THE THREE-FACTOR EATING QUESTIONNAIRE-R18 IS ABLE TO DETERMINE DIFFERENT EATING BEHAVIORS AND FOOD PATTERNS IN CONGREGATE MEAL PARTICIPANTS

by

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(Under the Direction of Mary Ann Johnson)

ABSTRACT

The purpose of this study was to analyze the construct validity of the Three-Factor Eating Questionnaire – Revised 18-item (TFEQ-R18) in congregate meal participants, and to assess the eating behaviors elucidated from this questionnaire with food intake. Participants were older adults (*n* = 124, mean (SD) age = 75 (8) years, 76% women, 56% White, 44% Black, and 51% obese (BMI $\geq$ 30 kg/m^2)) receiving congregate meals. The TFEQ-R18 measures cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE), and the 6 food groups assessed with a short food frequency questionnaire were sweets, salty snacks, fruits, vegetables, whole grains, and milk. The TFEQ-R18 was found to have acceptable construct validity and reliability in this sample. Robust associations were seen with UE and vegetables, and with EE and salty snacks. These results suggest that the TFEQ-R18 is a valid measure of CR, UE, and EE, and may be useful in development of nutrition interventions in congregate meal participants.

INDEX WORDS: TFEQ-R18; Older adult; Congregate meal participant; Eating behavior; Cognitive restraint; Uncontrolled eating; Emotional eating; Three-Factor Eating Questionnaire; OAANP

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

CHAPTER 1

INTRODUCTION

The older adult population (65+) is growing at a rapid rate with rapidly changing needs. Currently older adults represent 13.1% of the US population, and this number is expected to rise to at least 19.3% within 20 years (AOA 2011). With age, the prevalence of chronic health conditions increases, and it has been estimated that among older adults, at least 80% have at least one chronic disease (Wolff et al 2002). Similar to most states, Georgia has experienced a surge in the older adult population. The state of Georgia has had the 5th highest increase (31.4%) in the nation for number of persons 65 and older from 2000 to 2010 (AOA 2011).

To support this older population, the Older Americans Act Nutrition Program (OAANP) was established to lessen food insecurity and hunger, promote socialization, health, and well-being, and delay adverse nutrition-related health conditions through health promotion and prevention services for persons aged 60 and over. To carry out these goals, OAANP authorizes funding for distribution of congregate (Title III C1) and home-delivered meals (Title III C2) targeted to individuals with the greatest social and economic needs (AOA 2012). Typically, congregate meal participants receive 5 lunches per week, but depending on the funding and need in various states and localities, participants might receive fewer meals or more meals such as breakfast and/or weekend meals. Participants have high levels of obesity and obesity-related disorders (Penn et al 2009, Brewer et al 2010) and moderate to

high levels of nutritional risk (Quigley et al 2008). Nationally it has been found that older adults (60 years and older) have higher levels of overweight (BMI ≥ 25 to < 30), obesity (BMI ≥ 30), Class 2 obesity (BMI ≥ 35), and Class 3 obesity (BMI ≥ 40) than the overall population (Flegal et al 2012). In Georgia this prevalence has been found to be even higher than the national averages (Penn et al 2009, Porter and Johnson 2011). Thus, it is of great interest to explore factors that may be associated with obesity in this population.

Eating behaviors, such as cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE), have been suggested as possible factors relating to overweight and obesity (Anglé et al 2009, Porter and Johnson 2011, Provencher et al 2003). These behaviors have been well studied among adult and adolescent obese and healthy weight populations, but are less well studied in older populations (Mangweth-Matzek et al 2006). The Three-Factor Eating Questionnaire – Revised 18 (TFEQ-R18) is an 18-item instrument used to identify these eating behaviors. This questionnaire, originally developed in an obese adult population (Karlsson et al 2000), has shown acceptable reliability and validity in adolescents and adults, and obese and non-obese samples (Anglé et al 2009, Karlsson et al 2000, de Lauzon et al 2004). The TFEQ-R18 is a common tool in current research measuring eating behaviors, and the few construct validities that have been conducted have shown good acceptability and reliability, but little is known about its validity in diverse populations, e.g., older adults and subgroups of the older adult population such as congregate meal participants.

Due to the increasing older adult population and high prevalence of obesity in Georgia, the purpose of the current study was to determine the validity and reliability of the TFEQ-R18 in

a sample of congregate meal participants, and the relationship of the 3 assessed eating behaviors with food intake. The study was conducted in 4 senior centers in Northeast Georgia that have OAANP and provide congregate meals.

Chapter 2 is a review of the literature outlining demographics and health of the older adult population, history of the TFEQ-R18 and the 3 eating behaviors assessed by this questionnaire, analysis involved in measuring construct validity, and food frequency questionnaires.

Chapter 3 is a manuscript to be submitted to the journal of *Journal of Nutrition in Gerontology and Geriatrics.* This chapter includes the methods, results, discussion of the outcomes of the questionnaire's construct validity analysis and relationships elucidated between eating behaviors with food intake, and data tables.

Chapter 4 presents a summary of the major findings and conclusions of this study.

CHAPTER 2

LITERATURE REVIEW

Older Adults

The percentage of the US population over 65 years of age has grown significantly over the last century, and this trend is projected to continue. In 2010, older adults numbered 40.4 million, or 13.1% of the total population, and are expected to reach approximately 72.1 million by 2030, representing nearly one-fifth (19.3%) of the US population. Since 1900 the number of older adults 65 years and older is 13 times higher (from 3.1 million to 40.4 million) and the percentage of the total population has more than tripled (from 4.1% to 13.1%). The oldest group (100+) is 53% larger than it was in 1990. The state of Georgia has had the 5th highest increase (31.4%) in the nation for number of persons 65 and older from 2000 to 2010. In the nation, one of every 5 elderly African-Americans (18.0%) was poor in 2009, compared to 6.8% of elderly Whites and 18.0% of elderly Hispanics. In Georgia, 10.7% of elderly persons are below poverty line, only eclipsed by 7 other states (KY, LA, MS, NM, NY, ND, SD) and the District of Columbia. As reported by older Americans, 87% listed Social Security as the major source of income in 2008 (AOA 2011).

The increase in older adults has led to a greater prevalence of chronic health conditions in the total population. The majority of older persons have at least one chronic health condition and many have multiple conditions. The prevalence of chronic conditions increases with age; approximately 74% of those aged 65 – 69 have at least one chronic health condition, and

88% above the age of 85 also report at least one chronic condition (Wolff et al 2002). During 2007-2009, the most frequently reported conditions were: 50% diagnosed arthritis, 34% uncontrolled hypertension, 32% cardiovascular disease, 23% any cancer, 19% diabetes, and 14% sinusitis (AOA 2011). Forty-three percent of all Medicare recipients reported chronic conditions related to endocrine, nutritional, and metabolic disorders (Wolff et al 2002). Only 40% reported their health status as excellent or good overall health compared to 64% of all aged persons 18 – 64 years. Additionally, 37% of older persons reported a disability in 2010 (AOA 2011). Disability increases with age, and there is a strong relationship between reported health status and disability status (Wolff et al 2002).

Older Americans Act Nutrition Program

To support this older population, the Older Americans Act (OAA) was established in 1965 at the federal and state levels to provide community social services. To assist the most vulnerable of this population, the Older Americans Act Nutrition Program (OAANP) was established under Title III of the OAA (AOA 2012). The purpose of OAANP in the population aged 60 and over is to lessen food insecurity and hunger, promote socialization, health, and well-being, and delay adverse nutrition-related health conditions through health promotion and prevention services. To carry out these goals, OAANP distributes funds for congregate (Title III C1) and home-delivered meals (Title III C2) to be provided for individuals with the greatest social and economic needs. The targeted population includes minority and low-income individuals, rural-dwellers, individuals with limited English language proficiency, and individuals at risk for institutional care. In 2010, the OAANP

received approximately $819 million to provide 96.4 million congregate meals and 145.5 million home-delivered meals to over 2.6 million individuals (AOA 2012).

In Georgia, the state is divided into 12 Area Agencies on Aging (AAA). The purpose of these AAAs, "is to improve the life of seniors and persons with disabilities in the State of Georgia through education, information sharing, collaboration, and advocacy" (G4A 2012). The Northeast Georgia AAA provides many aging services, including congregate meals at 13 senior centers in the region, which are supported through the OAANP (G4A 2012).

Selected Digestive and Metabolic Changes in Older Adults

As individuals age, they may eat less and often make different food choices, despite a high prevalence of overweight and obesity in the elderly (Donini et al 2003, Flegal 2012). In general, there is a reported decline in food intake and an associated loss in motivation to eat, indicating that there may be physiological or social contributing factors, or a combination of both. Conversely, as a function of age older adults have a decreased basal metabolic rate, which can lead to weight gain in individuals who fail to decrease food intake corresponding to the age-related decline in energy expenditure. Commonly however, a decrease in body weight occurs in individuals over the age of 70 years who do not eat enough to meet energy demands. Anorexia of aging has largely been defined as a physiological effect associated with aging which manifests itself as a reduction in desire to eat and pleasure in eating. This reduction in energy intake usually leads to lower consumption of foods and beverages. This reduced consumption can also be the result of slower gastric emptying, reduced senses of taste and smell, and physical factors such as ill-fitting dentures or poor dentition.

Additionally, older individuals are major users of prescription medications, many of which can cause malabsorption of nutrients, loss of appetite, and gastrointestinal distress. Some studies have found that older adults tend to consume less energy-dense foods and fast foods, but consume more energy-dilute grains, vegetables and fruits (Donini et al 2003, Drewnowski and Shultz 2001).

Nutritional Risks in Congregate Meal Participants

Nutrition-related risk factors that can influence older adult health include inadequate food and nutrient intake, poor dentition, chewing and swallowing problems, poverty, food insecurity, living and eating alone, social isolation, polypharmacy, functional disabilities, diet-related diseases, and minority status (Quigley et al 2008). Using the Nutrition Screening Initiative (NSI) Checklist instrument, which identifies the warning signs of nutritional risk, Quigley et al found that 56% of Oklahoma congregate meal participants were at moderate or high nutritional risk. Among respondents at moderate or high nutritional risk, the most common affirmative responses included, "having an illness or condition that affected food eaten; eating alone; taking 3 or more medications; and inability to shop, cook, and feed themselves" (Quigley et al 2008). Similarly in another study of community-dwelling individuals aged 60 years and greater, there were associations of higher mortality with eating alone, taking 3 or more medications, and difficulty cooking, shopping, and eating (Sahyoun et al 1997). All of these characteristics are potential target areas of nutrition intervention programs.

Obesity in Older Adults

In the year these data were collected, 2010, the prevalence of obesity in these studies was 51% (50% men and 53% women, Porter and Johnson 2011), while the national average in older men and women aged 60 years and older was 37% and 42%, respectively nationally (Flegal et al 2012). It has been found that older adults participating in OAANP's Georgia congregate meals have even higher levels of overweight and obesity compared to the national averages (Penn et al 2009, Porter and Johnson 2011).

The prevalence of BMI-defined obesity in US adults continues to exceed 30% in most age groups, but is starting to show some signs of leveling off. From 1999 to 2010, obesity showed no significant increase in women overall, but the increases were statistically significant for non-Hispanic Black women (59% prevalence for BMI $\geq$ 30) and Mexican American women (45% prevalence for BMI $\geq$ 30). During 2009-2010, the prevalence of BMI $\geq$ 30 in non-Hispanic White women was 32%, in non-Hispanic Black women was 59%, and in Mexican-American women was 45%. During this same period for all men, there was a linear trend for an increase, but the most recently reported two years (2009-2010) did not differ significantly from the previous 6 years (Flegal et al 2012).

Obesity has shown strong positive associations with chronic conditions, physical function, disability and mental health (Penn et al 2009, Porter and Johnson 2011, Villareal et al 2005) as well as eating behaviors defined as CR, UE, and EE, as assessed by the TFEQ-R18 (Anglé et al 2009, de Lauzon-Guillian et al 2006, Porter and Johnson 2011). Moreover, and due to these positive associations and increased risks, obesity is associated with decreased survival

and quality of life, and an increased risk of institutionalization and serious medical complications (Villareal et al 2005). A recent study investigating the impact of obesity on chronic health conditions in Georgia's congregate meal participants found that there was a significant association between reported chronic health conditions and obesity (Penn et al 2009). Robust positive associations of obesity (BMI ≥ 30) were seen with number of health conditions, hypertension (82% of obese sample), joint pain (81%), arthritis (79%), hyperlipidemia (62%), and diabetes (45%) (Penn et al 2009).

Three-Factor Eating Questionnaire and Revised 18-Item Version

To identify eating behaviors related to food choices, questionnaires have been developed to describe these behaviors, such as the Dutch Eating Behavior Questionnaire (DEBQ) (van Strien et al 1986) and the Three-Factor Eating Questionnaire (TFEQ) (Stunkard and Messick 1985). Some questionnaires are lengthy to administer (46 to 51 items), which may limit their use in multifactorial epidemiological studies where multiple questionnaires are obligatory. The original TFEQ was a 51-item tool constructed by Stunkard and Messick in an obese sample (n = 220) that defined three measures of eating behaviors: (1) cognitive restraint of eating, (2) disinhibition, and (3) hunger. Using principal component analysis, Karlsson and colleagues derived the 18-item revised version (TFEQ-R18) (Karlsson et al 2000) from the original 51-item TFEQ (Stunkard and Messick 1985), increasing relevancy of the tool while reducing length and respondent burden. The TFEQ-R18 comprises questions related to assessing cognitive restraint (CR, 6 items), uncontrolled eating (UE, 9 items), and emotional eating (EE, 3 items) and identifies 3 different eating behavior scales corresponding to CR (conscious and regular restriction of one's food intake in an attempt to control body weight

and body shape), UE (overconsumption of food due to a variety of stimuli, associated feelings of being out of control, and subjective feelings of hunger), and EE (tendency to eat in response to negative emotional feelings or mood such as depression, anxiety or sadness). Each question is answered on a 4-point Likert scale (e.g., 1 = never, 2 = rarely, 3 = sometimes, 4 = always); higher values indicate the potential presence of the eating behavior.

The TFEQ-R18 was developed among Swedish obese adults (aged 37-57 years, *n* = 4,377) in 2000 (Karlsson et al 2000). In 2004, the construct validity of the TFEQ-R18 was analyzed by de Lauzon and colleagues in a sample of French adults (*n* = 529) and teenagers and young adults (*n* = 358) of weight classifications representative of the general population (de Lauzon et al 2004). The TFEQ-R18 was found to be a valid and reliable tool applicable to the general population. In 2009, Anglé and colleagues examined the applicability of the TFEQ-R18 in a large sample of young Finnish females aged 17 to 20 years (*n* = 2,997) (Anglé et al 2009). The factor structure of the TFEQ-R18 was verified by principal component analysis with Varimax rotation; the original factor structure was replicated and the instrument was found to be structurally valid. Konttinen and colleagues verified the internal reliability coefficients (Cronbach's alpha) of 2 scales of the TFEQ-R18, CR and EE, and found these scales to be satisfactorily reliable in 25-64 year old Finnish men (*n* = 1,679) and women (*n* = 2,035); UE was not analyzed, nor were item convergent or item discriminate validity determined (Konttinen et al 2010a).

In research by de Lauzon et al, one CR item was found discrepant in convergent validity in the adult and teenage groups (*"How frequently do you avoid "stocking up" on tempting*

foods?" 1 = almost never, 2 = seldom, 3 = usually, 4 = almost always). Discriminate validity in the adult group had a single item discrepancy in the UE scale (de Lauzon et al 2004). Overall this questionnaire has shown satisfactory reliability and validity when analyzed in adolescents and adults, obese and non-obese samples. The TFEQ-R18 is a common tool used in current research and the few construct validity studies that have been reported have shown good reliability, but little is known about its validity in diverse populations, e.g., older adults and subpopulations of older adults, such as congregate meal participants.

In the current data collected during summer 2010 from congregate meal participants at 4 senior centers in the Northeast Georgia AAA region, slight modifications were made to the TFEQ-R18. As previously reported (Porter and Johnson 2011), for all items "I" was adapted to "you", as questions were read to participants, and item 1 was modified from, *"When I* ***smell a sizzling steak or juicy piece of mea****t, I find it very difficult to keep from eating, even if I have just finished a meal.*" to "*When you* ***see any of your favorite foods****, do you find it very difficult to keep from eating, even if you have just finished a meal?*" These changes were implemented to improve measurement in assessing difficulty controlling eating when attracted by an external stimulus in this population. This single-item change has similarly been made and validated in a previous study (Anglé et al 2009). Specific components of identified eating behaviors have been strongly associated with food choices in the general population, and can be useful in developing tools for nutrition education interventions and weight management counseling.

Eating Behaviors and Disordered Eating

The psychology and sociology of eating behaviors require further investigation given the increasing prevalence worldwide of obesity and other health conditions. Eating disorders and disordered eating, while similar in phrasing, are distinctly different. Eating disorders are classified by the DSM-IV or American Psychological Association (APA) and include anorexia nervosa, bulimia nervosa, and eating disorders not otherwise specified (EDNOS) (APA 2008). Eating disorders have shown positive associations with physical health consequences including death, gastrointestinal problems, endocrine disorders, cardiovascular and pulmonary conditions, diminished bone mineral density, and mental health problems (Hudson et al 2007, Mitchell and Crow 2006). Disordered eating, which has not been officially defined by any authoritative body, does share some concepts that are also assessed by the TFEQ-R18. The term disordered eating is used to describe an unhealthy relationship with food, such as binge eating, skipping meals for weight loss, restricting certain types of food, eating to cope with stress or emotional distress, and frequent and strict dieting (Pereira and Alvarenga 2007). However, because there are no official definitions of disordered eating, the TFEQ-R18 cannot be considered a definitive questionnaire to measure the absence, presence, or extent of disordered eating, nor is it assumed to be a predictive tool of eating disorders. Disordered eating behaviors may be risk factors for the development of eating disorders (APA 2008), but research is ongoing (Reba-Harrelson et al 2009). Prevalence of eating disorders and disordered eating in the population is speculative at least in part because of the stigma associated with these conditions and potential underreporting (APA 2008).

Eating behaviors that deviate from the norm are most commonly associated with the young female population; however this singular population focus is inaccurate. Mangweth-Matzek and colleagues found that in women aged 60-70 years, irrespective of body weight or BMI, the majority reported dissatisfaction with body weight and body shape, and 4% demonstrated an eating disorder, closely resembling occurrence in younger populations (Mangweth-Matzek et al 2006).

Cognitive Restraint

The concept of restraint is the conscious and regular restriction of one's food intake in an attempt to control body weight and body shape (Karlsson et al 2000). Individuals with high restrained eating possess high awareness of the quantity and type of food consumed, and consume less food than desired. Restrained eating is not the same as dieting. Studies have shown that individuals demonstrating CR, coupled with low UE and low EE, are associated with successful, maintained weight loss or weight maintenance (Foster et al 1998, Keränen et al 2009). High CR scores have been positively associated with healthier food choices (Konttinen et al 2010a, de Lauzon et al 2004) such as green vegetables, fish, and reduced-fat foods, and negatively associated with candy/chocolate, potatoes, and French fries (de Lauzon et al 2004). In adults it has been found that individuals with the highest levels of CR reported the lowest energy and fat intake, highest fiber and carbohydrate intake, and the greatest weight loss (Keränen et al 2011, Provencher et al 2003); however, high CR also has been associated with obesity (Anglé et al 2009, de Lauzon-Guillian et al 2006, Porter and Johnson 2011). Several studies have shown that women display higher levels of CR than men (de Lauzon et al 2004, Provencher et al 2003). In female university students, an

increasingly significant likelihood of following a lacto-ovo or vegan diet paralleled the level of dietary restraint (McLean and Barr 2003).

Overall there are mixed results regarding whether high CR is associated with low energy intake and/or energy intakes below daily requirements (McLean and Barr 2003, Provencher et al 2003). It has been suggested to separate CR into 2 subscales: rigid and flexible restraint. Rigid restraint is defined as an uncompromising approach to eating, dieting, and weight, whereas flexible restraint is a more mediated approach to eating, dieting, and weight which, for example, "fattening" foods are eaten in limited amounts without associated feelings of guilt (Provencher et al 2003, Westenhoefer et al 1999). In women, rigid restraint has been shown to be positively and significantly related to weight, BMI and body fat, whereas flexible restraint was negatively correlated with body fat and waist circumference (Provencher et al 2003). Importantly, high rigid restraint has been associated with high UE, which suggests an individual following a strict and rigid diet could lead to episodes of loss of control over eating. High flexible restraint has been associated with lower disinhibition, possibly leading to a lower level of loss of control, and greater likelihood of weight loss or weight maintenance (Provencher et al 2003, Westenhoefer et al 1999).

Uncontrolled Eating

UE refers to the overconsumption of food due to a variety of stimuli, associated feelings of being out of control, and subjective feelings of hunger (Anglé et al 2009, Karlsson et al 2000). High UE scores have been associated with obesity (Anglé et al 2009, Porter and Johnson 2011), increased levels of dysphoria (Foster et al 1998), and episodes of binge eating

(Foster et al 1998). Higher UE is supported by a strong relationship with binge eating severity (Foster et al 1998). In adults it has been shown that individuals that demonstrate UE report the highest energy and fat intake (Keränen et al 2011, Provencher et al 2003). More specifically, in adults UE has been positively associated with energy-dense high-fat foods, comfort foods such as casseroles/side dishes, pork products, potatoes, yogurt, and green vegetables (women and men combined sample), cheese only in women, and fruit only in men (de Lauzon et al 2004).

Provencher et al (2003) found that obese men and women exhibited higher UE scores than their overweight and non-obese counterparts. Although the research is limited, there may be some gender differences such as women may display higher levels of UE than men (Provencher et al 2003) and teenage and young adult boys may have higher levels of UE than their female equivalents, but no significant gender difference was seen in adults (de Lauzon et al 2004).

Emotional Eating

EE consists of the tendency to eat in response to negative emotional feelings or mood such as depression, anxiety or sadness (Anglé et al 2009, Konttinen et al 2010a). Emotions have been found to affect eating behavior along the entire process of ingestion: motivation to eat, food choice, response to food, eating speed, and amount ingested (Macht 2008). Some previous research suggests that EE is associated with obesity (Anglé et al 2009, Porter and Johnson 2011), but this association has not been seen consistently (Konttinen et al 2010a). In adults, several studies have shown that women display higher levels of EE than men (de

Lauzon et al 2004, Konttinen et al 2010a, Provencher et al 2003). EE has shown strong positive association with yogurt, pasta and cereal grains (de Lauzon et al 2004), sweet and salty snack foods such as cakes, pastries, cookies, peanuts, and sweet beverages (Konttinen et al 2010a, de Lauzon et al 2004, Macht 2008), and nuts, seeds, and fruit only in women, and negative associations with alcoholic drinks in women (de Lauzon et al 2004).

Comfort Food

Food is a fundamental part of our well-being and quality of life, and extends beyond simply satisfying hunger needs and providing nourishment. Specific foods can become symbolic and particular food habits can be derived from emotional, social, religious, and cultural experiences. During times of stress, eating behaviors are often driven by the consumption of comfort foods. Comfort food consumption has been seen as a response to emotional stress, and consequently, a strong factor in food selection made by individuals that demonstrate EE. Comfort foods are foods whose consumption induces some level of improved emotional state by relieving negative psychological affects or by increasing positive feelings (Wansink et al 2003). Comfort food selection can be attributed to a combination of physiological and psychological stimuli. Physiological impetuses behind food choices can involve the body's natural response to correct nutrient and energy imbalances, while psychological motivations can be driven by the pleasure derived from certain food choices. In a recent survey of adults (n = 411), Wansink et al found that 60% of the most preferred comfort foods were snack-related and relatively high in salt or sugar (23% potato chips, 14% ice cream, 12% cookies, 11% candy/chocolate) (Wansink et al 2003), foods typically classified as energy-dense and nutrient-poor.

Comfort food preferences have been shown to differ by age and by gender. Wansink and colleagues found significant differences between male and female preferences, as well as age (n = 1005) (Wansink et al 2003). Females tend to prefer comfort foods that are snack-related (candy/chocolate, ice cream), but males prefer more nutritious meal-related comfort foods (pizza/pasta, steak/beef, casseroles/side dishes, and soup). Females also rank vegetables and salads as comfort foods more than males. There are also varying resultant feelings that encompass comfort food selection and consumption. Individuals that consume more meal-related comfort foods tend to feel less guilty and healthier than those who consume more snack-related comfort foods. Regardless of choice, no comfort food selections by females cultivate healthy feelings, and most males feel relatively healthier than females based on comfort food consumption. Similarly, consumption of comfort foods by females, regardless of being snack- or meal-related, tends to make females feel relatively guiltier than males (Wansink et al 2003).

By age, significant differences have also been seen in comfort food selection. Younger people (18-34 years) tend to prefer snack-related comfort foods (potato chips, ice cream, cookies, candy/chocolate), most commonly potato chips, compared to adults and older individuals (35-54 and 55+ years, respectively). The older age groups were more likely to choose meal-related comfort foods (steak/beef, casseroles/side dishes, vegetables/salads, and soup). Individuals over the age of 55 years ranked soup and steak/beef burgers highest for comfort food preferences (Wansink et al 2003).

Eating Behaviors and Other Health Conditions

In our current obesogenic environment, eating behaviors are one group of factors that have been proposed to account for individual differences in the susceptibility to gaining weight. Restrained eating, which has been researched most extensively, has shown mixed results demonstrating a causal link between obesity and dietary restraint (Karlsson et al 2000). EE has shown a strong positive association ($r = 0.31$, $n = 3714$) to depression in both adult men and women, and both of these factors were related to a higher body mass (Konttinen et al 2010a, Konttinen et al 2010b). Conversely, restrained eating and depressive symptoms were unrelated (Konttinen et al 2010a).

Recent research has revealed significant associations of eating behaviors and mental health with obesity in older adults (Porter and Johnson 2011). When obesity was defined as BMI ($\geq$ 30 kg/m^2), it was positively associated with CR, UE, EE, depression, anxiety, and stress in correlation analyses ($n = 113$) (Porter and Johnson 2011). Additional research exploring associations of EE in adult populations in Finland ($n = 3714$) has revealed that men and women demonstrating higher EE scores consumed more sweet energy-dense foods (cookies, buns, other sweet-baked items, chocolate) independent of depressive symptoms. In men, EE was also associated with a greater consumption of non-sweet energy dense foods (pizza, hamburgers, French fries, chips, popcorn, and mayonnaise-based salads). Neither gender displayed any association of EE with fruit and vegetable consumption. Restrained eating was associated with healthier food choices (i.e., higher fruit and vegetable consumption) and lower sweet and non-sweet energy-dense foods (Konttinen et al 2010a).

Food Frequency Questionnaires

Food frequency questionnaires (FFQ) are designed to assess an individual's nutrient intake and habitual food consumption through past recall. FFQs are used in intervention studies to measure the composition of total diet and dietary change, observational studies to compare food and dietary intakes between groups, and epidemiological studies to examine relationships between diet and disease (Wirfält et al 1998). FFQs have been criticized for imprecise data measurements and unreliable or reproducible results (Schaefer et al 2000), but compared to biochemical measures of intake and dietary records, these questionnaires are very advantageous in terms of cost to administer and participant burden. These advantages are particularly important because they allow large sample populations to be enrolled in prospective studies and repeated assessments of diet during the follow-up period (Willett 2001).

The Block FFQ and the Willett FFQ are two widely used assessment tools. In a study of obese adult women (n = 101), Wirfält et al found that the Block 60-item reduced FFQ and the Willett 153-item FFQ were reliable and reproducible measurements of food intake compared to 3 24-hour dietary recalls (Wirfält et al 1998). However, it was also found that the reduced 60-item Block FFQ showed an overall energy underestimation bias, but was more accurate in categorizing percent energy from fat and carbohydrate intake than the 153-item Willett FFQ. The Willett FFQ was more successful classifying individuals' vitamin A and calcium intakes than the Block FFQ and showed no overall energy underestimation bias (Willett 2001, Wirfält et al 1998).

To improve accuracy of FFQs and reduce underestimation biases, it has been suggested that questionnaires focus attention on trying to measure dietary behaviors. Questions about habitual dietary practices (e.g., "How many servings of vegetables do you usually eat each day?") may be more accurately and easily recalled than specific portion sizes and frequencies of a long list of foods (Kristal 2005). There are multiple challenges when collecting dietary intake, particularly in recalling past intakes over a period of time (Kristal 2005). An older adult population adds further challenges due to potential impairments in cognition, hearing, and vision. However, utilization of the FFQ in short, simplified or standard form is thought to be an effective method of capturing dietary patterns in older adults, because it requires generic memory recall rather than short term memory of detailed descriptions (Huang et al 2011). In a recent study by Huang et al (2011), a simplified food frequency questionnaire, without portion sizes, was validated in an elderly population. This study aimed to demonstrate the validity of the simplified version while reducing the burden placed on respondents, and found that portion size estimations do not necessarily improve validity of FFQs. Multiple other studies have also produced comparable FFQ validity and maintain reproducibility for a number or nutrients by level of cognitive function in the older adult population (Klipstein-Grobusch et al 1998, Tucker et al 1999). FFQs and/or individual food group questions have been found to confirm positive associations of serum vitamin B_{12} concentrations with animal food intake (Johnson et al 2003) and serum vitamin D concentrations with milk intake (Johnson et al 2008) in congregate meal participants. In individuals 65 years and older, biomarkers of calcium and riboflavin status were associated positively with dairy intake, while serum vitamin C concentrations were associated with fruit intake (Huang et al 2011). Plasma carotenoid concentrations have also shown significant

positive associations with the intake of fruit- and vegetable-containing carotenoids in individuals 67 years and older (Tucker et al 1999). These findings provide a strong foundation for examining dietary patterns of older individuals through the use of FFQs and individual food group questions.

Psychometrics and Construct Validity

There is a need for valid and effective instruments to evaluate behaviors and conditions that are applicable to a wide range of populations. Psychometrics is the field of study concerned with the theory and technique of psychological measurement. The field is primarily concerned with the construction and validation of measurement instruments such as questionnaires, tests, and personality assessments. Construct validity refers to whether a scale measures or correlates with the theorized construct (e.g., CR, UE, EE) that it purports to measure. In other words, it is the extent to which the scale to be measured is actually measured. A construct is not restricted to one set of observable indicators or attributes, but commonly encompasses several indicators. Construct validity can be evaluated by statistical methods to determine if a common factor underlies several measurements using different observable indicators (Cronbach and Meehl 1955, Nunnally 1978).

Evaluation of construct validity requires determining the correlations of the measure to be examined in regards to variables that are known to be related to the construct (purportedly measured by the instrument). This is consistent with the multitrait/multi-item matrix of examining construct validity described in Campbell and Fiske's landmark paper (Campbell and Fiske 1959). Correlations that fit the expected pattern contribute evidence of construct

validity. Construct validity is a judgment based on the accumulation of correlations from numerous studies using the instrument under evaluation (Cronbach and Meehl 1955, Nunnally 1978). This study evaluated the construct validity of the TFEQ-R18; it has not been validated exclusively in an older population or in congregate meal participants, but the instrument has been validated in several general populations (Anglé et al 2009, Karlsson et al 2000, de Lauzon et al 2004). Acceptable construct validity will add to accumulating evidence of this tool's applicability in diverse populations.

For the establishment of construct validity, convergent validity and discriminate validity must be met (Campbell and Fiske 1959). Item convergent validity is confirmed when each item in a questionnaire substantially correlates to the scale that it was assumed to represent. Item-discriminant validity is confirmed when items correlate significantly higher within their assigned scale than with all other scales. Scaling fulfillment is fulfilled by the proportion of items in a scale that meet both discriminant and convergent validity. To examine convergent and discriminate validity, multitrait/multi-item analysis is frequently employed, which presents the intercorrelations resulting from each trait measured against all other traits in the construct (Campbell and Fiske 1959). Previous researchers have demonstrated this concept analyzing the TFEQ-R18 (Karlsson et al 2000, de Lauzon et al 2004).

Internal-consistency reliability of a scale is estimated by Cronbach's alpha coefficients (Cronbach and Meehl 1955). Questionnaires are generally deemed reliable when the Cronbach's alpha is between 0.7 and 0.9, with an expected range of 0 to 1 (de Lauzon et al 2004). The advantage of using the Cronbach's alpha measure in a new sample (i.e.,

congregate meal participants, older adults) is if coefficients are similar to those found by other researchers, then under the testing conditions and sample, this questionnaire can have reliability similar to other published reports. Adjustments to the scales can be made if needed. If validity and reliability are found unacceptable, then factor analysis can be used to derive a new factor structure and new scales (Anglé et al 2009).

CHAPTER 3

THE THREE-FACTOR EATING QUESTIONNAIRE-R18 IS ABLE TO DETERMINE DIFFERENT EATING BEHAVIORS AND FOOD PATTERNS IN CONGREGATE MEAL PARTICIPANTS

Furman JD, Gerst K, Porter KN, Johnson MA. To be submitted to *Journal of Nutrition in Gerontology and Geriatrics*.

Abstract

The purpose of this study was to determine the construct validity and reliability of the Three-Factor Eating Questionnaire (revised 18 item, TFEQ-R18), and the relationship of the 3 eating behavior scales, cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE), with food intake. Participants were 60 years and older and received congregate meals from 4 senior centers in northeast Georgia (n = 124, mean (SD) age = 75 (8) years, 76% women, 55% White, 44% Black, and 51% obese (BMI $\geq$ 30 kg/m^2)). The intake of 6 food groups was assessed with a short food frequency questionnaire (FFQ, sweets, salty snacks, fruits, vegetables, whole grains, and milk). For the 3 eating behavior scales, item convergent validity and item discriminate validity analyses were acceptable and within the range reported in other studies. Cronbach's alpha analyses confirmed the reliability of the 3 eating behavior scales: CR (alpha = 0.78), UE (alpha = 0.83), and EE (alpha = 0.83). In the unadjusted analyses, higher CR was associated with significantly higher intake of vegetables, higher UE was associated with significantly higher intake of sweets, salty snacks, and vegetables, and higher EE was associated with significantly higher intake of sweets and salty snacks. There were no associations of any of the eating behaviors with the intake of fruit, whole grains, or milk in the total sample. Eating behaviors were dichotomized based on the median split for logistic regression analyses. In multivariate logistic regression analyses controlling for potential confounders (age, gender, race, and education), higher UE was associated with a higher intake of vegetables ($\geq$ 4/day, OR: 2.7, 95% CI 1.06, 6.89, $p < 0.05$) and higher EE was associated with a higher intake of salty snacks ($\geq$ 1/day, OR 3.9, 95% CI 1.58, 9.72, $p < 0.01$), but there were no other associations of eating behaviors with food group intake. These findings suggest that the TFEQ-R18 measuring CR, UE, and EE is a

valid and reliable measure of eating behaviors, and perhaps should be considered when designing nutritional interventions to modify the intake of sweets, salty snacks, and vegetables among congregate meal participants

Introduction

Eating behavior associated with food choices is an important facet associated with health, development of chronic conditions, and lifestyle choices. To identify eating behaviors related to food choices, questionnaires have been developed to describe these behaviors, such as the Dutch Eating Behavior Questionnaire (DEBQ) (van Strien et al 1986) and the Three-Factor Eating Questionnaire (TFEQ) (Stunkard and Messick 1985). Specific components of eating behaviors have been strongly associated with food choices in the general population, and can be useful in developing tools for nutrition education interventions and weight management counseling. Some questionnaires are lengthy to administer (46 to 51 items), which may limit their use. Karlsson and colleagues (2000) developed an 18-item revised version (TFEQ-R18) of the original 51-item TFEQ by Stunkard and Messick (1985). The TFEQ-R18 identifies 3 different eating behavior scales corresponding to CR (conscious and regular restriction of one's food intake in an attempt to control body weight and body shape), UE (overconsumption of food due to a variety of stimuli, associated feelings of being out of control, and subjective feelings of hunger), and EE (tendency to eat in response to negative emotional feelings or mood such as depression, anxiety or sadness). The TFEQ-R18 was developed among obese individuals and has been validated in non-obese samples of adolescents and adults (Anglé et al 2009, Karlsson et al 2000, de Lauzon et al 2004).

The older adult population is growing in the United States and as of 2010, represents 13.1% of the population, a figure estimated to increase to 19.3% by 2030 (AOA 2011). The Older Americans Act Nutrition Program (OAANP) targets individuals aged 60 years or older, minority older adults, and those living in rural areas to provide food and nutrition assistance, such as congregate meals distributed as 5 lunches per week. Congregate meal participants are characterized by high levels of obesity and obesity-related disorders in Georgia (Penn et al 2009, Brewer et al 2010), thus it is of interest to explore factors that may be associated with obesity in this population. Porter and Johnson (2011) recently reported that CR and EE, as measured by the TFEQ-R18, were associated with obesity in congregate meal participants. Despite the common use of the TFEQ-R18 in current research, few studies have reported on the psychometric properties of the tool and little is known about its validity in diverse populations, e.g., older adults and subgroups of the older adult population such as congregate meal participants. Thus, the aim of the present study was to evaluate the validity of the TFEQ-R18 in this sample of congregate meal participants and to determine the relationships of these 3 eating behaviors, CR, UE, and EE, with the intake of certain food groups.

Methods

Study design

This study was cross-sectional in design and participants were individuals 60 years and older receiving congregate meals at 4 senior centers in northeast Georgia's Area Agency on Aging (AAA) in summer 2010. All methods, questionnaires, and procedures were approved by the University of Georgia, the Georgia Department of Human Services, and the Athens Community Council on Aging Institutional Review Boards on Human Subjects. Procedures

were explained and consent forms were read to participants, and written informed consent was obtained from each participant. A total of 124 individuals agreed to participate in the study. Non-participants (n = 106) were those who were unavailable during the study period, refused or were uninterested in the study, or were unable to answer questions and/or understand the informed consent, as determined by the interviewer. Compared to non-participants, the participants were more likely to be younger (77 and 75 years, respectively, $p < 0.01$) and more likely to be Black (30% and 44%, $p < 0.05$), but there was no statistical difference in gender (67% and 76% female, $p = 0.24$).

Three-Factor Eating Questionnaire – R18

Eating behaviors were described using the 18-item Three-Factor Eating Questionnaire (TFEQ-R18) developed by Karlsson et al (2000). The TFEQ-R18 consists of 18 questions with response categories on a 4-point Likert scale (e.g., 1 = never, 2 = rarely, 3 = sometimes, 4 = always; see Appendix A). As previously reported (Porter and Johnson 2011), for all items "I" was adapted to "you", as questions were read to participants, and item 1 was modified from, *"When I **smell a sizzling steak or juicy piece of mea**t, I find it very difficult to keep from eating, even if I have just finished a meal.*" to "*When you **see any of your favorite foods**, do you find it very difficult to keep from eating, even if you have just finished a meal?*" These changes were implemented to improve measurement in assessing difficulty controlling eating when attracted by an external stimulus in this population. This single-item change has similarly been made and validated in a previous study (Anglé et al 2009). CR is assessed with 6 questions, UE with 9 questions, and EE with 3 questions, and responses within each scale were summed into scale scores. Higher scores reflect higher levels of CR, UE, or EE.

The mean CR, UE, and EE scale scores (SD) were: CR, 11 (4), UE, 14 (5); and EE, 5 (3). The median CR, UE, and EE scale scores (range) were: CR, 10 (6 to 21); UE, 13 (9 to 31); and EE, 4 (3 to 12).

Psychometric analysis procedure

The original TFEQ-R18 was constructed in a Swedish obese population (Karlsson et al 2000) and was used here in an older adult American population. The construct validity of this tool has been established in populations of French adolescents and adults (n = 236) (de Lauzon et al 2004), and Finnish young women (n = 2,997) (Anglé et al 2009), and Finnish adults (n = 3,714) (Konttinen et al 2010a), and therefore the internal validity and reliability of this tool in our sample had to be confirmed. The internal-consistency reliability of the 3 scales in the questionnaire was measured using Cronbach's alpha coefficient with a criterion of 0.7 used to define adequate internal consistency. A multitrait/multi-item analysis was performed to test scaling assumptions underlying the construction and scoring of the TFEQ-R18. The aim of the analysis was to determine the validity and reliability of the TFEQ-R18 by verifying that each item was strongly correlated to its assigned scale (convergent validity) and more correlated to its assigned scale than to the other 2 scales (discriminate validity). In this approach, the correlation between each item and its own scale is corrected for overlap, i.e., the scale is calculated without the specific item in the analysis to avoid unreliable correlation inflation. An item-scale correlation matrix was computed, and the Pearson correlations for each item were compared across scales. Item convergent validity was demonstrated when the extent to which each item correlated meaningfully to the scale it was assumed to represent ($r \geq 0.40$, corrected for overlap). Item discriminate validity was indicated when the

item correlated more strongly with the scale it was supposed to represent than with all other scales. As suggested by previous researchers (Karlsson et al 2000, de Lauzon et al 2004), item-discriminate scale correlations were significantly different by using 2 standard errors of the correlation matrix ($1/\sqrt{n}$). Scaling fulfillment was assessed by the proportion of items in a scale that met both convergent and discriminate validity.

Food groups

Six food groups were assessed that reflect the current targets of nutrition education interventions designed to increase the intake of fruits, vegetables, whole grains, and milk products, and to decrease the intake of calorie-dense nutrient-poor foods in this population (Lee et al 2010). Intakes of sweets and salty snacks (adapted from the Block FFQ), fruits and vegetables (Hendrix et al 2008; Toobert et al 2000), whole grains (Ellis et al 2005) and milk (Cheong et al 2003) were assessed as follows: "How many times a day do you eat something sweet, such as candy, cookies, cakes, pie, donuts, ice cream?" (range = 0 to 7), "How many times a day do you eat salty snacks, such as chips, French Fries, pretzels?" (range = 0 to 7), "How many servings of fruits and 100% fruit juices do you usually have each day?" (range = 0 to 7), "How many servings of vegetables do you usually eat each day?" (range = 0 to 7), "How often do you eat whole wheat or whole grain bread, such as 100% whole wheat bread?" (range = 0 times per week to 3 times per day), "How often do you eat whole grain cereals, such as oatmeal, Cheerios®, bran flakes or bran cereals?" (range = 0 times per week to 3 times per day), "How often do you drink milk as a beverage including soy milk?" (range = 0 times per week to 3 times per day), and "How often do you eat milk on cereal including soy milk?" (range = 0 times per week to 3 times per day). Summary scores were created for

total whole grain and milk intake by summing food categories and then dividing them by 7 to determine frequency of intake per day. (Appendix B)

Statistical analysis

Descriptive statistics including means, standard deviations, and frequencies, along with Wilcoxon, chi-square, correlations, Cronbach's alpha and logistic regression analyses were calculated (The Statistical Analysis System, SAS, Cary, NC). Because there is no consensus on what constitutes "low" and "high" CR, UE, or EE, these variables were dichotomized at the median split for this sample to create "low" and "high" scores as described previously (Porter and Johnson 2011). Food group variables were dichotomized based on the distribution of the responses for each variable and/or nutritionally meaningful categories to represent the lowest 2 tertiles vs. the highest tertile of intake, which was ≥ 2/day for sweets, ≥ 1/day for salty snacks, ≥ 3/day for fruits and 100% juice, ≥ 4/day for vegetables, ≥ 2/day for whole grains, and ≥ 2/day for milk. As described in the psychometric analysis section, correlation analyses and Cronbach's alpha coefficients were used to assess validity of the TFEQ-R18 scales. Multivariate logistic regression analysis was used to identify the independent variables (eating behaviors, dichotomized) significantly associated with the dependent variables (specific food group, dichotomized), when controlled for potential confounders. In these regression analyses, sociodemographic confounding variables included gender (0 = male or 1= female), race/ethnicity (0 = White or 1 = Black), age (0 = < 70 or 1 = ≥ 70 y, which approximates the lowest tertile vs. the highest two tertiles), and education (0 = < 8 or 1 = ≥ 8 y, which approximates the lowest quintile vs. the highest four quintiles of the sample, and reflects a very low level of educational attainment), and BMI (0

= < 30 or 1 = ≥ 30); all of these categories were used in a previous study (Porter and Johnson 2011).. Food insecurity was assessed by the NSI checklist question, *"Do you always have enough money to buy the food you need?*" with a negative answer indicative of insecurity (White et al 1992). Because the literature suggests that gender differences occur in the scales of the TFEQ-R18 (Karlsson et al 2000, Konttinen et al 2010a, de Lauzon et al 2004, Provencher et al 2003), some analyses were stratified by gender. A level of $p < 0.05$ was accepted as statistically significant.

Results

Participants

The characteristics of the study participants are shown in Table 3.1 ($n = 124$). The mean (SD) age was 75 (8), 76% were female, and 44% were Black. BMI was 31 (7) and 51% were obese (BMI ≥ 30). Medical conditions were self-reported: 72% reported hypertension, 61% arthritis, 36% diabetes, and 30% some form of heart condition (such as angina, congestive heart failure, heart attack or other heart problems).

Reliability

For each of the 3 TFEQ-R18 scales (CR, UE, and EE), internal-consistency reliability coefficients (Cronbach's alpha) were all acceptably above the standard 0.70, but below the 0.90 limit recommended for individual assessment (Table 3.2). The Cronbach's alpha ranged from 0.79 (CR) to 0.83 (UE and EE, individually); combining the scales of UE and EE yielded 0.88. These coefficients are similar to those reported in previously validated

populations (Anglé et al 2009, Karlsson et al 2000, Konttinen et al 2010a, de Lauzon et al 2004).

Multitrait/multi-item scaling analysis

Table 3.2 demonstrates reliability estimates and summary of results of multitrait/multi-item scaling tests of the TFEQ-R18, and Table 3.3 provides the detailed correlations of each item to each scale comparison. For item convergent validity, the minimum desired scale correlation values ($r \geq 0.40$, corrected for overlap) was exceeded for 5 of 6 CR items, 9 of 9 UE items, and 3 of 3 EE items, and therefore showed very good internal consistency. The CR item that did not meet minimum value had a correlation of $r = 0.35$ (item #15). The discriminate validity test was met by 12 of 12 CR items, 17 of 18 UE items, and 6 of 6 EE items. The UE item that did not meet the discriminate validity test identified strongly to the EE scale (item #17). In summary, 5 of 6 CR items, 8 of 9 UE items, and 3 of 3 EE items met criteria for both convergent and discriminate validity.

Associations of eating behavior with mean food intake

Table 3.4 summarizes the mean intake of the 6 food groups in the low vs. high scales of CR, UE, and EE. Compared to low CR, high CR was associated with higher intakes of vegetables in the total sample and in men, but not in women. Compared to low UE, high UE was associated with higher intakes of sweets, salty snacks, and vegetables in the total sample, with higher vegetables in men, and with higher sweets in women. Compared to low EE, high EE was associated with higher intakes of sweets and salty snacks in the total sample, in men, and in women, and with higher fruits and 100% fruit juice in men.

Table 3.5 reports the Spearman correlation coefficients of the 6 food groups by the dichotomized eating behavior scales. CR was significantly associated with vegetables in the total sample and in men, but not in women. UE was associated with sweets and salty snacks in the total sample and in women, and associated with salty snacks only in men, when analyzed independently. EE was associated with sweets and salty snacks in the total population, in men, and in women.

Relationships between eating behavior and food intake

Multivariate logistic regression analyses with odds ratios were conducted to determine the independent associations of eating behaviors (dichotomized) with food group intake (dependent variable, dichotomized) when controlled for potential confounders (Table 3.6). When controlled for age, race, education, gender, eating behaviors or obesity, independently or in combination, several significant associations were seen. CR was not significantly associated with the intake of any food group, but higher CR did show non-significant positive associations with the odds of consuming ≥ 4 vegetable servings daily (OR 2.0, 95% CI 0.88, 4.71, $p < 0.10$, no controlling factors) and non-significantly decreased the odds of consuming ≥ 1 salty snacks per day (OR 0.4, 95% CI 0.17, 1.04, $p < 0.10$ controlling for sociodemographics, UE, EE, and obesity,). Higher UE significantly increased the odds of consuming ≥ 4 vegetable servings daily (ranging from OR 2.5, 95% CI 1.05, 5.77, $p < 0.05$, no controls, to OR 3.0, 95% CI 1.02, 8.64, $p < 0.05$, controlling for sociodemographics, CR, EE, and obesity), and non-significantly increased the odds of consuming ≥ 2 sweets or ≥ 1 salty snacks per day (ranging from OR 2.1, 95% CI 0.98, 4.36, $p < 0.10$, no controls, to OR 2.3, 95% CI 0.97, 5.38, $p < 0.10$, no controls). Higher EE significantly increased the odds of

consuming ≥ 1 salty snacks per day (ranging from OR 3.2, 95% CI 1.46, 7.18, $p < 0.01$, no controls, to OR 4.3, 95% CI 1.54, 11.80, $p < 0.01$, controlling for sociodemographics, CR, EE, and obesity) and non-significantly increased the odds of consuming ≥ 2 sweets per day (ranging from OR 2.1, 95% CI 0.89, 5.16, $p < 0.10$, no controls, to OR 2.4, 95% CI 0.89, 6.60, $p < 0.10$, controlling for sociodemographics and obesity). Significant associations were also seen when controlling for gender and the increased odds of men consuming ≥ 3 fruits or 100% fruit juice daily (OR 3.7, 95% CI 1.21, 11.64, $p < 0.05$) and ≥ 4 vegetable servings daily (OR 4.1, 95% CI 1.14, 14.54, $p < 0.05$). This sample was too small to obtain reliable estimates from models within each gender group independently, thus, these data are not reported. *R*-squared (R^2) values (Table 3.7), expressed as proportion of variance explained, ranged from 0.00 to 0.06 for sweets, 0.00 to 0.15 for salty snacks, 0.00 to 0.07 for fruits and 100% fruit juice, 0.00 to 0.22 for vegetables, 0.00 to 0.06 for whole grains, and 0.00 to 0.05 for milk.

Relationships between eating behaviors

Spearman correlation analysis between eating behaviors showed significant associations among the continuous scales of the 3 eating behaviors (all $p < 0.01$) and the correlations (r) were; CR and UE = 0.32, CR and EE = 0.34, and UE and EE = 0.57. When analyzing correlations between dichotomized eating behaviors the correlations were (all $p < 0.05$): CR and UE = 0.22, CR and EE = 0.25, and UE and EE = 0.38.

Discussion

The purpose of this study was to verify the validity of the TFEQ-R18 and its 3 eating behavior scales in a sample of congregate meal participants and to explore associations of these eating behaviors with specific food categories. The major findings are that the TFEQ-R18 is valid in this sample of congregate meal participants and that CR, UE, and EE were associated with several of the food group intakes in the bivariate analyses, with the most robust associations being with UE and higher vegetable intake, as well as EE and higher salty snack intake, that were also detected in the multivariate logistic regression modeling.

The original 51-item TFEQ was developed in an adult weight-loss and dieting population (Stunkard and Messick 1985), which was revised to an 18-item instrument (TFEQ-R18) in an obese Swedish population (Karlsson et al 2000). This tool has been validated in French adolescents and adults (de Lauzon et al 2004), Finnish young women (Anglé et al 2009), and Finnish adults (Konttinen et al 2010a), but not in older adults or congregate meal participants. The multitrait/multi-item scaling analysis demonstrated satisfactory internal consistency of the TFEQ-R18 in this population. Only 1 minor discrepancy was detected in the CR scale when verifying item convergent validity: the item-scale correlation for item #15 (*"How frequently do you avoid 'stocking up' on tempting foods?"* 1 = almost never, 2 = seldom, 3 = usually, 4 = almost always) was lower than expected ($r = 0.35$), while all other items on this scale were highly correlated. This item did not show high association to any scale. The presence of 24% reported food insecurity in this sample may attenuate individuals' ability to actually "stock up" on any foods. In de Lauzon's TFEQ-R18 validation in French adolescents and adults (2004), this same item was found to be in item

convergent discrepancy, overall suggesting some underlying weakness in this item. The 1 UE item that did not meet the discriminate validity test ("*Do you go on eating binges though you are not hungry?"* 1 = never, 2 = rarely, 3 = sometimes, 4 = at least once a week)) identified to the EE scale strongly (r = 0.72). Overall, our findings corroborate the TFEQ-R18 as a valid measure of these eating behaviors not only in the adolescent, adult, and general populations, and overweight and obese populations, but also in this sample of congregate meal participants.

The 3 different eating behaviors were associated with different patterns of reported food category intake. High CR showed significantly higher number of servings of vegetables consumed per day than low CR. While this relationship was only seen as a non-significant trend in the multivariate regression analyses, it does reinforce that presentation of this eating behavior is an attempt to control body weight through food choices generally deemed healthier, which is in accord with previously published findings (de Lauzon et al 2004). It has been suggested to separate cognitive dietary restraint into 2 subscales: rigid and flexible restraint. Rigid restraint is defined as an uncompromising approach to eating, dieting, and weight, whereas flexible restraint is a more mediated approach to eating, dieting, and weight which, for example, "fattening" foods are eaten in limited amounts without associated feelings of guilt. High flexible restraint has been associated with lower disinhibition, possibly leading to a lower level of loss of control, and greater likelihood of weight loss or weight maintenance. High rigid restraint has been associated with high UE, which suggests an individual following a strict and rigid diet could lead to episodes of loss of control and overeating (Karlsson et al 2000, Provencher et al 2003, Westenhoefer et al 1999). The high

vegetable intake associated with UE seen in this study could be due to the loss of control exhibited by high (rigid) CR resulting in demonstration and carryover of the same food choices. High UE and high EE reported significantly higher daily consumption of sweets and salty snacks, which is consistent with previous studies (Lähteenmäki and Tuorila 1995, de Lauzon et al 2004). These findings, combined with the single item discriminate discrepancy, the high correlation between these two eating behaviors, and the collective UE and EE Cronbach's alpha (0.88), suggest a strong relationship between UE and EE, which has also been seen in other adult populations (de Lauzon et al 2004, de Lauzon-Guillian et al 2006). However independently, the construct validity does support the eating behaviors are separate and independent, but these behaviors may also appear concurrently.

When controlling for demographics the most robust associations of the eating behaviors were seen with UE and EE. Previous research in this sample has suggested a relationship of these eating behaviors with obesity (Porter and Johnson 2011), so additional models controlled for both demographics and obesity. Additional models explored the associations of eating behaviors controlling for other eating behaviors, demographics, and/or obesity, as previous research has indicated strong relationships between CR, UE, and EE (de Lauzon et al 2004, de Lauzon-Guillian et al 2006). In all models, high UE was positively associated with vegetables in bivariate and multivariate logistic regression analysis with escalating R^2 from 0.04 (model with no controls) to 0.22 (model controlling for sociodemographics, CR, EE, and obesity) suggesting that these variables also explain some of the variance in vegetable intake Similarly, high EE was positively associated with salty snacks, which was replicated in bivariate and logistic regression analyses with escalating R^2 from 0.07 (model with no

controls) to 0.15 (model controlling for sociodemographics, CR, EE, and/or obesity) suggesting that these variables also explain some of the variance in salty snack intake. In this model, controlling for obesity did not increase the proportion of variance explained, suggesting obesity is not related to intake in this model. Other significant associations between eating behaviors and food intake were eliminated once the confounding factors were entered into the models.

This study found that associations with mean intake of these 6 reported food categories and eating behaviors are mostly independent of gender, apart from a few exceptions. Notably, high EE in men was associated with higher daily consumption of fruit and 100% fruit juice, but this association was not seen in women or in the total sample, confirming similar findings in previous papers (de Lauzon et al 2004, Provencher et al 2003). Comfort food preferences have been seen to vary across gender and age ranges (Wansink et al 2003), but there was insufficient power to further explore these relationships in logistic regression modeling.

The prevalence of these eating behaviors and the strong associations seen with specific food categories, specifically those associated strongly with less nutritious food groups are alarming. This population is currently the target of nutrition education interventions designed to increase the intake of nutrient-rich foods such as fruits, vegetables, whole grains, and milk products, and to decrease the intake of calorie-dense nutrient-poor foods such as sweets and salty snacks. The existence of these eating behaviors and the associated potentially unmanageable dietary choices in an overwhelmingly obese population lends

greater credence to the intensity and magnitude of eating behavior related problems in this population.

Future studies

A more comprehensive list of food groups may be important in future studies, as well as determining ways to overcome potential underreporting of "unhealthy" foods. This study did not employ data from a full-length FFQ, but instead utilized a short FFQ measuring intake of 6 food categories reported in servings or frequency of consumption per day. By relying on self-reported data, it would therefore be useful to compensate for underreporting and self-reporting biases. A previous study defined specific foods that tend to be underreported in a general population, many of which are important to this study (Lafay et al 2000). Namely, it was found that underreporting individuals most frequently reported lower intakes of food items rich in fat, carbohydrates, or sugar as consumed less frequently or in smaller quantities compared to non-underreporters. It was also found that foods systematically underreported concerned specific food items generally believed to be unhealthy (Lafay et al 2000). Further research is warranted to relate specific eating behaviors and the tendency to underreport specific food items or food categories as well as overall energy intake. Understanding this relationship may be beneficial in the analyses of health, chronic disease, and diet in all populations.

Because health awareness and access to healthier foods is strongly mediated by social and economic factors, it would also be of great interest to further understand the dynamics of eating behaviors across socioeconomic status. In this population, all of the participants are

offered 1 congregate meal 5 days per week, 51% were obese, 18% had an education of 8th grade or lower, and 24% of the respondents reported being food insecure. Although it was beyond the scope of the present study, it would be important in future studies to determine the reliability and validity of the TFEQ-R18 in food insecure and obese older adults, as well as the relationship of food insecurity and disordered eating behaviors.

Limitations

There are some limitations in this study. The study was cross-sectional in design, and thus conclusions regarding causality or its direction cannot be made regarding findings. Many of the participants have hearing or vision problems making it difficult to understand and complete questionnaires; however, interviewers completed this study by reading questions to participants and recording their respective responses. Congregate meals that meet the Dietary Guidelines for Americans (USDHHS and USDA 2010) are provided about 5 times per week and may be a substantial part of food intake, thus there may be a reduction in the food choices that might be made individually and may dilute and/or distort the relationship of eating behaviors with food group intake. The recruited population was limited to mobile, older individuals receiving nutritional assistance, and thus does not reflect all older people served by OAA Programs or the overall older adult population. The frequency of consumption, but not portion or serving sizes, was reported for these 6 food categories. Although the accuracy of FFQs has been questioned (Schaefer et al 2000), the use of food group categories has been validated in older adults and found to be an accurate predictor of serum vitamin B_{12} concentrations (with animal food intake, Johnson et al 2003) and serum vitamin D concentrations (with milk intake, Johnson et al 2008) in congregate meal

participants, and calcium and riboflavin status (with dairy intake, Huang et al 2011) and serum vitamin C (with fruit intake, Huang et al 2011) in individuals 60 to 65 years and older. Lastly, the sample population was small and had low representation in certain subgroups that limited the power to explore relationships of eating behaviors and dietary patterns in men or other ethnic groups such as Hispanics (76% female; 55% White, 44% Black) (Johnson and Porter 2011).

Conclusions

In conclusion, this study was able to fill in a research gap for the applicability of the TFEQ-R18 in this sample of congregate meal participants; it was found to be reliable and valid in this sample therefore extending its validity. This study adds new information that supports our interests regarding the interconnectedness of food choices and eating behaviors, and extends the research of others regarding the associations of food choices and eating behaviors related to CR, EE, and UE (Anglé et al 2009, Karlsson et al 2000, Konttinen et al 2010a, de Lauzon et al 2004). This sample population is currently the target of nutrition education interventions designed to increase the intake nutrient-rich foods, and to decrease the intake of calorie-dense nutrient-poor foods. This investigation into eating behaviors and the intake of selected food groups provides needed knowledge and understanding of previously unstudied risk factors for poor food choices, which can be targeted in order to improve nutrition education programs for older adults participating in publicly and privately funded food and nutrition assistance programs. Thus, these findings have the potential to affect project strategies and focus areas to reduce complications resulting from these problematic eating

behaviors, better target nutrition education, and improve counseling for healthy weight management.

TABLE 3.1 Characteristics of Participants

	All		Female		Male	
	N	Mean (SD) or %	*N*	Mean (SD) or %	*N*	Mean (SD) or %
Age, *years*	124	75 (8)	94	75 (8)	30	72 (7)
< 70	38	31%	24	26%	14	47%
≥ 70	86	69%	70	74%	16	53%
Gender	124		94	76%	30	24%
Race	124		94	76%	30	24%
White	68	55%	52	55%	16	53%
Black	54	44%	41	44%	13	43%
Non-White or Black	2	2%	1	1%	1	3%
Education level, *years*	121	10 (4)	91	10 (3)	30	12 (4)
< 8	22	18%	18	20%	4	13%
≥ 8	99	82%	73	80%	26	87%
Body mass index	124	31 (7)	94	31 (7)	30	32 (5)
< 30	61	49%	47	50%	14	47%
≥ 30	63	51%	47	50%	16	53%
Hypertension[1]	89	72%	73	79%	16	53%
Arthritis[1]	76	61%	60	79%	16	21%
Diabetes[1]	45	36%	34	36%	11	37%
Heart condition[1]	37	30%	25	68%	12	32%
Food insecure[2]	30	24%	24	80%	6	20%

[1] Hypertension, arthritis, diabetes, and heart disease self-reported, with responses coded as 0 = no and 1 = yes.

[2] Food insecurity was assessed by a negative answer to, "Do you always have enough money to buy the food you need?," with responses coded as 0 = no and 1 = yes.

TABLE 3.2 Summary of Multitrait/Multi-item Testing of the TFEQ-R18

		Multitrait/multi-item scaling tests					
		Item convergent validity		Item discriminate validity			
Scale	No. of items	Assigned scale[1]	Criterion[2]	Other scales[3]	Criterion[4]	Scaling fulfillment[5]	Reliability[6]
Cognitive restraint	6	0.35–0.62	5/6	0.07–0.31	12(12)/12	5/6	0.78
Uncontrolled eating	9	0.41–0.70	9/9	0.00–0.72	11(17)/18	8/9	0.83
Emotional eating	3	0.64–0.75	3/3	0.22–0.61	5(6)/6	3/3	0.83

[1] Range of Pearson correlations between items and their hypothesized scale (corrected for overlap).

[2] Proportion of item-scale correlations that meet minimum standard for convergent validity ($r \geq 0.40$, corrected for overlap).

[3] Range of Pearson correlations between items and other scales.

[4] Proportion of correlations that were significantly higher (or higher, but not significantly) between items and their hypothesized scales than to all other scales.

[5] Proportion of items that met criteria for item-scale convergent validity and item-scale discriminate validity.

[6] Cronbach's alpha.

TABLE 3.3 Pearson Correlations of Multitrait/Multi-item Testing of the TFEQ-R18

Cognitive restraint questions (6)	**CR**	**UE**	**EE**
2. Do you deliberately take small helpings as a means of controlling your weight? *Always (4), Usually (3), Rarely (2), Never (1)*	0.56	0.07	0.08
11. Do you consciously hold back at meals in order not to gain weight? *Always (4), Usually (3), Rarely (2), Never (1)*	0.58	0.21	0.13
12. Do you not eat some foods because they make you fat? *Always (4), Usually (3), Rarely (2), Never (1)*	0.62	0.25	0.25
15. How frequently do you avoid "stocking up" on tempting foods? *Almost always (4), Usually (3), Seldom (2), Almost never (1)*	0.35	0.21	0.31
16. How likely are you to consciously eat less than you want *Very likely (4), Moderately likely (3), Slightly likely (2), Unlikely (1)*	0.51	0.22	0.26
18. Do you feel you are restrained in your eating *Always restrained (constantly limiting food intake and never "giving in") (4), Usually restrained (3), Rarely restrained (2), Never restrained (eating whatever you want, whenever you want (1)*	0.58	0.17	0.13

Uncontrolled eating questions (9)	**CR**	**UE**	**EE**
1. When you see any of your favorite foods, do you find it very difficult to keep from eating, even if you have just finished a meal? *Always (4), Usually (3), Rarely (2), Never (1)*	0.22	0.41	0.34
4. Sometimes when you start eating, do you feel you just can't seem to stop? *Always (4), Usually (3), Rarely (2), Never (1)*	0.19	0.70	0.54
5. Being with someone who is eating often makes you hungry enough to eat also? *Always (4), Usually (3), Rarely (2), Never (1)*	0.17	0.52	0.48
7. When you see a real delicacy, do you often get so hungry that you have to eat right away? *Always (4), Usually (3), Rarely (2), Never (1)*	0.25	0.60	0.47
8. Do you get so hungry that your stomach often seems like a bottomless pit? *Always (4), Usually (3), Rarely (2), Never (1)*	0.32	0.53	0.27
9. Are you always hungry so it is hard for you to stop eating before you finish the food on your plate? *Always (4), Usually (3), Rarely (2), Never (1)*	0.14	0.55	0.43
13. Are you always hungry enough to eat at any time? *Always (4), Usually (3), Rarely (2), Never (1)*	-0.03	0.50	0.26
14. How often do you feel hungry? *Almost always (4), Often between meals (3), Sometimes between meals (2), Only at meal times (1)*	0.13	0.46	0.38
17. Do you go on eating binges though you are not hungry? *At least once a week (4), Sometimes (3), Rarely (2), Never (1)*	0.19	0.54	0.72

Emotional eating questions (3)	**CR**	**UE**	**EE**
3. When you feel anxious, do you find yourself eating? *Always (4), Usually (3), Rarely (2), Never (1)*	0.25	0.61	0.66
6. When you feel blue, do you often overeat? *Always (4), Usually (3), Rarely (2), Never (1)*	0.25	0.52	0.75
10. When you feel lonely, do you console yourself by eating? *Always (4), Usually (3), Rarely (2), Never (1)*	0.22	0.57	0.64

Non-shaded cells are representative of item convergent validity; shaded cells are representative of item discriminate validity.

TABLE 3.4 Average Intake of Food Category by Dichotomized Eating Behavior [1]

	Cognitive Restraint		*Uncontrolled Eating*		*Emotional Eating*	
Total Sample	Low	High	Low	High	Low	High
Sweets (times per day)	1.09	1.22	0.97	1.32 *	0.90	1.34 **
Salty snacks (times per day)	0.55	0.45	0.40	0.58 *	0.27	0.96 **
Fruits & 100% juice (servings per day)	1.86	1.95	1.86	1.95	1.77	1.31
Vegetables (servings per day)	2.41	2.80 *	2.38	2.83 *	2.50	1.37
Whole grains (times per day)	1.47	1.58	1.47	1.58	1.50	0.92
Milk (times per day)	1.34	1.50	1.34	1.50	1.31	1.10

	Cognitive Restraint		*Uncontrolled Eating*		*Emotional Eating*	
Females only (n = 93)	Low	High	Low	High	Low	High
Sweets (times per day)	1.07	1.18	0.98	1.25 *	0.94	1.25 *
Salty snacks (times per day)	0.56	0.34	0.40	0.47	0.25	0.56 **
Fruits & 100% juice (servings per day)	2.14	2.06	2.12	2.08	2.14	2.07
Vegetables (servings per day)	2.65	2.90	2.62	2.92	2.64	2.88
Whole grains (times per day)	1.39	1.62	1.46	1.56	1.48	1.53
Milk (times per day)	1.39	1.52	1.42	1.50	1.37	1.52

	Cognitive Restraint		*Uncontrolled Eating*		*Emotional Eating*	
Males only (n= 30)	Low	High	Low	High	Low	High
Sweets (times per day)	1.13	1.33	0.94	1.57	0.81	1.71 *
Salty snacks (times per day)	0.53	0.80	0.38	1.00	0.31	1.07 *
Fruits & 100% juice (servings per day)	1.07	1.60	1.19	1.50	0.94	1.79 *
Vegetables (servings per day)	1.73	2.47 *	1.75	2.50 *	2.19	2.00
Whole grains (times per day)	1.70	1.44	1.50	1.64	1.54	1.60
Milk (times per day)	1.22	1.41	1.15	1.50	1.17	1.48

[1] Respondents were grouped into "low" or "high" demonstration of the eating behavior according to median split: CR ≥ 10, UE ≥ 13, EE ≥ 4.

Asterisks indicate a significant difference between means of dichotomized eating behaviors:
* $P < 0.05$; ** $P < 0.01$.

TABLE 3.5 Spearman Correlation Coefficients of Food Group Intake with Eating Behavior, By Gender[1]

Total Sample	*Cognitive restraint*	*Uncontrolled eating*	*Emotional eating*
Sweets (times per day)	0.018	0.228 **	0.286 ***
Salty snacks (times per day)	-0.068	0.266 **	0.271 **
Fruits & 100% juice (servings per day)	0.090	0.054	0.012
Vegetables (servings per day)	0.227 **	0.107	0.014
Whole grains (times per day)	0.095	0.081	0.009
Milk (times per day)	0.083	0.083	0.156

Females only (*n* = 93)	*Cognitive restraint*	*Uncontrolled eating*	*Emotional eating*
Sweets (times per day)	0.040	0.223 *	0.225 *
Salty snacks (times per day)	-0.094	0.241 *	0.229 *
Fruits & 100% juice (servings per day)	0.005	0.005	-0.127
Vegetables (servings per day)	0.152	0.081	0.004
Whole grains (times per day)	0.152	0.106	0.043
Milk (times per day)	0.045	0.029	0.089

Males only (*n*= 30)	*Cognitive restraint*	*Uncontrolled eating*	*Emotional eating*
Sweets (times per day)	-0.040	0.260	0.465 **
Salty snacks (times per day)	0.048	0.369 *	0.462 **
Fruits & 100% juice (servings per day)	0.188	0.090	0.348
Vegetables (servings per day)	0.418 *	0.115	-0.076
Whole grains (times per day)	-0.053	-0.017	0.139
Milk (times per day)	0.158	0.153	0.311

[1] All variables are continuous.
Asterisks indicate significance: * $P < 0.05$; ** $P < 0.01$; ***$P < 0.001$.

TABLE 3.6 Logistic Regression Models Exploring Associations Between Eating Behavior and Food Category Intake[1]

	Sweets[2]	Salty snacks[2]	Fruits & 100% juice[2]	Vegetables[2]	Whole grains[2]	Milk[2]
Sociodemographics [OR (95% CI)][3]						
Age	1.7 (0.68, 4.49)	0.9 (0.42, 2.03)	1.1 (0.50, 2.64)	1.0 (0.41, 2.33)	0.5 (0.23, 1.07)†	0.7 (0.32, 1.58)
Gender	0.7 (0.29, 1.81)	0.5 (0.23, 1.21)	3.7 (1.21, 11.64)*	4.1 (1.14, 14.54)*	0.9 (0.38, 1.99)	1.3 (0.53, 3.12)
Race	1.2 (0.51, 2.67)	1.8 (0.83, 1.70)	1.4 (0.67, 3.12)	0.5 (0.21, 1.14)†	1.1 (0.52, 2.24)	0.7 (0.35, 1.60)
Education	1.6 (0.50, 5.18)	0.6 (0.24, 1.62)	1.0 (0.36, 2.64)	-[6]	2.1 (0.77, 5.91)	2.0 (0.69, 5.96)
Cognitive Restraint [OR (95% CI)][4]	1.1 (0.49, 2.52)	0.7 (0.33, 1.40)	1.3 (0.62, 2.91)	2.0 (0.88, 4.71)†	1.4 (0.69, 2.93)	0.7 (0.34, 1.54)
Sociodemographics	1.2 (0.51, 2.86)	0.7 (0.30, 1.43)	1.2 (0.54, 2.75)	1.7 (0.69, 4.28)	1.4 (0.66, 3.02)	0.7 (0.31, 1.50)
Sociodemographics + Obesity[5]	1.2 (0.46, 2.91)	0.6 (0.25, 1.33)	1.3 (0.53, 3.06)	1.5 (0.52, 4.18)	1.7 (0.72, 3.80)	0.7 (0.31, 1.70)
Sociodemographics + UE + EE	0.9 (0.36, 2.28)	0.4 (0.17, 1.01)†	1.2 (0.50, 2.75)	1.5 (0.56, 3.91)	1.4 (0.65, 3.17)	0.6 (0.27, 1.41)
Sociodemographics + UE + EE + Obesity[5]	0.9 (0.36, 2.44)	0.4 (0.17, 1.04)†	1.2 (0.50, 3.02)	1.3 (0.44, 3.85)	1.7 (0.71, 3.83)	0.7 (0.28, 1.60)
Uncontrolled Eating [OR (95% CI)][4]	2.3 (0.97, 5.38)†	2.1 (0.98, 4.36)†	1.3 (0.62, 2.91)	2.5 (1.05, 5.77)*	1.1 (0.53, 2.22)	1.1 (0.53, 2.37)
Sociodemographics	2.2 (0.90, 5.40)†	2.0 (0.89, 4.42)†	1.3 (0.57, 2.91)	2.7 (1.06, 6.89)*	1.0 (0.47, 2.16)	1.1 (0.50, 2.38)
Sociodemographics + Obesity[5]	2.2 (0.88, 5.56)†	2.0 (0.87, 4.44)	1.3 (0.57, 3.07)	2.5 (0.96, 6.63)†	1.1 (0.49, 2.33)	1.2 (0.52, 2.60)
Sociodemographics + CR + EE	1.8 (0.70, 4.85)	1.6 (0.66, 3.97)	1.3 (0.53, 3.17)	3.0 (1.04, 8.76)*	0.9 (0.41, 2.15)	1.1 (0.45, 2.51)
Sociodemographics + CR + EE + Obesity[5]	1.9 (0.70, 4.95)	1.6 (0.66, 3.98)	1.3 (0.54, 3.25)	3.0 (1.02, 8.64)*	1.0 (0.42, 2.23)	1.1 (0.46, 2.57)
Emotional Eating [OR (95% CI)][4]	2.1 (0.89, 5.16)†	3.2 (1.46, 7.18)**	1.2 (0.54, 2.58)	1.6 (0.68, 3.62)	1.2 (0.56, 2.43)	1.5 (0.70, 3.26)
Sociodemographics	2.4 (0.90, 6.15)†	3.9 (1.58, 9.72)**	1.0 (0.44, 2.36)	1.1 (0.42, 2.72)	1.0 (0.47, 2.29)	1.3 (0.60, 3.05)
Sociodemographics + Obesity[5]	2.4 (0.89, 6.60)†	4.1 (1.60, 10.63)**	1.0 (0.43, 2.48)	0.9 (0.32, 2.41)	1.1 (0.49, 2.61)	1.5 (0.65, 3.62)
Sociodemographics + CR + UE	2.0 (0.71, 5.54)	4.3 (1.57, 11.59)**	0.9 (0.35, 2.23)	0.6 (0.20, 1.79)	1.0 (0.42, 2.32)	1.5 (0.61, 3.46)
Sociodemographics + CR + UE + Obesity[5]	2.0 (0.71, 5.89)	4.3 (1.54, 11.80)**	0.9 (0.36, 2.32)	0.6 (0.18, 1.74)	1.1 (0.45, 2.61)	1.6 (0.63, 3.96)

[1] *n* = 119 to 124, because of missing data (2 not White or Black, 3 missing education, 1 missing sweets, 1 missing salty snacks, 1 missing fruits/100% juice, 1 missing vegetables, 1 missing whole grains, 1 missing milk, and some missing more than 1 of these variables).

[2] Food groups dichotomized by the upper third quadrant: sweets ≥ 2, salty snacks ≥ 1, fruit ≥ 3, vegetables ≥ 4, whole grains ≥ 2, and milk ≥ 2.

[3] Odds ratios calculated for each individual sociodemographic variable coded as age (0 = < 70 years, 1 = ≥ 70 years), gender (0 = male, 1 = female), race (0 = White, 1 = Black), and education (0 = < 8th grade, 1 = ≥ 8th grade).

[4] Eating behaviors dichotomized by the median split: CR ≥ 10, UE ≥ 13, EE ≥ 4.

[5] Values controlled for obesity (BMI ≥ 30).

[6] Odds ratio for vegetables that controlled for education was too small to obtain a reliable estimate, thus, this data is not reported.

Asterisks indicate a significant difference between odds ratios: * $P < 0.05$; ** $P < 0.01$; † indicates a non-significant difference, $P < 0.10$.

TABLE 3.7 *R*-Squared Values from Logistic Regression Models Exploring Associations Between Eating Behavior and Food Category Intake[1, 2]

	Sweets[3]	Salty snacks[3]	Fruits & 100% juice[3]	Vegetables[3]	Whole grains[3]	Milk[3]
Sociodemographics[4]						
Age	0.01	0.00	0.00	0.00	0.03	0.01
Gender	0.00	0.02	0.05	0.05	0.00	0.00
Race	0.00	0.02	0.01	0.02	0.00	0.00
Education	0.01	0.01	0.00	[7]	0.02	0.01
Cognitive Restraint[5]	0.00	0.00	0.00	0.02	0.01	0.01
Sociodemographics	0.02	0.05	0.07	0.19	0.05	0.04
Sociodemographics + Obesity[6]	0.02	0.06	0.07	0.19	0.06	0.04
Sociodemographics + UE + EE	0.06	0.15	0.07	0.22	0.05	0.04
Sociodemographics + UE + EE + Obesity[6]	0.06	0.15	0.07	0.22	0.06	0.05
Uncontrolled Eating[5]	0.03	0.03	0.00	0.04	0.00	0.00
Sociodemographics	0.05	0.06	0.07	0.21	0.04	0.03
Sociodemographics + Obesity[6]	0.05	0.06	0.07	0.21	0.05	0.03
Sociodemographics + CR + EE	0.06	0.15	0.07	0.22	0.05	0.04
Sociodemographics + CR + EE + Obesity[6]	0.06	0.15	0.07	0.22	0.06	0.05
Emotional Eating[5]	0.02	0.07	0.00	0.01	0.00	0.01
Sociodemographics	0.05	0.12	0.07	0.18	0.04	0.03
Sociodemographics + Obesity[6]	0.05	0.12	0.07	0.19	0.05	0.04

Sociodemographics + CR + UE	0.06	0.15	0.07	0.22	0.05	0.04
Sociodemographics + CR + UE + Obesity[6]	0.06	0.15	0.07	0.22	0.06	0.05
Minimum R-squared value	0.00	0.00	0.00	0.00	0.00	0.00
Maximum R-squared value	0.06	0.15	0.07	0.22	0.06	0.05

[1] *n* = 119 to 124, because of missing data (2 not White or Black, 3 missing education, 1 missing sweets, 1 missing salty snacks, 1 missing fruits/100% juice, 1 missing vegetables, 1 missing whole grains, 1 missing milk, and some missing more than 1 of these variables).

[2] *R*-squared values expressed as proportion of variance explained by the model.

[3] Food groups dichotomized by the upper third quadrant: sweets ≥ 2, salty snacks ≥ 1, fruit ≥ 3, vegetables ≥ 4, whole grains ≥ 2, and milk ≥ 2.

[4] Sociodemographic variables coded as age (0 = < 70 years, 1 = ≥ 70 years), gender (0 = male, 1 = female), race (0 = White, 1 = Black), and education (0 = < 8th grade, 1 = ≥ 8th grade).

[5] Eating behaviors dichotomized by the median split: CR ≥ 10, UE ≥ 13, EE ≥ 4.

[6] Values controlled for obesity (BMI ≥ 30).

[7] *R*-squared value for vegetables that controlled for education was too small to obtain a reliable estimate, thus, this data is not reported.

CHAPTER 4

SUMMARY

The primary goal of this study was to determine if the Three-Factor Eating Questionnaire – Revised 18-Item (TFEQ-R18) was valid for use in congregate meal participants, and if the elucidated eating behaviors were associated with specific food intake. The first specific aim of the study was to determine the construct validity and reliability of the TFEQ-R18 in a sample of congregate meal participants. The first hypothesis was that the three scales, cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE), would have acceptable internal validity (convergent and discriminate) and reliability (Cronbach's alpha). The second specific aim was to analyze the relationship of eating behaviors identified in the TFEQ-R18 with the intake of certain food groups. The second hypothesis was that CR would be positively associated with "healthy foods" such as fruits and vegetables, and UE and EE would be positively associated with sweet and non-sweet energy-dense foods. The major findings of this study are that the TFEQ-R18 demonstrates acceptable construct validity and reliability in this sample of congregate meal participants, and that CR, UE, and EE were associated with several of the food group intakes in the bivariate analyses, with the most robust associations seen with UE and higher vegetable intake, as well as EE and higher salty snack intake, that were detected in the multivariate logistic regression analyses.

The TFEQ-R18 is an 18-item instrument that identifies eating behaviors that may contribute causally to obesity (e.g., UE or EE) or may be responses to obesity and attempts to lose

weight (e.g., CR) (Anglé et al 2009, de Lauzon-Guillian et al 2006, Porter and Johnson 2011). The questionnaire was developed in an obese adult population (Karlsson et al 2000), and has been validated in large samples of adolescents and adults, and obese and nonobese individuals (Anglé et al 2009, de Lauzon et al 2004). The TFEQ-R18 is a common tool in current research and the few construct validity studies that have been conducted have shown good acceptability, but little has been understood about its validity in diverse populations, e.g., older adults, congregate meal participants, and other subgroups of older adults. This study conducted analyses of convergent and discriminate validity using multitrait/multi-item scaling, which established satisfactory internal consistency of the TFEQ-R18 in this sample. One discrepancy was detected in the CR scale when verifying item convergent validity while all other items on this scale were highly correlated. This item did not show high association to any scale, and this same item was found to be in item convergent discrepancy by others (de Lauzon et al 2004), overall suggesting some underlying weakness in this item. One item was found discrepant in discriminate validity tests; this item in the UE scale identified strongly to the EE scale. Overall, our findings substantiate the TFEQ-R18 as a valid measure of disordered eating behaviors not only in the adolescent, adult, and general populations, and average weight and obese populations, but also in this sample of congregate meal participants.

The 3 different eating behaviors were associated with different patterns of reported food intake. This study found significant relationships between CR, UE, and EE with specific food groups. In bivariate analyses, high CR was positively and significantly associated with higher vegetable intake. In multivariate logistic regression analyses, this finding was no

longer seen. In bivariate analyses, high UE was positively and significantly associated with higher intakes of sweets, salty snacks, and vegetables. In multivariate regression analyses controlling for demographics and obesity, higher UE significantly increased the odds of consuming ≥ 4 vegetable servings daily (OR 3.0, 95% CI 1.02, 8.64, $p < 0.05$), but the associations of UE with sweets and salty snacks were no longer observed. In bivariate analyses, high EE was associated with higher intakes of sweets and salty snacks, and multivariate regression analyses confirmed the relationship with salty snacks, but the relationship with sweets was no longer seen. High EE significantly increased the odds of consuming ≥ 1 salty snacks per day (OR 4.3, 95% CI 1.54, 11.80, $p < 0.001$).

The relationship of higher CR with higher vegetable intake emphasizes that this eating behavior is an attempt to control body weight through food choices generally deemed healthier, which is in agreement with previously published findings (de Lauzon et al 2004). Numerous researchers have suggested dividing CR into 2 subscales: rigid and flexible restraint. Rigid restraint is defined as an inflexible approach to eating, dieting, and weight, whereas flexible restraint is a more moderated approach to eating, dieting, and weight. High rigid restraint has been associated with high UE, possibly leading to events of loss of control and overeating (Karlsson et al 2000, Provencher et al 2003, Westenhoefer et al 1999). The high vegetable intake associated with UE seen in this study could be due to the loss of control exhibited by high (rigid) CR resulting in presentation and carryover of the same food choices. High UE and high EE reported significantly higher daily consumption of sweets and salty snacks, which is consistent with previous studies (Lähteenmäki and Tuorila 1995, de Lauzon et al 2004). These findings, as well as the UE item in discriminate validity

discrepancy, add force to the conjecture that a strong relationship exists between UE and EE, which has been seen in other adult populations (de Lauzon et al 2004, de Lauzon-Guillian et al 2006).

Overall, this study demonstrated that the TFEQ-R18 is an acceptable instrument for use in congregate meal participants, and that the prevalence of these disordered eating behaviors and the strong associations seen to specific food categories, specifically those associated strongly with less nutritious food groups, needs to be addressed. Future studies could benefit by including a complete food frequency questionnaire and further explore the food groups noted above that have shown strong associations to specific eating behaviors, and overall energy intake. Understanding these relationships may be beneficial in the analyses of mental and physical health, and chronic disease in all populations. In this population, all of the respondents are offered 1 congregate meal 5 days per week, 51% were obese, 18% had an education of 8^{th} grade or lower, and 24% of the respondents reported being food insecure. It would also be of interest to examine the relationship of eating behaviors to socioeconomic status, determine the reliability and validity of the TFEQ-R18 in food insecure and obese older adults, as well as the relationship of food insecurity and these eating behaviors.

In conclusion, this investigation of the TFEQ-R18 extends the applicability of this instrument to a wider audience. Congregate meal participants receive approximately 5 healthy mid-day meals per week that comply with the Dietary Guidelines (USDHHS and USDA 2010), but the existence of these identified eating behaviors could be influencing the consumption of foods consumed at other times and perhaps undermine the effectiveness of nutrition

education programs that are also offered regularly at these congregate meal sites. Thus, these findings have the potential to impact nutrition education and intervention programs, enhance weight management counseling, and may signal the need to involve a multi-disciplinary team in the promotion of healthy eating habits in this population.

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APPENDICES

Appendix A – Three-Factor Eating Questionnaire – Revised 18-Item

Three-Factor Eating Questionnaire: ***Explain to the participant, "The next questions will have four answers, such as always, usually, rarely, or never."***	**Always**	**Usually**	**Rarely**	**Never**
1. When you see any of your favorite foods, do you find it very difficult to keep from eating, even if you have just finished a meal?	4	3	2	1
2. Do you deliberately take small helpings as a means of controlling your weight?	4	3	2	1
3. When you feel anxious, do you find yourself eating?	4	3	2	1
4. Sometimes when you start eating, do you feel you just can't seem to stop?	4	3	2	1
5. Being with someone who is eating often makes you hungry enough to eat also?	4	3	2	1
6. When you feel blue, do you often overeat?	4	3	2	1
7. When you see a real delicacy, do you often get so hungry that you have to eat right away?	4	3	2	1
8. Do you get so hungry that your stomach often seems like a bottomless pit?	4	3	2	1
9. Are you always hungry so it is hard for you to stop eating before you finish the food on your plate?	4	3	2	1
10. When you feel lonely, do you console yourself by eating?	4	3	2	1
11. Do you consciously hold back at meals in order not to gain weight?	4	3	2	1
12. Do you not eat some foods because they make you fat?	4	3	2	1
13. Are you always hungry enough to eat at any time?	4	3	2	1

14. How often do you feel hungry?	Almost always (4)	Often be-tween meals (3)	Some-times be-tween meals (2)	Only at meal times (1)
15. How frequently do you avoid "stocking up" on tempting foods?	Almost always (4)	Usually (3)	Seldom (2)	Almost never (1)
16. How likely are you to consciously eat less than you want?	Very likely (4)	Moder-ately likely (3)	Slightly likely (2)	Unlike-ly (1)
17. Do you go on eating binges though you are not hungry?	At least once a week (4)	Some-times (3)	Rarely (2)	Never (1)
18. Do you feel you are restrained in your eating? Always restrained (constantly limiting food intake and never "giving in"), Usually restrained, Rarely restrained, or Never restrained (eating whatever you want, whenever you want).	Always (4)	Usually (3)	Rarely (2)	Never (1)
19. **The cognitive restraint scale is the sum of items 2, 11, 12, 15, 16, 18.**				
20. **The uncontrolled eating scale is the sum of items 1, 4, 5, 7, 8, 9, 13, 14, and 17.**				
21. **The emotional eating scale is the sum of items 3, 6, and 10.**				

Appendix B – Short Food Frequency Questionnaire (extract from a larger physical and mental health questionnaire)

Read Questions to Participants and Record Their Answers	
1. How many times a day do you eat something sweet, such as candy, cookies, cakes, pie, donuts, ice cream?	0 1 2 3 4 5 6 7
2. How many times a day do you eat salty snacks, such as chips, French fries, pretzels?	0 1 2 3 4 5 6 7
3. How many servings of fruits and 100% fruit juices do you usually have each day?	0 1 2 3 4 5 6 7
4. How many servings of vegetables do you usually eat each day?	0 1 2 3 4 5 6 7
5. How often do you eat whole wheat or whole grain bread (such as 100% whole wheat bread)? <1/wk 1/wk 2/wk 3/wk 4/wk 5/wk 6/wk 1/day 1-2/day 2/day 2-3/day 3/day* DK	
6. How often do you eat whole grain cereals (such as oatmeal, Cheerios®, bran flakes or bran cereal)? <1/wk 1/wk 2/wk 3/wk 4/wk 5/wk 6/wk 1/day 1-2/day 2/day 2-3/day 3/day* DK	
7. How often do you eat milk as a beverage (including soy milk)? <1/wk 1/wk 2/wk 3/wk 4/wk 5/wk 6/wk 1/day 1-2/day 2/day 2-3/day 3/day* DK	
8. How often do you eat milk on cereal (including soy milk)? <1/wk 1/wk 2/wk 3/wk 4/wk 5/wk 6/wk 1/day 1-2/day 2/day 2-3/day 3/day* DK	