1) | 4.1 (1.7) | 7.8 (3.1) | 7.1 (6.8) | 7.3 (4.8) | 5.5 (5.3) |
| **Sobriety (months)[3]** | 15.1 (14.9) | 7.4 (4.0) | 4.4 (2.1) | 4.5 (5.6) | 5.0 (2.7) | 8.8(6.7) |
| **Addiction years** | 25.7 (7.6) | 21.7 (10.6) | 32.4 (5.3) | 20.1 (10.0) | 24.6 (10.5) | 28.2 (7.4) |
| **Race: n (%)** | | | | | | |
| White | 4 (44) | 4 (40) | 1 (20) | 4 (57) | 6 (40) | 1 (11) |
| Black | 4 (44) | 4 (40) | 3 (60) | 3 (43) | 5 (33) | 6 (67) |
| Hispanic | 1 (12) | 0 (0) | 0 (0) | 0 (0) | 3 (20) | 1 (11) |
| Other | 0 (0) | 2 (20) | 1 (20) | 0 (0) | 1 (7) | 1 (11) |
| **Education: n (%)** | | | | | | |
| < High school | 0 (0) | 2 (20) | 1 (20) | 0 (0) | 3 (20) | 3 (33.3) |
| ≥ High school/GED | 9 (100) | 8 (60) | 4 (80) | 7 (100) | 12 (80) | 6 (66.7) |
| **Marital Status n (%)** | | | | | | |
| Married | 2 (22) | 1 (10) | 0 (0) | 0 (0) | 1 (7) | 0 (0) |
| Single/Divorced/sep | 7 (77) | 9 (90) | 5 (100) | 7 (100) | 15 (93) | 9 (100) |
| **Employment before treatment n(%)[4]** | | | | | | |
| Employed | 4 (44) | 6 (60) | 1 (20) | 1 (14) | 2 (13) | 0 (0) |
| Unemployed | 5 (56) | 4 (40) | 4 (80) | 6 (86) | 13 (87) | 9 (100) |

[1]Overall differences: F= 2.487, p= .044
[2] Overall differences: F= 3.320, p= .012.
[3] Overall differences: F= 2.823, p= .026
[4] Overall differences: chi-square = 12.773, p= .026

There were statistically significant differences in mean age, addiction histories (time in treatment program and sobriety), and employment status among the 55 participants (with complete before and after intervention outcome assessments) across the six study sites. As illustrated in Table 4.3, on average, participants in site number

six were older (M=50.6 ± 2.9 years), in the treatment program longer (M= 6.4± 1.8 months), and were more likely to be unemployed (100%) before their current drug treatment episode than those participants in the other study sites. Also, participants in study site number one had maintained a longer sobriety time than their counterparts in the other study facilities.

**Results for nutrition education class participation**

**Table 4.4. Nutrition class participation in the six study sites based on RHEALTH enrollment and class attendance records**

| | **Site1** | **Site 2** | **Site 3** | **Site 4** | **Site 5** | **Site 6** |
|---|---|---|---|---|---|---|
| ***Community Treatment Program Pre-Intervention Occupancy*** | 18 | 16 | 13 | 12 | 28 | 20 |
| **Class 1: Basic Nutrition (Nutrients & Food Guide Pyramid)** | | | | | | |
| All class participants | 13 | 13 | 5 | 6 | 20 | 7 |
| RHEALTH[1] | 9 | 9 | 5 | 6 | 17 | 7 |
| RHEALTH[2] | 3 | 9 | 5 | 5 | 14 | 5 |
| **Class 2: Portion Control** | | | | | | |
| All class participants | 10 | 9 | 8 | 9 | 18 | 8 |
| RHEALTH[1] | 9 | 8 | 8 | 9 | 12 | 8 |
| RHEALTH[2] | 5 | 8 | 5 | 5 | 10 | 5 |
| **Class 3: Vegetable Intake** | | | | | | |
| All class participants | 10 | 9 | 8 | 9 | 22 | 7 |
| RHEALTH[1] | 8 | 8 | 6 | 8 | 15 | 7 |
| RHEALTH[2] | 2 | 8 | 5 | 5 | 12 | 6 |
| **Class 4: Fruit Intake** | | | | | | |
| All class participants | 13 | 6 | 10 | 9 | 13 | 6 |
| RHEALTH[1] | 11 | 6 | 6 | 9 | 7 | 5 |
| RHEALTH[2] | 2 | 6 | 5 | 5 | 7 | 4 |
| **Class 5: Sugar & Sweetened Beverages** | | | | | | |
| All class participants | 12 | 9 | 10 | 10 | 17 | 22 |
| RHEALTH[1] | 8 | 7 | 7 | 9 | 10 | 7 |
| RHEALTH[2] | 2 | 7 | 5 | 6 | 9 | 6 |
| **Class 6: Fats** | | | | | | |
| All class participants | 13 | 8 | 9 | 12 | 19 | 10 |
| RHEALTH[1] | 12 | 6 | 6 | 12 | 10 | 7 |
| RHEALTH[2] | 2 | 6 | 4 | 7 | 8 | 5 |
| **Mean class participation rate (%)[3]** | **66** | **56** | **64** | **76** | **64** | **50** |

[1] RHEALTH participants with only post assessments
[2]RHEALTH participants with at least two assessments (baseline and post-intervention)
[3] All class participants /Site occupancy

Information on program participation came from three sources, class attendance logs, RHEALTH enrollment and the treatment facility occupancy records. The mean nutrition education class participation rate (six weekly nutrition classes) across the six study sites was 63%. As presented in Table 4.4, participation rate was the highest for site number four (76%) and lowest for site number six (50%). The study sites were then grouped into higher and lower class participation sites. Four sites (1, 3, 4 & 5) were placed in the higher class participation group, and two sites, numbers two and six were categorized as the lower class participation sites based on the lowest percentile; these sites had implementation scores that were at or below the lower quartile.

**Delivery of nutrition education components (Dose & Implementation)**

**Table 4.5. RHEALTH dose delivered in the six study sites based on the nutrition education curriculum scores***

| **Nutrition Education :** | **Site 1** | **Site 2** | **Site 3** | **Site 4** | **Site 5** | **Site 6** | **Total Score n (%)** |
|---|---|---|---|---|---|---|---|
| (1) 6 Weekly nutrition classes | 3 | 3 | 3 | 3 | 3 | 3 | ***18 (100)*** |
| (2) Handouts with key nutrition concepts | 3 | 3 | 3 | 3 | 3 | 3 | ***18 (100)*** |
| (3) Food Guide Pyramid poster | 3 | 2 | 3 | 1 | 3 | 3 | ***15 (83)*** |
| (4) Classroom activities | 3 | 3 | 3 | 3 | 3 | 3 | ***18 (100)*** |
| (5) Cooking activities including all recipes | 3 | 3 | 2 | 2 | 2 | 2 | ***14 (77)*** |
| (6) Tasting | 3 | 3 | 3 | 3 | 3 | 3 | ***18 (100)*** |
| (7) Weekly "take home" challenges | 3 | 2 | 3 | 3 | 3 | 3 | ***17 (94)*** |
| **Total Score** | **21** | **19** | **20** | **18** | ***20*** | **20** | ***118 (94)*** |
| **% Dose** | ***100*** | ***90*** | ***95*** | ***86*** | ***95*** | ***95*** | ***M=94*** |

* 3= all of the time; 2= most of the time; 1= sometimes; 0= no/none.

More than 90% of the nutrition education activities were implemented across the six study sites, except for the Food Guide Pyramid poster and the cooking activity elements where 83% and 77% (not shown) of these activities respectively were implemented across the six study sites. The lowest implementation rate of the seven key nutrition education elements was seen in site number four where 86% of the total nutrition education activities were implemented. Site number one had the highest implementation for all the nutrition education activities of 100%. As shown in Table 4.5, the RHEALTH nutrition education component mean dose for all study sites combined was 94%.

**Participant (perceived) exposure and receptiveness**

At the end of each class, students completed a brief, in-class feedback survey concerning their receptiveness to the nutrition class and cooking activities. Respondents in all study sites reported a high level of receptivity to the nutrition classes (not presented). Rarely did the percentage reporting receptivity to the nutrition class drop below 80%, lower receptive rates were noted for both the portion control and vegetables classes in site number four, and the vegetable class in site number five. Similarly, high level of participant receptiveness to the cooking activities was reported for all the classes across the six sites as shown in Table 4.6. More than 80% of the respondents in all the study sites reported that the recipes used in the cooking activities were “great, I’ll make it again” or “Ok, not bad.”

**Fidelity and completeness of the food service component implementation**

For the food service component, there were nine primary elements directly related to changing the food quality in the treatment facilities, and two additional

elements that pertained to meeting with the staff food service personnel to implement and monitor these changes (total of 11). Table 4.7 lists each of the food service guidelines and the times they were observed and/or reported being correctly implemented.

**Table 4.6. Class participants' feedback on cooking activity and recipes used in the nutrition classes across the six study sites**

| **Class 1: Basic nutrition including Nutrients & Food Guide Pyramid** | **Site 1 % (n)** | **Site 2 % (n)** | **Site 3 % (n)** | **Site 4 % (n)** | **Site 5 % (n)** | **Site 6 % (n)** |
|---|---|---|---|---|---|---|
| Recipes great, I'll make again | 43 (3) | 80 (8) | 100 (5) | 67 (4) | 83 (10) | 100 (3) |
| Recipes OK, not bad | 43 (3) | 20 (2) | 0 (0) | 33 (2) | 17 (2) | 0 (0) |
| Not Something I care for | 14 (1) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| **Class 2: Portion Control** | | | | | | |
| Recipes great, I'll make again | 100 (8) | 100 (8) | 86 (6) | 50 (4) | 83 (10) | 100 (7) |
| Recipes OK, not bad | 0 (0) | 0 (0) | 14 (1) | 38 (3) | 8 (1) | 0 (0) |
| Not Something I care for | 0 (0) | 0 (0) | 0 (0) | 12 (1) | 9 (1) | 0 (0) |
| **Class 3: Vegetable Intake** | | | | | | |
| Recipes great, I'll make again | 67(6) | 86 (6) | 80 (4) | 71 (4) | 58 (7) | 100 (3) |
| Recipes OK, not bad | 22 (2) | 0 (0) | 20 (1) | 14 (1) | 25 (3) | 0 (0) |
| Not Something I care for | 11 (1) | 14 (1) | 0 (0) | 15(1) | 17 (2) | 0 (0) |
| **Class 4: Fruit Intake** | | | | | | |
| Recipes great, I'll make again | 100 (8) | 100 (7) | 86 (6) | 100 (7) | 100 (6) | 100 (6) |
| Recipes OK, not bad | 0 (0) | 0 (0) | 14 (1) | 0 (0) | 0 (0) | 0 (0) |
| Not Something I care for | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| **Class 5: Sugar & Sweetened Beverages** | | | | | | |
| Recipes great, I'll make again | 100 (10) | 100 (6) | 88 (7) | 70 (7) | 100 (8) | 69 (11) |
| Recipes OK, not bad | 0 (0) | 0 (0) | 12 (1) | 20 (2) | 0 (0) | 25 (4) |
| Not Something I care for | 0 (0) | 0 (0) | 0 (0) | 10 (1) | 0 (0) | 6 (1) |
| **Class 6: Fats** | | | | | | |
| Recipes great, I'll make again | 88 (7) | 100 (6) | 88 (7) | 73 (8) | 78 (12) | 100 (7) |
| Recipes OK, not bad | 12 (1) | 0 (0) | 12 (1) | 27 (3) | 22 (3) | 0 (0) |
| Not Something I care for | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

As shown in Table 4.7, the most frequently adopted food service elements for all the study sites combined, based on the interviews, observations, and the records reviewed during the three process assessment points, was key element (5), "offer choices of fruits and vegetables daily". The least frequently adopted food service element pertained to offering a vegetarian/meatless dish option on the weekly dinner menu at least once; none of the six study sites adopted this essential element.

On average, the six study sites implemented 10 of the 11 required food service elements with site number one showing the highest implementation score (73) and site number six ranked the lowest (31) across all the food service elements. The fidelity rate of the combined food service elements varied across the study sites, ranging from 36% to 84%. As illustrated in Table 4.7, two of the six study sites (site numbers six and two respectively) had the lowest fidelity rates and were put into the lower-implementation group, resulting in the four remaining sites (sites 1, 3, 4 & 5) being classified as higher implementers.

The four sites that scored high in fidelity and completeness of the food service component (1, 3, 4 & 5) had similarly high food service implementation scores, and thereby were grouped together while the two sites (site number 2 & 6) had the lowest scores, and thus were placed in the lower implementation group because their scores were at or below the lowest percentile.

A comparison of fidelity and completeness on the food service components using the Wilcoxon rank sums score test (Table 4.8) revealed that treatment facilities in the high implementing group reported significantly higher implementation for four out of the nine essential food service elements listed in Table 4.8: providing water and 100% juices daily in the treatment facility, offering fruit and/or a vegetable salad at each dinner meal, offering choices of fruits and vegetables daily, and limiting fried foods on the weekly menus.

**Table 4.7. RHEALTH intervention implementation and fidelity based on the essential food service components across the six treatment facilities**

| *Food Service Component (FS):* | *Site 1* | *Site 2* | *Site 3* | *Site 4* | *Site 5* | *Site 6* | *Total* |
|---|---|---|---|---|---|---|---|
| **1. Provided low-fat milks (1&2%,skim)** | | | | | | | |
| Week 1 | 3 | 3 | 3 | 3 | 1 | 1 | **14** |
| Mid program | 3 | 3 | 3 | 3 | 3 | 1 | **16** |
| End of program | 3 | 3 | 3 | 3 | 3 | 3 | **18** |
| | | | | | | | ***48*** |
| **2. No Kool-Aid or sugary drinks** | | | | | | | |
| Begin of program | 3 | 3 | 3 | 2 | 2 | 1 | **14** |
| Mid program | 2 | 2 | 3 | 3 | 2 | 3 | **15** |
| End of program | 2 | 1 | 3 | 3 | 2 | 1 | **12** |
| | | | | | | | ***41*** |
| **3. Provided water and 100% Juices** | | | | | | | |
| Begin of program | 1 | 2 | 1 | 1 | 1 | 2 | **8** |
| Mid program | 3 | 2 | 3 | 3 | 3 | 1 | **15** |
| End of program | 3 | 1 | 3 | 3 | 2 | 1 | **13** |
| | | | | | | | ***36*** |
| **4. Provided fruit/vegetable salad @ dinner** | | | | | | | |
| Begin of program | 2 | 1 | 1 | 1 | 1 | 1 | **7** |
| Mid program | 3 | 1 | 3 | 3 | 3 | 1 | **14** |
| End of program | 3 | 3 | 3 | 3 | 3 | 2 | **17** |
| | | | | | | | ***38*** |
| **5. Offered choices of F&V** | | | | | | | |
| Begin of program | 3 | 1 | 3 | 3 | 3 | 1 | **14** |
| Mid program | 3 | 2 | 3 | 3 | 3 | 2 | **16** |
| End of program | 3 | 3 | 3 | 3 | 3 | 2 | **17** |
| | | | | | | | ***50*** |
| **6. Offered vegetarian/meatless dish at least once per week** | | | | | | | |
| Begin of program | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Mid program | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| End of program | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| | | | | | | | ***0*** |
| **7. Offered lower-fat snacks: e.g. pretzels, popcorn, fruits** | | | | | | | |
| Begin of program | 3 | 1 | 1 | 1 | 2 | 0 | **8** |
| Mid program | 3 | 1 | 3 | 3 | 3 | 1 | **14** |
| End of program | 3 | 3 | 3 | 3 | 3 | 1 | **16** |
| | | | | | | | ***38*** |
| **8. Limited sweetened foods & sugary foods** | | | | | | | |
| Begin of program | 3 | 0 | 1 | 2 | 3 | 0 | **9** |
| Mid program | 3 | 2 | 2 | 3 | 3 | 0 | **13** |
| End of program | 3 | 2 | 2 | 3 | 3 | 1 | **14** |
| | | | | | | | ***36*** |

**Table 4.7. (Continued)**

| **9. limited Fried Foods on menus** | ***Site 1*** | ***Site 2*** | ***Site 3*** | ***Site 4*** | ***Site 5*** | ***Site 6*** | ***Total*** |
|---|---|---|---|---|---|---|---|
| Begin of program | 3 | 1 | 2 | 2 | 2 | 0 | **10** |
| Mid program | 3 | 3 | 3 | 3 | 3 | 0 | **15** |
| End of program | 3 | 3 | 3 | 3 | 3 | 1 | **16** |
| | | | | | | | ***41*** |
| **10. Initial meeting with staff food coordinator** | 3 | 3 | 3 | 3 | 3 | 3 | ***18*** |
| **11. Three follow up meetings with staff food personnel** | 3 | 3 | 3 | 3 | 3 | 1 | ***16*** |
| ***Sum (out of 87)*** | ***73*** | ***53*** | ***67*** | ***69*** | ***66*** | ***31*** | |
| ***% Fidelity (% implemented/total)*** | ***84*** | ***61*** | ***77*** | ***79*** | ***76*** | ***36*** | |
| ***Overall Mean Score (SD)*** | ***2.52 (.99)*** | ***1.83 (1.1)*** | ***2.31 (1.1)*** | ***2.38 (1.1)*** | ***2.28 (1.0)*** | ***1.07 (.92)*** | |

* 3= all of the time; 2= most of the time; 1= sometimes; 0= no/none.

**Table 4.8. Comparison of sites scoring high and low on class participation and implementation of the intervention on individual food service components**

| **Food service elements** | **Rank sum score** | | **z** | ***p*** |
|---|---|---|---|---|
| | ***High Implementation (n=4)*** | ***Low Implementation (n=2)*** | | |
| Provided lower-fat milks (1 & 2%, skim) | 15.5 | 5.5 | -0.822 | .411 |
| No Kool-Aid or sugary drinks | 17.5 | 3.5 | -1.644 | 0.1 |
| Provided water and 100% Juices | 18.0 | 3.0 | -1.967 | **.049** |
| Offered Fruit/Vegetable salad @ dinner | 18.0 | 3.0 | -1.967 | **.049** |
| Offered choices of fruits & vegetables | 18.0 | 3.0 | -2.191 | **.028** |
| Offered lower-fat snacks: e.g. pretzels, popcorn, fruits | 18.0 | 3.0 | -1.879 | .06 |
| Limited sweetened foods & sugary snacks | 18.0 | 3.0 | -1.879 | .06 |
| Limited fried foods on menus | 18.0 | 3.0 | -1.967 | **.049** |
| 3 Follow up meetings with staff food personnel | 16.0 | 5.0 | -1.414 | .157 |

Bolded items showed statistically significant differences between higher and lower implementing sites p=<0.05 using Wilcoxin rank sums scores.

**Level of class participation and intervention implementation and intervention outcomes**

The sites grouped in the high (1, 3, 4&5) and low (2&6) nutrition class participation and intervention implementation sites were the same. Since all sites scored high in implementation of the nutrition education classes, these scores were not included in subsequent analysis. As noted previously in chapter two, forty four percent of the men (n=55) who were assessed at baseline were also evaluated after the six-week intervention period. Men who were lost to follow-up were younger and reported shorter addiction histories. All of the men lost to follow-up were lost because they dropped out of their treatment programs due to a substance abuse relapse or treatment completion/graduation.

**Table 4.9. Comparisons of changes in dietary intakes and body mass index in participants in high and low class participation and intervention implementation sites**

| ***Class participation& food service implementation group*[§]** **Δ Outcome variables:** | **Unadjusted means (SD)** | | **Adjusted means (SE)** | | | |
|---|---|---|---|---|---|---|
| | ***Higher(n=36)*** | ***Lower(n=19)*** | ***Higher(n=36)*** | ***Lower(n=19)*** | ***F*** | ***P*** |
| Total Energy (kcal) | -642 (1009) | -496 (740) | -654(211) | -472(149) | 3.321 | **.03** |
| % kcal from Fat | -1.30(4.0) | -2.41(5.3) | -1.03(.65) | -2.92(.91) | 8.650 | **<.001** |
| % kcal from sweets | -3.53(1.1) | -3.07(1.4) | -3.54(1.5) | -3.05(2.1) | 15.20 | **<.001** |
| Daily servings fats, oils, sweets | -1.38(1.9) | -0.34(2.6) | -1.25(.33) | -0.58(.46) | 6.504 | **<.005** |
| Daily servings of vegetables | .853(2.0) | 1.23(2.5) | .728(.37) | 1.46(.52) | 1.054 | .37 |
| Daily servings of fruits | .631(1.0) | .884(1.3) | .543(.19) | 1.05(.26) | 2.700 | .06 |
| Body Mass Index | -0.66(.17) | -0.80(3.1) | -2.50(.46) | -2.0(.50) | 7.410 | **<.001** |
| Waist circumference | -.913(5.2) | -2.79(4.4) | -1.65(1.5) | 2.77(1.6) | 1.196 | .32 |

Controlling for baseline related variables, time in treatment program, for dietary variables, and included age, education, and baseline physical activity for body mass index. A significance level of $\leq .05$ was accepted.

[§] Sites numbers 1, 3, 4 & 5 were grouped in the higher class participation and implementation group; and sites numbers 2 and 6 were the lower class participation and lower implementation group.

As we hypothesized, participants in the high participation and high implementation sites reported greater reductions in mean total energy, percent calories from sweets, daily serving of fats, oils and sweets (M= -642 ± 1009, M= -3.53 ± 1.1 and M= -1.38 ± 1.9 respectively), and body mass index (M= -2.50 ± .46) than their counterparts in the lower implementing intervention sites (M= -496 ± 740, M= -3.07 ± 1.4, M= -0.34 ± 2.6, and M=-2.0 ± .52 respectively); (refer to Table 4.9). The overall effect of the implementation levels on changes in these dietary outcomes remained significant even after adjusting for related baseline variables and the length of time spent in the treatment program. Unexpectedly, the pair-wise comparisons showed that participants in the lower implementation sites reported significantly greater reductions in percent calories from fat (M= -2.92 ± .91) at the end of the intervention than participants in the higher-implementation sites (M= -1.03 ± .65).

**Contextual factors**

Contextual factors documented by the primary investigator from the interviews with key staff and participant informants, and from direct observations indicated that variation in implementation and participation most commonly occurred through events or activities outside of the intervention. These factors included staff involvement, staff turnover, and resident turnover.

**High class participation and intervention implementation sites**

There was evidence of high staff involvement in high participation and high implementation sites. For example, the staff in site number one, one of the four sites in the higher class participation and implementation group, was enthusiastic about the intervention including the targeted changes in the food environment. Staff members also strongly encouraged the study participates and new residents to attend the weekly

nutrition classes, which reflected in the weekly class attendance records, and the food service implementation. Site number one had the highest class participation and fidelity rates among the six study sites. One key informant had this to say when asked about the staff members' attitudes and involvement in the intervention, "Staff is buying into it [intervention], no fry foods, no beef, just chicken. They are also spending more time on the menus and are sampling the foods we cooked during class [the cooking activities]." Another participant said, "The supervisor has been a big promoter of this too [the intervention];" and the key staff informant said this when asked about the intervention program, "The project is a good idea because it provides insight into proper nutrition...good timing, good hands on experience for the guys!"

High staff involvement was also observed in site number four, another high intervention implementing site. Initially some of the residents in this study site were unreceptive toward the food changes that were implemented, particularly toward the additional changes made by the treatment program supervisor. The supervisor went above and beyond the food changes required by the RHEALTH food service protocol; he purchased fewer eggs weekly, removed bacon from the menus, and offered limited hot foods during the weekly breakfast meals. The primary investigator held an emergency community meeting with the disgruntled residents to address their concerns, which subsequently increased receptivity toward the intervention in this site; and resulting in the highest class participation level among the six sites.

In site number three, the supervisor and the key staff food service coordinator left the treatment facilities towards the end of the intervention period, but this occurred after the time when all of the food service elements were expected to be implemented.

**Low class participation and intervention implementation sites**

Site number six, ranked the lowest in class participation and the food service implementation, had the least staff involvement. The staff food service coordinator in this site wore 'multiple hats' in the treatment program. He was responsible for coordinating all the food service activities as well as housing keeping and maintenance activities in the facility. During the intervention, he was also sent to a newly associated treatment facilities located in a different city to assist with that program management procedures. This key staff food service coordinator met with the primary investigator at the beginning of the intervention implementation, one of the three meetings required to assess and monitor the food service implementation. One key participant informant said this about the his responsibilities in the treatment facility, "The [staff] food coordinator has a lot of responsibilities, other than preparing food, plumbing, handyman, painting and preparing the menus so his dedication to either job might be lacking."

Low staff involvement was echoed by residents. When asked about the food service implementation in site number six, another key informant interviewed midway into the intervention implementation said, "They haven't made much change since you've been here; they still haven't been serving a lot of vegetables, still a lot of fried foods, no diabetic menus. I brought it up to staff that they have nutrition class but still haven't changed the nutrition." One hired cook who was interviewed in place of the key staff food coordinator said the following about the food environment during the implementation period: "The food environment needs a lot of work! I might see a little change but not a big change, perhaps because we are still trying to come up with a system." Another key participant said this, "Some changes [made] about 25% but a lot of chips, fried potatoes in the morning…over kill with the French Fries, home fries and potato chips. Kool-Aid four times a week…we haven't had fruit juices in a while.

So you are correcting the addiction but you are killing them [the residents] with the grease…we won't die from drugs but clogged arteries."

Site number two also reported high staff turnover during the intervention period. The program supervisor in site two, one of the sites in both the lower class participation and lower implementation groups, left the treatment program midway into the intervention period.

**Resident Turnover in All Sites**

All six intervention sites were operating below the full bed capacity at the beginning of the intervention, and they were constantly admitting new residents because of staff-initiated discharges resulting from substance abuse relapses. These events changed the dynamic of the treatment environment constantly as well as the food culture as new eating behaviors relating to residents' stages of recovery were exhibited. For example, during the intervention period, site number four (high implementation) experienced a high turnover of residents, which impacted the food culture and environment. The staff food service coordinator described the changes during the interviews with the primary investigator in the following way: "The new residents are out of control…a whole new culture because of the new guys came into the house. A lot of negative eating behaviors, breakfast is out of control, [residents] went from 41/2 dozens to 91/2 dozens [eggs] in a week; bacon is 40 pounds in a week…it's hard to believe that two or three people can change the culture of the house."

## DISCUSSION

RHEALTH, a multi-component pilot behavioral and environmental nutrition intervention, was designed to promote healthy eating among men in six residential

drug treatment facilities by targeting personal, behavioral and environmental factors through nutrition education, cooking activities and changes in the food environment. A process evaluation was designed a priori to assess the development and implementation of the intervention. The RHEALTH process evaluation components, previously recommended by others (Glasgow et al., 1999; Stickler & Linnan, 2002; Saunders et al., 2005), included the following components: nutrition class participation; dose delivered and received including participants' feedback; program fidelity and completeness of implementation; and relevant contextual factors. The process evaluation data were useful for illuminating areas in which the intervention worked as planned while shedding light on areas warrant improvement.

**Nutrition education class participation**

Process evaluation data revealed that program participation varied across the six intervention sites. Sites with low participation had, on average, residents with longer sobriety or 'clean' time and in the treatment programs longer than residents in the high intervention sites. One possible explanation may be that longer sobriety and time in the treatment facility afforded residents with more autonomy and greater opportunities to participate in daily activities outside of the treatment facility, and thereby less involvement in non-mandatory activities within the residential facility. This assumption is consistent with treatment models and previous findings suggesting developmental stages in recovery (Gorski & Miller 1986; Gorski, 1989; Cowan, 2006; Cowan & Devine, 2008). As longer abstinence is achieved, people in recovery are usually encouraged to establish more balanced lifestyles, including the pursuits of meaningful training and employment, good relationships with family, and social ties outside of the treatment facility context (Gorski, 1989).

Lower level of staff involvement and turnover may have also played a role in class participation and fidelity rates in some sites. When the supervisor in one site left the treatment program in the middle of the intervention period, this event may have interrupted motivation resulting in a change in attitude toward the intervention. Similarly, in another low participation and implementation site, the lack of attention given to the intervention was in part due to the demanding job responsibilities of the staff food coordinator. Contextual factors like these can pose a tremendous threat to an intervention implementation process, and thereby should be carefully documented and considered when interpreting process evaluation results (Steckler & Linnan, 2002; Johnson et al., 2010). Also, special attention should be given to intervention design to accommodate and address contextual issues outside of the control of the intervention, in order to minimize the potential impact on intervention delivery and implementation.

**Nutrition education dose and satisfaction**

The process data suggest that dose and implementation of the nutrition education curriculum was high across all the intervention sites. During the intervention period, the participants received an average of 94% of the curriculum. The successful implementation of the RHEALTH curriculum appeared to be based, in part, on having the primary investigator conducting all the curriculum activities. High participant satisfaction ratings indicated that the nutrition education classes and cooking activities were enthusiastically received by most participants. In the one site where some respondents reported less satisfaction toward the first three nutrition classes and cooking activities, and initially resisted the intervention, this may be explained in part by the supervisor's effort to launch his own independent food service initiatives; he implemented food policies beyond what was required by the RHEALTH intervention protocol. This unpredictable event, the supervisor using the intervention

platform to achieve his own food policy objectives, initially was a hindrance to the program implementation, and may have influenced the study outcomes. Fortunately, a community meeting held to address the residents' discontentment and concerns regarding the food environment, was well received and reflected in subsequent positive class feedback data. This supports the need for monitoring of interventions and to allow project leaders to deal with problems as soon as they arise.

**Fidelity and completeness of the food service component implementation**

Process evaluation data suggest an overall moderate fidelity percentage (69%) and completeness of implementation score (60 points out of a possible 87 points) across the six intervention sites Meta-analysis of implementation data from a variety of health promotion programs suggests that few studies have attained implementation levels above 80%; and that implementation levels around 60% may still produce positive outcome results ((Durlak & DuPre, 2008).

Four key differences were found in the implementation of food service elements. Variability in intervention fidelity and completeness of implementation has been consistently reported in a variety of study settings (Harachi et al., 1999; Dusenbury et al., 2003; Saunders et al., 2006; Durlak & DuPre, 2008). It is not practical to expect perfect or near-perfect implementation of interventions into real world settings, and variations can be achieved across providers within the same study (Durlak & DuPre, 2008). For example, the food service elements involving substitutions such as providing lower-fat milks in place of higher fat varieties, and 100% juices instead of sugary drinks were implemented fairly well across the six sites. Similarly, the food service elements that included adding food items such as daily fruits and vegetables were also adopted well.

Conversely, offering a vegetarian or meatless dish at least once during the week instead of a meat dish, was not well received at any site These findings are similar to a previous study that suggested it may be easier to add healthy food options such as fruits and vegetables than to eliminate some higher fat foods such as meats (Hagler et al., 2007). Another potential explanation for the lack of implementation of the vegetarian dish option may be that meat and other energy-dense foods are viewed as masculine foods in many cultures, and thereby are considered to be more suitable for men than vegetable or vegetarian meals (Fagerli & Wandel, 1999; Roos et al., 2001).

Still another plausible explanation may be found in one study by Povey and colleagues, (2001) that examined attitudes toward alternative diets; they found that meat eaters were the only respondents to report any positive belief about this diet, and they held the most negative beliefs towards vegetarian diets of the four dietary groups included in the study (Povey et al., 2001). The six study facilities provided rehabilitative services to men in recovery. Perhaps the vegetarian or meatless option was viewed as hard to prepare or was just unacceptable by both the staff food coordinators, who were mostly men, and the male residents who were responsible for preparing the dinner meal; consequently this food service element was not implemented. A future modification to the food service component would be to offer leaner meats on the weekly menus instead of a meatless dish option.

Staff turnover and involvement appeared to be especially important in the implementation of the food service component. Because staff turnover is a fact of life in real world settings, better monitoring and ongoing communication with all key staff members in the study sites will be necessary to address unexpected events as they arise.

**Intervention implementation, participation levels and key intervention outcomes**

As previously documented (Baranowski & Stables, 2000; Steckler & Linnan, 2002; Saunders et al., 2006), process evaluation data can be an effective tool to explain the effects of intervention implementation on study outcomes. Specifically, higher levels of behavioral change have been related to greater exposure to the intervention (Davis et al., 2000; Saunders et al., 2006; Durlak & DuPre, 2008), consistent with our process evaluation findings. Participants in the higher class participation and food service implementation sites reported better dietary outcomes: greater reductions in total energy, percent calories from sweets, and daily serving of fats, oils, and sweets compared to those in the lower-implementing sites.

It is not very clear why participants in the lower-participation and implementation sites showed better program outcomes in terms of calories from fat, although this difference may be related to more limited exposure to the intervention. More time spent outside of the treatment facility may be an alternative explanation for these program outcomes. Participants in intervention site six, one of the lower-participation and implementation sites, had lived in the treatment facility longer and had longer sobriety time than the participants in other five intervention sites. As discussed earlier, later recovery stages (Gorski, 1989; Cowan, 2006) may afford residents with greater autonomy and more flexibility to participate in activities outside of the treatment facility, and thereby less involvement in non-mandated activity such as the intervention.

If RHEALTH participants spend more time away from the treatment facility, then full participation is highly implausible given the demands on residents' time. Similarly, if the residents spend more time away from the food environment, it is also reasonable to assume that the food environment, regardless of the implementation level, would have less impact on the participants' dietary intake, particularly of

breakfast, lunch and dinner, more structured meals, which may account for a greater portion of calories particularly the percent calories from fat consumed. It is also plausible to think that residents who are more involved in structured activities, for example work, vocational training and walking as a mean of transportation, away from the treatment facilities may snack less throughout the day, and thus consume less percent calories from fat than those who spend more time sitting and snacking in the treatment facilities. Further research is necessary to understand how recovery stages (longer addiction histories) 'outside program activities' and intervention implementation level may affect dietary outcomes and body composition.

**Limitations**

The primary investigator conducted all the intervention and evaluation activities including the collection of process evaluation data. The lack of separation of intervention and evaluation personnel may have introduced some bias. However, the primary investigator's exposure to the evaluation activities may have increased awareness of the need for homogeny of intervention protocols, and thereby led to increased fidelity. While there was consistency in the delivery of the nutrition education component, variations in the food service implementation suggests that a standardized protocol may be impractical in nonequivalent treatment communities. The lack of monetary incentives to alleviate some of the burden with the purchase of healthier food options may have also played a role in the low implementation rate in some intervention sites, particularly those with budgetary concerns. Training sessions designed to educate treatment staff about nutrition including ways to incorporate healthy food options within budgets could have ameliorated some of the burden and frustration related to healthy food procurement, and thereby led to greater 'buy in' across all intervention sites. Another limitation to consider is the use of a single

instructor to carry out the nutrition education component. It is not clear if the process evaluation results would be similar for a larger scale study. Therefore the results of this pilot intervention can only be generalized to men in similar recovery contexts and exposed to similar intervention protocols, the use of a single instructor to administer the nutrition class component. Further research will be needed to assess the effectiveness of the RHEALTH intervention in a scaled up version with multiple instructors.

Each of the weekly nutrition classes was offered only one time during each week, which potentially may have influenced participation in the intervention. Offering more convenient class schedules as well as repeating weekly classes in order to maximize class participation, and thus program exposure should be considered. Also, the nutrition class did not tailor to specific recovery stages or specific addiction histories, which may have influenced the study outcomes. Previous reports (Cowan, 2006; Cowan & Devine, 2008) suggest that recovery stages may play a crucial role in dietary intake and body composition, and thereby interventions designed to improve dietary patterns of men in recovery from substance addiction must consider these factors in order to appropriately address specific needs of study participants with varied addiction histories.

There were significant differences in dietary outcomes in men in higher- and lower-participation and implementing sites, however, no process evaluation data were collected on eating behavior outside of these treatment facilities.

**Strengths and Lesson learned**

Overall, there is evidence that the delivery of the RHEALTH pilot intervention was successful in spite of the real-world challenges of residential substance abuse treatment facilities. This is demonstrated by the ability of the primary investigator to

deliver all intervention elements in every site through collaboration with key staff personnel in each study sites. Furthermore, the intervention was associated with improvements in the dietary intake and body mass index of men in the six study sites. The process evaluation generated a large amount of both quantitative and qualitative data, which allowed for a comprehensive assessment of RHEALTH intervention implementation and how it was perceived by participants and key staff personnel. Strength of this study was also the use of multiple data sources, which enabled us to assess the association of process evaluation components with key study outcomes. Specifically, we were able to examine how different levels of class participation and intervention implementation affect the change in dietary intake and body composition. The use of data triangulation in the analysis obtained from both staff and residents' points of view added rigor and increased validity of the RHEALTH process evaluation.

The key essential elements developed before the intervention provided an effective structure for collecting and summarizing process evaluation data from multiple data sources. These essential elements also enabled researchers to assess the fidelity and completeness of intervention delivery more efficiently. Observation and structured interviews provided informative data on contextual factors, including activities that occurred in the intervention sites that were unrelated to the RHEALTH intervention, which facilitated more appropriate interpretation of the process evaluation results.

**Implications**

This report illustrates the importance of process evaluation to monitor and assess program implementation and fidelity in real world settings. Process evaluation data can inform researchers and programming staff about how specific intervention

activities were implemented and how they were received, allowing future adjustments tailored to specific programming needs. Variations in the food service implementation highlight the need for close collaboration with staff in the treatment settings to tailor the intervention to the target setting. Our process evaluation results also show the importance of an intervention that combines nutrition education and change in the food environment.

Close collaboration with staff to obtain useful input into the intervention operations is essential to increase sense of ownership and support. The need to obtain firm commitment to administer the agreed-upon intervention protocols as well as ongoing supervision and consultation is warranted for successful program implementation in residential drug treatment facilities. The RHEALTH process evaluation illuminates the need for additional interventions to improve dietary intake and body composition of men in recovery tailored to specific addiction history. The need to have an intervention design that adapts to the multiple site structures and the daily reality of staff and resident turnover is also warranted. The evaluation of the pilot RHEALTH intervention showed positive results in spite of these challenges.

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# CHAPTER 5:

# CONCLUSIONS

The outcome and process evaluation of the RHEALTH program, a theory-based pilot educational and environmental nutrition intervention supports the potential of drug treatment facilities as feasible venues for improving dietary intake and preventing excess weight gain in recovery. Participation in the intervention was positively and significantly associated with increasing healthy food choices and increased availability of healthy foods in the treatment facilities. Our findings indicate greater increase in daily fruit and vegetable intake, greater reduction in total calories and calories from sweets at the end of the intervention compared to the pre-intervention period. The intervention was also associated with significant reduction in waist circumference, and improved self-efficacy for healthy eating and readiness for dietary change. Furthermore, the process evaluation results reveal that study sites with higher intervention implementation levels and nutrition class participation were associated with more positive study outcomes, which provides further evidence of the effectiveness of the RHEALTH intervention.

The intervention grounded in a social ecological perspective (Green et al., 2005) and the social cognitive framework (Bandura, 1977) was appropriate for this population; these frameworks helped us to navigate with better understanding how behavioral, interpersonal and environmental factors affect eating behaviors in residential treatment contexts. The application of the theories in a real-world context also helped us to measure more carefully and practically related health behavior constructs in order to derive evidence-informed judgments about the impact of the intervention. Effective health promotion programs depend on employment of the most

appropriate theory and practice strategies for a given context (Glanz et al., 2008). Our study provide some evidence for the appropriate application and testing of health behavior theories particularly self-efficacy, a construct of social cognitive theory, readiness to change (behavior) diet and self-regulation, which advance our understanding of these theories in a population of men recovering from substance addiction, and thereby moving research forward. On the other hand, social support theory was not as useful among our study participants, which may be a reflection of weak social ties and interpersonal transactions within the treatment facilities (Heaney & Israel, 2008). Additional studies are needed to elucidate the effect of social support within and outside of the treatment facilities on dietary intake and body composition of men in recovering from substance addiction.

Our investigation of demographic characteristics, addiction history, and food related psychosocial factors in a residential treatment context gained new insights into constraints and opportunities concerning food choice behaviors of men in recovery from substance addiction, and will add depth to the literature on variations in patterns of food choice and weight gain characterized by the this population. While there was no significant relationships found for BMI change during the intervention period, improvements in waist circumference was associated with the intervention period as well as longer addiction histories. It is not apparent why smaller reductions were found for addiction histories such as longer treatment and sobriety time when previous reports suggest that longer stay in treatment is associated with better treatment outcomes (SAMHSA, 2009; Cacciola et al., 2005; Hser et al., 1999, 1999b; Grella et al., 1999). Additional nutrition studies tailored to recovery populations are needed to tease out the relationship between addiction histories and body composition among men recovering from substance addiction particularly because our baseline findings and previous reports suggest high overweight and obesity trends in this population

(Jackson & Grilo, 2002; Hodgkins et al., 2003; Cowan & Devine, 2008; Emerson et al., 2009).

The effectiveness of research in health education and behavior is dependent upon having an understanding of health behaviors, and thereby transforming knowledge about those behaviors into effective strategies for improving health (Glanz et al., 2008). In spite of limited resources, the RHEALTH program has successfully demonstrated the transfer of knowledge into appropriate action-oriented strategies for the enhancement of nutritional health in a drug treatment context.

While this two-component intervention was associated with improved diet and body composition outcomes, we were not able to determine whether a one-component strategy, for example offering nutrition education only or the food environment component alone, would have been effective in achieving positive study outcomes. One way to explore this question would be to conduct a large-scale trial with the drug treatment facilities randomized into different treatment groups: a nutrition education group; another group consisted only of the food service component; a multi-component group; and a control group. Because our small non-randomized pilot study revealed modest and significant effects, we would expect that a larger randomized study would demonstrate similar if not stronger effects in the improvement of dietary intake and weight gain in this population. However, variations in residential treatment modalities may pose a challenge for randomization. The posttest differences observed may be explained by unmeasured differences in the treatment programs or in the characteristics of the men in residence rather than the intervention comparison groups (Trochim, 1999). Though we found no significant age-related differences in this current study, it has been suggested that older adults in treatment tend to have more years of regular drug use (Grella et al., 1999), and are more open to accept help and to change during substance-abuse treatments (Hser et al., 1999). Further investigations

addressing these socio-demographic and addiction characteristics are warranted to elucidate the role of each intervention component on dietary intake, food-related psychosocial factors, and body composition of men in recovery from substance addiction.

Several other issues should be considered when interpreting the findings of the RHEALTH study. The primary investigator conducted all the research activities included the nutrition education and evaluation activities which may have introduced some potential bias. We cannot ascertain if the use of multiple instructors to carry out various research activities such as the nutrition education and the process evaluations in these treatment facilities would have demonstrated similar results. The use of treatment staff and other service providers to carry out future intervention protocols and evaluations may be beneficial not only to reduce potential biases but also to encourage program ownership and long-term sustainability in study sites. It may also be more cost effective to incorporate intervention components into existing programs at the treatment facilities. For instance, facilitation of the weekly nutrition classes by existing staff (cost approximately $170 per class excluding transportation in time and materials) may be cheaper than implementation by an outside investigator (approximately $200 per class including transportation costs) and may encourage sustainability.

The relatively short intervention period may have curtailed the opportunity for greater improvements in the study outcomes particularly in body mass index, which may require longer follow-up time to assess meaningful and long-term changes (Jeffery et al., 2004; Malik et al., 2006). Although our six-week pilot intervention has shown modest and positive association with improvements in food choice behaviors, waist circumference, self-efficacy for healthy eating and readiness for dietary change, we anticipate better study outcomes with a longer intervention period.

Variations in the food service implementation across the study sites illuminate the need for staff training and firm commitment to administer the intervention procedures prior to the start of the study as well as ongoing supervision throughout the study. Additionally, the disparities in the food service implementation may suggest the impracticality of a standardized intervention protocol in non-equivalent treatment modalities. For example, staff and resident turnover were potential barriers to the intervention implementation in some study sites, however to address these environmental challenges, the involvement of all the staff members in each facility was strongly encouraged, and new residents were also invited to participate in the study upon arrival in the treatment facilities. Future study would benefit from tailoring intervention programs to the specific needs and milieu of residential treatment facilities.

To assess dietary intake, study participants were asked to provide retrospective dietary information, which may have introduced potential biases due to memory recall and reporting issues. However, the use of the Block food frequency questionnaire (BLOCK, 2005), a comprehensive and well validated dietary assessment tool (Block & Hartman, 1989) provides a good picture of dietary patterns over time, and thereby may have potentially reduced some of these biases.

The non-random nature of the study design may have also introduced some selection issues related to the characteristics of the study participants as well as the treatment facilities because of the admission criteria or other policies, and thus excluded the opportunity for different study outcomes to be manifested among residents who were not included in the study. The high enrollment rates across the study sites may have addressed this concern. However, inferences about this study should be limited to men with similar characteristics such as age and addiction history, and residing in similar residential drug treatment contexts.

Another limitation was participant attrition across the six study sites. The attrition rate was related to substance abuse relapse and program graduation, activities that were outside of the control of the study. Though the participants who dropped out of the treatment facilities and by default from our study did not differ significantly in key outcomes from those who completed the intervention, further research assessing long-term sustainability and attrition issues in recovery populations is warranted.

Our intention was to increase healthy food choice behaviors and cooking skills among men in recovery as well as to promote healthy food environments in the six residential treatment programs through nutrition education and healthy food-related policies. This current study lend support to previous work in other populations that suggest that dietary interventions tailored to improve internal dietary skills and behaviors delivered to individuals in various contexts can be effective in improving dietary behaviors (Hagler et al, 2007). To our knowledge, this is the first dietary intervention that explicitly assessed dietary behavioral change, body composition, and diet-related psychosocial factors of adult men living in residential drug treatment communities. The use of multiple assessments including measured height, weight and waist circumference conducted during face-to-face interviews helped to reduce inaccuracy in the data collection process.

A structured process evaluation was an integral part of the study, and allowed for a comprehensive appraisal of the intervention implementation across the six study sites. The inclusion of multiple evaluative tools to assess the association between key study outcomes and key process evaluation components also add strength to this pilot study. One other strength was the use of theories and information from prior formative research in this population as the foundation for the study design and development.

The results of this study have several implications for research and treatment practices. People in recovery from substance addition are predisposed to poor dietary

behaviors and excess weight gain (Hauser et al., 1989; Hudson et al., 1992; Hatcher, 2004; Cowan et al., 2008) that put them at increased risk for deleterious health conditions (Sutter et al., 1999; Howard et al., 2004), therefore more attention should be given to the dietary intake and weight gain in this population. Our results provide some evidence that an intervention targeting dietary intakes and the food environment in residential drug treatment contexts can also be beneficial. Future randomized trials should match treatment sites on participant demographics, for example, age, education, and addiction history; program characteristics such as treatment program structure, culture and norms, and food service policy (e.g. hired cooks vs. resident cook teams); as well as relevant theoretical constructs such as collective efficacy (SCT), social support and perceived severity and barriers to healthy food environments (Glanz et al., 2008). Treatment providers have the opportunity to implement supportive food-related policies as well as provide ongoing nutrition education that focus on increasing healthy food choice behaviors in these treatment facilities. Additional strategies to improve dietary intake of men in recovery need to be tailored to specific addiction histories, recovery stages, and treatment contexts.

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