RELATIONSHIPS OF DEPRESSION, ANXIETY, AND STRESS WITH EATING BEHAVIORS IN OLDER ADULTS

by

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(Under the Direction of Mary Ann Johnson)

ABSTRACT

The purpose of this study was to explore potential relationships of eating behaviors with mental health in congregate meal participants in Georgia (N = 124, mean age = 75 years, 76% female, 44% African American). Eating behaviors were evaluated with the Three-Factor Eating Questionnaire (18 questions) and mental health was assessed with the Depression Anxiety Stress Scale (21 questions). For analyses, depression, anxiety, and stress were each dichotomized (low or normal symptoms versus mild, moderate, or severe symptoms) and each eating behavior was dichotomized (lowest two tertiles or three quartiles of the distribution versus top tertile or quartile of the distribution). Analyses revealed significant relationships among the following: depression with emotional eating, stress with emotional eating and uncontrolled eating, and anxiety with cognitive restraint (all $p < 0.05$). Thus, depression, anxiety, and stress may influence eating behaviors and may be targets for weight management in these elders.

INDEX WORDS: TFEQ-R18, Three-Factor Eating Questionnaire, Depression Anxiety Stress Scale, DASS-21, Mental health, Depression, Anxiety, Stress, Eating Behavior, Cognitive restraint, Uncontrolled eating, Emotional eating, Congregate Meal Participant, Older Adult, Aging, OAANP, Senior Center

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BS, University of Georgia, 2011

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2013

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August 2013

ACKNOWLEDGEMENTS

I would first and foremost like to thank the faculty and staff at the University of Georgia within the Department of Foods and Nutrition. Without the education and guidance granted to me by these experienced professional educators, completing this research project would have been impossible. I would like to particularly recognize Dr. Mary Ann Johnson and Dr. Kathryn (Porter) Starr for their invaluable contributions to this research project as well as to my education and training as a scientific researcher and nutrition professional. I would also like to acknowledge Dr. Jung Sun Lee, Dr. Joan Fischer, and Dr. Alex Anderson for their significant impact on my educational experience within the field of nutrition.

I would like to recognize my advisory committee, Dr. Joan Fischer and Ms. Connie Crawley, whose expertise and cooperative support has tremendously facilitated my ability to complete this document. My graduate peers under the advisement of Dr. Mary Ann Johnson have also been an instrumental and appreciated support system, and I particularly wish to intensely thank my graduate peer, Susannah Gordon, for her encouragement and collaborative guidance involved in my research experience. Additionally, I must offer my full gratitude to Dr. Anne Glass for training me in the field of gerontology and further inspiring my interests in helping older adult populations.

Lastly, I am eternally grateful to my family for encouraging my academic development, affording me the opportunity to continue my education within the field of nutrition, and allowing me to realize my dreams.

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CHAPTER 1

INTRODUCTION

The population of older adults in the United States is growing rapidly, and the proportion of older adults age 65 y and older is expected to increase from 13.1 % to over 19.3 % by the year 2030 (Administration on Aging 2011). In addition to the overall increase of older adults in the U.S., a larger percentage of this population will be minority (Leveille et al 2005), and the increasing ethnic diversity will require further understanding of the health and nutrition challenges associated with different cultural groups in order to afford equally effective treatments to all elders.

Although life longevity has increased, the quality of life for many older adults has been hindered by a high prevalence of obesity and chronic disease. Older adults have a higher prevalence of obesity than their younger counterparts: 41.8 % of white females and 55.5% of African American females 65 y and older are obese (BMI $\geq$ 30), while 37.1% of white males and 37.8 % of black males 65 y and older are obese (Flegal et al 2012). The obesity epidemic within the U.S. population, including older adults, compounds the issue of normal physiological functional decline associated with aging. Obesity is associated with increased risk for development of chronic disease (Angheel et al 2011; Godin et al 2012; Leveille et al 2005; Vogelzangs et al 2012). Many other health and social influences affect the overall quality of life for an obese older adult, including mental health status, disability, social support, and access to adequate nutrition and health care services (Angheel et al 2011; Lin et al 2011). Mental health problems, including

depression, anxiety, and stress, are associated with chronic disease, especially affecting the well being of older adults (Mojtabai 2011). The complex interrelationships of depression, anxiety, and stress with eating behavior, obesity, and associated influences suggest a need for further research to investigate the causal pathways between mental health problems and obesity, including the relationships of depression, anxiety, and stress with eating behaviors.

Congregate meal participants in senior centers in northeast Georgia's Area Agency on Aging have a high prevalence of depression (23%), anxiety (23%), and obesity (54%, Porter and Johnson 2011), and although many participants are low-income, all have access to health promotion programs and referrals to mental health and dietetics professionals through the senior centers. A previous study showed a positive association between obesity and eating behaviors, particularly cognitive restraint and emotional eating (as assessed by the Three-Factor Eating Questionnaire R-18, deLauzon et al 2004) in this population. Additionally, the prevalence of anxiety and stress tended to be higher in obese individuals, but these were not associated in the fully adjusted models (Porter and Johnson 2011).

The purpose of this study is to determine whether positive associations exist among mental health problems and eating behaviors within this population of congregate meal participants. The older adult population is an important group for medical and nutritional research due to their unique needs, diversity, and increasing life span. Thus, understanding the effects of depression, anxiety, and stress on eating behaviors is important so that mental health and dietetics professionals may provide effective weight management programs that appropriately target the underlying depression, anxiety and stress, and/or unhealthy eating behaviors.

Chapter 2 is a review of the literature outlining the demographics, obesity statistics, and related health concerns of the older adult population, characterization of mental health problems (depression, anxiety, and stress), eating behaviors (cognitive restraint, uncontrolled eating, emotional eating), and proposed relationships of the mental health problems with diet, obesity, and the eating behaviors.

Chapter 3 is a summary of my research findings and is written in a manuscript style to be submitted to the *Journal of Nutrition in Gerontology and Geriatrics*. This chapter will summarize the methods and results of my research study and will discuss the implications for weight management interventions in older adults.

Chapter 4 is a summary of the major conclusions and the significance of this research study.

CHAPTER 2

LITERATURE REVIEW

Significance of older adult population

The older adult population is rapidly increasing in the United States and worldwide, particularly in developed countries where improved medical technology and treatments have led to an increased life span. The population of adults 65 y and older comprises 13.1% of the U.S. population and this percentage is expected to increase to 19.3% by the year 2030 (Administration on Aging 2011). Despite recent improvements in health care, the proportion of older adults who are obese and/or have related chronic diseases is high and has steadily increased over the past century (Flegal et al 2012; Leveille et al 2005). Therefore, many older persons may be spending longer periods of time during their lives battling disease and requiring help with activities of daily living, which may be detrimental to U.S. health care costs (Carter et al 2011). Efforts must be made to improve the quality of life in older adults to avoid a national health care crisis. Thus, the older adult population is a key group for medical and nutritional research due to their diversity and unique needs.

Obesity and related disease in older adults

The prevalence of obesity in the United States has increased over the past several decades, and the older adult population is no exception. Although caloric needs decrease as we age, many older individuals continue to consume excessive calories and may be sedentary, which increases their risk of becoming overweight or obese. National survey data shows that adults 65 y and

older, with the exception of black males, have a higher prevalence of overweight and obesity compared to the age-adjusted averages for all age groups (Fiest et al 2011; Flegal et al 2012). Older females are at greater risk for obesity than their male counterparts, especially if they are low-income and/or from a minority group (Angheel et al 2011; Clarke et al 1981; Leveille et al 2005; Punzalan et al 2006). In 2010, 41.8% of white females and 55.5% of black females 65 y and older were obese (body mass index $\geq$ 30 as calculated by body weight in kilograms divided height in meters squared), while both black and white males 65 y and older presented with a similar obesity prevalence of about 37% (Flegal et al 2012). Older adults may have an increased risk for becoming obese due to functional limitations, food insecurity, low physical activity, inadequate knowledge of nutrition, and use of certain medications that may promote weight gain (Clarke et al 1981; McNaughton et al 2012). A clear association has been established between obesity and increased risk for the development of chronic diseases such as diabetes, hypertension, arthritis, and/or cardiovascular disease (Leveille et al 2005; Vogelzangs et al 2012). It is estimated that nearly 80% of adults 65 y and older have at least one chronic health condition, and 50% suffer from two or more (Administration on Aging 2012; Elsner 2002). Approximately 95% of Medicare costs are to beneficiaries with at least one chronic disease (Carter et al 2011), but research has suggested that nearly 80% of health conditions that are associated with aging could be prevented or delayed through proper lifestyle behaviors (McNaughton et al 2012). Considering the interrelationships between age, ethnicity, obesity, and chronic disease, as well as the implications for future national healthcare, public health programs should promote behavioral interventions aimed at normalizing weight and preventing the onset of chronic disease(s).

Older Americans Act and congregate meal programs

The Older Americans Act (OAA) was passed by Congress in 1965, establishing authority for grants to states for community social services, research, and development projects geared towards Americans 60 y and older. This act established the Administration on Aging to oversee grants and administer programs. Today the OAA is the major organization for implementing social and nutrition projects for older adults and their caregivers (Administration on Aging 2010). OAA Title IIIC section 330 established congregate nutrition services in 1972, and the current purpose is to reduce hunger and food insecurity, provide socialization, and promote health in older adults (Administration on Aging 2012). In Georgia, the congregate meal program is implemented through the Georgia Department of Human Services, Division of Aging Services. One meal per person per weekday is typically served in congregate meal sites throughout Georgia, and each meal must provide at least one-third of the Recommended Daily Allowance of nutrients established by the Institute of Medicine (IOM 2010) and follow the meal patterns of the Dietary Guidelines for Americans (USDHHS and USDA 2011). Adults 60 y and older are eligible to receive the benefits of the program, and their spouses are eligible regardless of age (Georgia Department of Human Services 2011). Priority is given to persons with low-income, particularly minorities (Administration on Aging 2010), however, the issue of food insecurity is still prevalent in congregate meal participants (Porter and Johnson 2011; Lee 2010). Although reports demonstrate general nutritional adequacy within congregate meal programs (Grandjean et al 1981) and participants often have access to nutrition care services through the senior centers, the high prevalence of obesity and chronic disease in participants remains alarming (Porter and Johnson 2011).

Mental health problems

Mental health problems are common in the older adult population (American Psychological Association 2012; Theilke and Unutzer 2010) and depression and anxiety are the most common psychiatric conditions in elders. Depression affects approximately 20% and anxiety disorder affects approximately 11% of community-dwelling adults 55 y and older (Administration on Aging 2011). Depression has been characterized as the fourth leading contributor to the global burden of disease (World Health Organization 2012) and the leading cause of disability in the United States (National Institute of Mental Health 2010). The prevalence of mental health problems is less among community dwelling older adults when compared to institutionalized elders, but the majority older adults with psychological problems live within the community.

Symptoms of depression, anxiety, and stress

Depression, anxiety, and stress are mental health problems that result in changed behavior or mood. Depression is characterized by depressed mood, loss of interest, feelings of guilt or low self-worth, disturbed sleep or appetite, low energy, and poor concentration (World Health Organization 2012). Anxiety is characterized by increased breathing and stomach contractions, reduced levels of confidence and increased avoidance behavior, disrupted sleep patterns, increased fear, and sudden emotional outbursts (Powell 2000). Stress symptoms include disrupted sleeping, stomach problems, altered eating behaviors, difficulty swallowing, and dry mouth (Powell 2000). Many of the aforementioned symptoms of mental health problems seem to pose threats to normal eating behaviors.

Mental health problems in older adults

Although older adults have a lower prevalence of mental health disorders than younger cohorts (American Psychological Association 2011), elders with psychological problems may experience more severe problems in cognitive functioning, coping ability, emotional stability, and interpersonal behavior (Teng et al 2012; Wong et al 2011). Older persons with depressive symptoms tend to experience a greater prevalence of obesity-related chronic health problems such as diabetes and heart disease (Villareal et al 2005; Woo et al 2006). Depression is associated with many situations common in the older adult population, including stressful life events, low social support, disability, and life-long obesity (Guerdjikova et al 2006; Fiske et al 2009; Richardson et al 2012; Teng et al 2012). The strength of social supports is particularly protective against the development of depression in older, community-dwelling females (Teng et al 2012). Other risk factors for mental health problems in older adults include living alone, low socioeconomic status, and polypharmacy (Elsner 2002; Lin PC et al 2011; Teng et al 2012). White females tend to present more depressive symptoms than their male counterparts, but findings related to gender vary when this relationship is analyzed within black populations. One study in older adults found that black persons did not show gender differences in prevalence of depressive symptoms (Yancu 2011).

Mental health diagnosis and treatment issues

Unsettling issues exist concerning the diagnosis and treatment of mental health problems in elders. Older adults are less likely to seek treatment for their mental health problems than younger adults and they are more likely to under-report or minimize symptoms (Mackenzie et al 2011; Teng et al 2012). Only a small proportion of older adults have their mental health

problems recognized within their primary health care setting (Elsner 2002), and approximately 70% of adults 55 y and older with mood and anxiety disorders are not using treatment services (Byers et al 2012). Women have a 1.6 fold greater prevalence of depressive symptoms than men (Lin and Wang 2011), but men are less likely to seek treatment for mental health problems (Mackenzie et al 2011). Compared to white older adults, black elders are less likely to receive a mental health diagnosis, and those that are diagnosed with depression are less likely to receive treatment (Akincigil et al 2012). Additionally, cultural variations exist in regards to social acknowledgement of mental health problems and the willingness to share psychological concerns with a health professional (Jiminez et al 2013; Wong et al 2011).

Chronic disease relationships mental health problems

Mental health is associated with chronic disease, and this association appears stronger in older age groups (Mojtabai 2011). A clear association of depression and chronic disease has been established, and the severity of the depressive symptoms is directly related to the number and severity of existing chronic conditions (Robinson 2010). There is an increased prevalence of mental health problems in those that have been diagnosed with diabetes, cardiac disease, and/or arthritis (Angheel et al 2011; Robinson 2010; Teng et al 2012; Vogelzangs et al 2012), and conversely, adults suffering from one or more mental health problems have a greater risk for developing chronic medical conditions and tend to have higher medical co-morbidities (Lin et al 2011; Somerset et al 2011). Anxiety is positively associated with the presence of chronically painful conditions and chronic diseases (El-Gabalawy 2011), and certain medications may lead to new or aggravated depressive symptoms (Elsner 2002).

Depression, anxiety, and stress relationships with dietary patterns and obesity

There is a known relationship of depression, anxiety, and stress with diet and obesity, but the limited research done in this area with older adult populations has produced mixed results (de Wit et al 2010; Luppino et al 2010; Teng et al 2012). There is evidence to suggest that obesity is related to stress, depression, and anxiety in older adults, however the direction of causality is unclear and may be dependent on other confounding variables (Angheel et al 2011; Godin et al 2012; Vogelzangs et al 2012). Various psychological states may either trigger or inhibit eating in individuals, and the dietary outcome is dependent on whether food is used as a palliative coping agent to reduce negative feelings (Geliebter and Aversa 2003). Epidemiological data generally support a positive association between obesity and depression, however, body mass and gender appear to mediate this relationship. Research has revealed that positive relationships exist with depression and waist circumference as well as with anxiety and energy intake in obese females, whereas this relationship is absent in lean females (Schneider et al 2010; Stewart-Knox et al 2012). A study in community-dwelling females (46 - 49 y and 70 - 74 y) found that unhealthy diets are positively related to depression and anxiety in women and to depression in men, and unhealthy diets are positively associated with anxiety regardless of gender (Jacka et al 2011). Persistent fluctuation in body weight has been linked to increased changes in mood and increased likelihood of depression (Elsner 2002), and intentional weight loss tends to reduce depressive symptoms (Simon et al 2010; Somerset et al 2011). In a study of congregate meal participants with a high prevalence of obesity (54%), the prevalence of anxiety and stress tended to be higher in obese individuals, but these mental health problems and obesity were not associated in the fully adjusted models (adjusted for mental health problems, demographics, food insecurity, self-reported health, and chronic disease, Porter and Johnson 2011). The inconsistencies in current

literature regarding the relationships of depression, anxiety, and stress with poor diet and obesity in older adults suggests a need for further research to investigate the causal pathways between mental health problems and obesity, including the relationships of depression, anxiety, and stress with eating behaviors.

Eating behavior relationships with dietary patterns and obesity

Eating behaviors such as cognitive restraint (conscious restriction of food intake in order to control body weight or promote weight loss), emotional eating (inability to resist emotional cues, overeating during emotional mood state), and uncontrolled eating (tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger) are significantly related to dietary choices (de Lauzon et al 2004). The prevalence of dieting behaviors utilizing cognitive restraint increased over the past several decades, particularly in females (14% in 1966 to 44% in 1996, Keskitalo et al 2008), but the prevalence of obesity is also increasing. Although cognitive restraint has facilitated healthy weight management within some younger populations and/or older populations in other countries, much of the research in U.S. older adults demonstrates that body mass index is positively correlated with cognitive restraint behaviors that require conscious restriction of food intake instead of relying on physiological hunger and satiety cues (Flint et al 2008; Lluch et al 2000; Herman and Mack 1975; Lowe 1993). Cognitive restraint often results in high prevalence of relapse and propagates feelings of personal failure, guilt, and low self-confidence (Lattimore et al 2004; Punzalan et al 2006; Remick et al 2008). Some studies have suggested that weight loss approaches that focus on non-dietary factors such as self-acceptance rather than cognitive restraint produce greater improvements in depressive symptoms (Bacon et al 2002). Research studies in middle-aged women have

discovered that uncontrolled eating behaviors are associated with energy intake, increased body weight, intensified feelings of hunger, and low self-awareness (Flint et al 2008), while emotional eating behaviors are associated with increased obesity prevalence and food consumption (Schneider et al 2010; Costanzo et al 2001; Geliebter and Aversa 2003). In a study of congregate meal participants with a high prevalence of obesity (54%), eating behaviors such as cognitive restraint and emotional eating were significantly related to obesity in the target population (Porter and Johnson 2011). Previous studies have suggested that risk factors for cognitive restraint may include high body mass, being female, and low self-esteem; risk factors for uncontrolled eating may include high stress and low emotional support; and risk factors for emotional eating may include high stress and low coping ability (Costanzo et al 2001; Lattimore et al 2004; Mazur et al 2011; Punzalan et al 2006).

Assessment of mental health and eating behaviors

Depression anxiety stress scale-21

The depression anxiety stress scales have been shown to be valid tools for measuring depression, anxiety, and tension-stress, as well as distinguishing between depression and anxiety (Cronbach's alpha analysis: depression, alpha = 0.97; anxiety, alpha = 0.92, stress, alpha = 0.05, Antony et al 1998). The DASS-21 is a revised, simplified version of the DASS-42 with a cleaner factor structure and smaller inter-factor correlations, increasing its effectiveness for identifying and measuring mental health problems (Antony et al 1998). The DASS-21 includes 7 questions for each category of mental health (depression, anxiety, stress) and asks participants to respond based on their experiences from the previous week (e.g., 0 = did not apply to me at all; 1 =

applied to me to some degree or some of the time; 2 = applied to me a considerable degree or a good part of the time; 3 = applied to me very much or most of the time).

Three factor eating questionnaire revised-18 version

Three-Factor Eating Questionnaire Revised 18-Item (TFEQ-R18, de Lauzon et al 2004) is a validated tool for the assessment of eating behaviors in obese and non-obese individuals (de Lauzon et al 2004), and the revised 18-item version was selected for this study, rather than the long version (Stunkard and Messick 1985), because of its ease in administration to an older adult population. The TFEQ-R18 includes 18 questions categorized for the following eating behaviors: cognitive restraint (conscious restriction of food intake in order to control body weight or promote weight loss), uncontrolled eating (tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger), and emotional eating (inability to resist emotional cues, overeating during emotional mood state). Each question includes four response categories (e.g., 1 = never; 2 = rarely; 3 = sometimes; 4 = always). Previous Cronbach's alpha analysis of the TFEQ-R18 in the target population found that all categories of eating behaviors were above the acceptable criteria of alpha = 0.70 (cognitive restraint, alpha = 0.78; uncontrolled eating, alpha = 0.83; emotional eating, alpha = 0.83), validating the use of the TFEQ-R18 as a reliable assessment of eating behaviors for this research study. Cronbach's alpha analysis is a method used to evaluate internal construct validity of assessments as questionnares in order to determine the extent to which the theorized scale measurement correlates with the scores that are actually measured (Cronbach and Meehl 1955; Nunnally 1978).

Relationships of mental health and eating behaviors

Research has indicated positive associations of depression, anxiety, and stress with eating behaviors in younger populations, especially among females (Gan et al 2011; Basler 2009), but little research has explored these relationships in older adults in the United States.

Stress is associated with emotional eating and uncontrolled eating in women practicing cognitive restraint (Markus et al 2011). One study found an increased level of cortisol (a stress hormone) in the urine of females with high cognitive dietary restraint, indicating that cognitive restraint may be a source of stress (Rideout et al 2006), but it is unclear whether stress may initiate behaviors of cognitive restraint. In animal models, a blunted cortisol response is seen along with increased sagittal fat and body mass in high stress groups, and long-term adaptation to stress coupled with dense caloric intake may be associated with increased visceral fat accumulation (Tomiyama et al 2011).

High cognitive restraint behavior has been indicated by several research studies as an increased risk for emotional eating and uncontrolled eating, mediated by negative feelings of anxiety and stress, and often leading to weight gain (Costanzo et al 2001; Lattimore et al 2004). Failure to adhere to high personal expectations of cognitive restraint may lead to feelings of low self-worth and depression and may enhance the stress and anxiety experienced during the next temptation to break dietary restraint ideals (Goldfield and Legg 2006; Remick et al 2008; Elfhag and Morey 2007).

Leptin is a hormone that increases with body fat storage and is involved in appetite maintenance. Research suggests that this hormone may also affect the motivational aspects of eating behaviors. Leptin has been associated with cognitive restraint in both obese and normal weight individuals exhibiting addictive lifestyle behaviors, and those with pathological eating behaviors are more prone to high levels of stress and weight gain (Koopmann et al 2011). Cognitive restraint has been shown to lead to emotional and cognitive disturbances and to problems with eating, and treating cognitive restraint may improve depression (Le Barzic 2001).

Emotional eating is more prevalent in females and is often associated with use of food to cope with negative psychological emotions, such as depression, anxiety, or stress (Elfhag and Morey 2007; Geliebter and Aversa 2003; Kenardy et al 2003; Lattimore et al 2004; Sims et al 2007). Additionally, obese persons exhibiting high emotional eating tendencies are at increased risk for experiencing negative psychological consequences such as depression or anxiety and are more likely to respond to perceived psychological distress by overeating (Costanzo et al 2001; Kenardy et al 2003; Lattimore et al 2004).

Additional research is needed to further examine the relationships of depression, anxiety, and stress with eating behaviors in older adults, particularly among congregate meal participants who have a high prevalence of mental health problems, eating behaviors, and obesity (Porter and Johnson 2011).

Additional considerations

Cultural and ethnic considerations

African Americans currently comprise 8.3% of the U.S. population 65 y and older, and this percentage is expected to rise sharply in the next several decades. Additionally, Georgia has a large population of African Americans (6.1% of U.S. total, Administration on Aging 2011), and some studies report that African Americans have a higher prevalence of depression, but decreased rates of diagnosis and treatment (Akincigil et al 2012; Gonzalez et al 2010). Black females have a high prevalence of obesity (55.5%, Flegal et al 2012), and are thus at greater risk for developing chronic disease (Angheel et al 2011). In African Americans 65 y and older, increased psychological distress is associated with having more chronic diseases (Kim et al 2011). Further research is needed to examine the variations of mental health issues and treatment access issues in African Americans in order to identify any health disparities and ultimately improve weight management programs and overall health in this population.

Gender considerations

Approximately 3 out of 5 persons 65 y and older are women, and the proportion increases with age (Administration on Aging 2011). Women have a 1.6 fold greater prevalence of depressive symptoms than men (Lin PC et al 2011), but men are less likely to seek treatment for mental health problems (Mackenzie et al 2011). Depressive risk factors for men 85 y and older include having a lower educational level, greater number of chronic diseases, and low social support, with low social support especially increasing risk of depressive symptoms in women 85 y and older (Lin PC et al 2011). Cognitive restraint and emotional eating behaviors may have a stronger relationship with obesity in women, and factors of particular importance include consciously eating less than desired, consciously having to avoid "stocking up" on tempting

foods, avoiding foods because they are fattening, eating when anxious, and overeating when feeling anxious, lonely, or "blue" (Porter and Johnson 2011).

Medication considerations

Older adults are often taking many medications that may individually affect their moods. Some commonly reported side effects of polypharmacy include depressive symptoms and changes in appetite (Clarke et al 1981). Often, medications utilized for chronic disease management, including certain anti-hypertensives, corticosteroids, estrogens, antipsychotics, and anti-Parkinson's drugs, require a certain set of dietary restrictions that may affect eating behaviors. These medications may involve drug-drug and drug-food interactions that have negative effects on cognition and mood and may lead to the development or aggravation of depressive symptoms (Elsner 2002). Additionally, substantial evidence supports that psychotropic drugs, employed for the treatment of mental health problems, alter appetite and body weight. However, the extent of weight gain or loss associated with these medications varies substantially by the targeted neuropeptides, length of psychotherapy treatment, and number of concomitant psychotropic medications employed. Neuroleptic drugs, tricyclic and heterocylic antidepressents, monoamine oxidase inhibitors, and lithium are typically associated with weight gain, and it is unclear whether selective-serotonin reuptake inhibitors increase or decrease body weight (Serretti and Mandelli 2010).

Research study

The research approach used in this thesis is based on the current knowledge that mental health problems, such as depression, are prevalent in older people (Administration on Aging 2011), and

may be associated with weight problems (de Wit et al 2010: Luppino et al 2010; Teng et al 2012). This study builds on a previous study that showed eating behaviors, particularly cognitive restraint and emotional eating, were positively associated with obesity in a sample of congregate meal participants in northeast Georgia (Porter and Johnson 2011, Porter 2012). The primary aim of this research study is to determine whether mental health problems are positively associated with eating behaviors. It is hypothesized that increased scores of depression, anxiety, and stress will be associated with increased eating behaviors (cognitive restraint, uncontrolled eating, emotional eating), and based on the obesity-related literature (Elfhag and Morey 2007; Geliebter and Aversa 2003; Kenardy et al 2003; Lattimore et al 2004; Porter and Johnson 2011; Sims et al 2007), it is expected that mild to severe levels of depression, anxiety, and stress will be positively associated with emotional eating, and anxiety will be positively associated with cognitive restraint (Costanzo et al 2001; Lattimore et al 2004).

This study is part of a larger research project under the direction of Dr. Mary Ann Johnson that analyzes data collected during summer 2010 at congregate meal sites in senior centers in northeast Georgia and aims to determine the interrelationships of depression, anxiety, and stress, eating behaviors, dietary patterns, and obesity. Jessica Furman confirmed the validity of the TFEQ-R18 within our sample of participants and analyzed potential relationships of eating behaviors with dietary intake, discovering robust relationships with uncontrolled eating and vegetable intake ($\geq$ 4/day, OR: 2.7, 95% CI 1.06, 6.89, $p < 0.05$) and with emotional eating and salty snack intake (>1/day, OR 3.9, 95% CI 1.58, 9.72, $p < 0.01$) (Furman 2012). Dr. Kathryn (Porter) Starr previously analyzed independent relationships of inappropriate eating behaviors and depression, anxiety, and stress with obesity and found significant relationships of cognitive

restraint and emotional eating with obesity ($p < 0.05$) (Porter and Johnson 2011; Porter 2012). Susannah Gordon is analyzing how non-dietary influences may be associated with obesity in these participants (Gordon 2013, forthcoming). The goal of this combined research approach is to offer a more comprehensive understanding of potential factors leading to obesity in congregate meal participants and to offer insight on how health professionals can better address underlying issues of obesity to improve future weight management strategies for older adults.

CHAPTER 3

RELATIONSHIPS OF DEPRESSION, ANXIETY, AND STRESS WITH EATING BEHAVIORS IN OLDER ADULTS

Jackson KP, Johnson MA. To be submitted to *Journal of Nutrition in Gerontology and Geriatrics.*

Abstract

This study explored the relationships of eating behaviors with mental health in congregate meal participants in northeast Georgia (N = 124, mean age = 75 years, 76% female, 44% African American). Eating behaviors, including cognitive restraint (conscious restriction of food intake in order to control body weight or promote weight loss), uncontrolled eating (tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger), and emotional eating (inability to resist emotional cues, overeating during emotional mood state), were evaluated with the Three-Factor Eating Questionnaire (18 questions: 6 assessing cognitive restraint, 9 assessing uncontrolled eating, 3 assessing emotional eating); mental health was assessed with the Depression Anxiety Stress Scale (21 questions). For analysis, depression, anxiety, and stress were assessed as continuous variables and also each dichotomized based on clinically accepted severity ratings (low or normal symptoms versus mild, moderate, or severe symptoms). Similarly, each eating behavior was assessed as a continuous measure or dichotomized (lowest half, two tertiles, or three quartiles of the distribution versus top half, tertile, or quartile of the distribution). In correlation analyses, the most consistently significant relationships were that depression was positively associated with emotional eating, anxiety was associated positively with cognitive restraint and emotional eating, and stress was positively associated with all three eating behaviors ($p < 0.05$ - 0.0001), but several of these relationships were not statistically significant when eating behaviors were dichotomized at the median split or at the top quartile split. In a series of logistic multivariate regression analyses with eating behaviors dichotomized at the top tertile of the distribution, the most consistently significant relationships were that depression was associated positively with emotional eating and stress was positively associated with both emotional eating and

uncontrolled eating ($p < 0.01$ - 0.001) when controlled for potential cofounders (demographics and chronic conditions), while anxiety was associated positively with cognitive restraint when controlled for demographics ($p < 0.05$ - $p < 0.001$), but not when controlled for demographics and chronic conditions. Thus, depression, anxiety, and stress are related to eating behaviors and may be targets to address for the prevention and management of obesity in these older adults. Additional research is needed to determine how depression, anxiety, and stress are related to eating behaviors so that health professionals may provide effective weight management programs in congregate meal participants.

Introduction

Adults 65 y and older in the United States comprise approximately 13.1% of the population, and this percentage is expected to increase to 19.3% by the year 2030 (Administration on Aging 2011). Older adults have a high prevalence of obesity (Flegal et al 2012; Houston et al 2009; Seagle et al 2009; Villareal et al 2005), which has been associated with mental health problems (de Wit et al 2010; Luppino et al 2010; Teng et al 2012). Obesity also has been associated with eating behaviors such as cognitive restraint (conscious restriction of food intake in order to control body weight or promote weight loss), uncontrolled eating (tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger), and emotional eating (inability to resist emotional cues, overeating during emotional mood state), as assessed with the validated Three Factor Eating Questionnaire-Revised 18-Item (TFEQ-R18, Anglé et al 2009; de Lauzon et al 2004; Porter and Johnson 2011). Adults 60 y and older who are congregate meal participants in senior centers in northeast Georgia's Area Agency on Aging have a high prevalence of depression (23%), anxiety (23%), and obesity (54%, Porter and

Johnson 2011). The older adult population is an important group for medical and nutritional research due to their unique needs and increasing life span, and understanding the relationships of depression, anxiety, and stress with eating behaviors is essential so that mental health and dietetics professionals may provide effective weight management programs that are appropriately targeted to address the underlying depression, anxiety and stress, and/or to the unhealthy eating behaviors.

The Older Americans Act (OAA) was passed by Congress in 1965, establishing authority for grants to states for community social services, research, and development projects geared towards Americans over 60 y. OAA Title IIIC section 330 established congregate nutrition services in 1972 with the purpose of reducing hunger and food insecurity, providing socialization, and promoting health in older adults (Administration on Aging 2012). In Georgia, the congregate meal program is implemented through the Georgia Department of Human Services, Division of Aging Services. One meal per person per weekday is typically served in congregate meal sites throughout Georgia, and each meal must provide at least one-third of the Recommended Daily Allowance of nutrients (Georgia Department of Human Services 2011) and meet the Dietary Guidelines for Americans (USDHHS and USDA 2010). Additionally, all congregate meal participants have access to health promotion programs and referrals to mental health and dietetics professionals through the senior centers where meals are served.

Mental health problems are common in the older adult population (American Psychological Association 2012; Theilke and Unutzer 2010), with depression affecting approximately 20% and anxiety disorder affecting approximately 11% of community-dwelling adults 55 y and older

(Administration on Aging 2011). The prevalence of mental health problems is less among community dwelling older adults when compared to institutionalized elders, but the majority of older adults with psychological problems live within the community, and the mental health of this group must also be considered. Depression is associated with many situations that may be common in the older adult population, including stressful life events, low social support, disability, and number of medical conditions (Fiske et al 2009; Richardson et al 2012; Teng et al 2012). Additional risk factors for mental health problems in older adults include female gender, having low socioeconomic status, low social engagement, and taking multiple medications (Elsner 2002; Lin PC et al 2011; Teng et al 2012). Although relationships of depression, anxiety, and stress with dietary patterns and obesity have been documented in younger populations (de Wit et al 2010: Luppino et al 2010), less research exists in this area for older populations in the United States. There is evidence to suggest that obesity is related to stress, depression, and anxiety in older adults, however the direction of causality is unclear (Angheel et al 2011; Godin et al 2012; Vogelzangs et al 2012). A study in community-dwelling adults found that unhealthy diets were positively related to depression and anxiety in women and to depression in men, and unhealthy diets were positively associated with anxiety regardless of gender (Jacka et al 2011). The association of mental health problems with greater chronic health conditions has been documented (Angheel et al 2011; El-Gabalawy 2011; Pachana et al 2010; Robinson 2010; Teng et al 2012; Vogelzangs et al 2012), and this relationship appears to be stronger in older age groups (Fiske et al 2009; Lin et al 2011; Mojtabai 2011).

Some research exists concerning the relationships of mental health problems and eating behaviors in older adults, but the majority of the current literature focuses on such relationships

in younger female populations (Basler 2009; Gan et al 2011). Cognitive restraint, defined as the conscious restriction of food intake to control body weight or promote weight loss, has aided in healthy weight management within some younger populations and/or older adults in other countries, but much of the research in U.S. older adults demonstrates that body mass index is positively correlated with cognitive restraint behaviors that require conscious restriction of food intake instead of relying on physiological hunger and satiety cues (Flint et al 2008; Lluch et al 2000; Herman and Mack 1975; Lowe 1993). Research in middle-aged women discovered that uncontrolled eating behaviors are associated with energy intake, increased body weight, intensified feelings of hunger, and low self-awareness (Flint et al 2008), while emotional eating behaviors are associated with increased obesity prevalence and food consumption (Schneider et al 2010; Costanzo et al 2001; Geliebter and Aversa 2003). Emotional eating is most prevalent in females and is often a behavior used to inappropriately use food to cope with negative psychological emotions, such as depression, anxiety, or stress (Elfhag and Morey 2007; Geliebter and Aversa 2003; Kenardy et al 2003; Lattimore et al 2004; Sims et al 2007). Additionally, obese persons exhibiting high emotional eating tendencies are at increased risk for experiencing negative psychological consequences such as depression or anxiety and are more likely to respond to perceived psychological distress by overeating (Costanzo et al 2001; Kenardy et al 2003; Lattimore et al 2004). Previous data on congregate meal participants in northeast Georgia revealed cognitive restraint and emotional eating were significantly related to obesity in the target population, and the prevalence of anxiety and stress tended to be higher in the obese individuals, but were not associated with obesity in the fully adjusted models (adjusted for demographics, food insecurity, self-reported health, and chronic disease, Porter and Johnson 2011).

Due to the high prevalence of depression, anxiety, and obesity in congregate meal participants and the previous research showing associations of mental health and eating behaviors with obesity, it is essential to further analyze how psychological issues in older community-dwelling adults affect these eating behaviors so weight management approaches for this population may be improved. Therefore, the purpose of this study was to determine relationships of depression, anxiety, and stress with eating behaviors related to obesity in community-dwelling older adults participating in the congregate meal programs at senior centers in northeast Georgia.

Methods

This study was cross-sectional in design and data were collected in the summer of 2010 (Porter and Johnson 2011). All individuals age 60 y and older who received congregate meals from four senior centers in northeast Georgia's Area Agency on Aging (AAA) were invited to participate. Questionnaires and procedures were approved by Institutional Review Boards on Human Subjects of the University of Georgia and the Georgia Department of Human Services. Written informed consent was obtained and procedures and consent forms were read and explained to all participants. The recruitment procedures yielded 124 participants, and non-participants (n = 106) were those who refused to participate, were unavailable during the study period, or were unable to comprehend the informed consent and/or answer questions as determined by the interviewer (Porter and Johnson 2011). Compared to non-participants, participants were younger (77 and 75 years, respectively, $p = 0.01$) and more likely to be black (30% and 44% black, respectively, $p = 0.04$, Porter and Johnson 2011). All measures, except height and weight, were self-reported and two participants who were of Asian origin were excluded from analyses involving race/ethnicity because of this small sample size.

Mental health was assessed with the Depression Anxiety Stress Scale-21 (DASS-21, Antony et al 1998) that includes seven questions each for depression, anxiety, and stress during the past week and measures participant responses on a four-point Likert scale (0 = did not apply to me at all; 1 = applied to me to some degree or some of the time; 2 = applied to me a considerable degree or a good part of the time; 3 = applied to me very much or most of the time). A copy of the questions included in the DASS-21 may be found in the Appendix (Antony et al 1998; Lovibond and Lovibond 1995). The DASS-21 is a revised version of the DASS-42 (Lovibond and Lovibond 1995), and the 21-item version was chosen for this study due to its ease of administration in an older adult population (fewer questions) while exhibiting a cleaner factor structure, smaller interfactor correlations, and maintaining validity (Cronbach's alpha: depression, alpha = 0.97; anxiety, alpha = 0.92, stress, alpha = 0.05, Antony et al, 1998). A summary score was created for each category, ranging from 0 to 21, and then multiplied by two (range 0 to 42) to determine severity from DASS-42 clinically accepted severity categories (Psychology Foundation of Australia 2013). Clinically accepted severity ranges were developed based on normative data from a large sample of Australian adults (n = 2914, means (standard deviations): 6.34 (6.97), 4.7 (4.91), 10.11 (7.91) for depression, anxiety, and stress scales, respectively, Lovibond and Lovibond 1995). The clinically accepted values for the DASS-42 to determine mild to severe symptoms were summary scores greater than or equal to 10 for depression, 8 for anxiety, and 15 for stress. Summary scores were dichotomized based on severity, and participants were assigned to one of two categories (0 = low or normal symptoms; 1 = mild, moderate, or severe symptoms). Chronic health conditions were assessed from self-reports (0 = no, 1 = yes, Penn et al 2009).

Eating behaviors were assessed with the Three-Factor Eating Questionnaire Revised-18 (TFEQ-R18, de Lauzon et al 2004) that includes 18 questions related to cognitive restraint, uncontrolled eating, and emotional eating (most questions have the response categories of 1 = never; 2 = rarely; 3 = sometimes; 4 = always). These response categories were altered from original categories (definitely false, mostly false, mostly true, and definitely true) to improve participants' understanding. Summary scores were created by summing the responses to the questions that corresponded to cognitive restraint (6 questions, range of 1 - 24), uncontrolled eating (9 questions, range of 1 - 36), and emotional eating (3 questions, range of 1 - 12). The summary scores for participants were ranked in ascending order and recoded to severity scores, which were categorized as either high or low for each eating behavior according to the median split of the distribution of the participants ($n \geq 62$, at which the summary scores were: cognitive restraint ≥ 10, uncontrolled eating ≥ 13, and emotional eating ≥ 4), the top tertile of the distribution ($n \geq 83$, at which the summary scores were: cognitive restraint ≥ 13 uncontrolled eating ≥ 15, and emotional eating ≥ 6; bottom two tertiles = 0 versus top tertile = 1), and the top quartile of the distribution ($n \geq 93$, at which the summary scores were: cognitive restraint ≥ 15, uncontrolled eating ≥ 16, and emotional eating ≥ 7; bottom three quartiles = 0 and the top quartile = 1). Other researchers have used only the median split of summary scores to recode for severity of eating behaviors in studies assessing relationships of eating behaviors with obesity, mental health, or dietary intake (Furman 2012; Porter and Johnson 2011): However, this study included the top tertile and top quartile of the distribution to investigate the robustness of the relationships based on my hypothesis that depression, anxiety, and stress may influence higher levels of eating behaviors. As previously summarized (Porter and Johnson 2011), for all questions, "I" was changed to "You" because questions were read to participants. One item was

reworded from the original question, “When I smell a sizzling steak or a juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal,” and changed to “When you see any of your favorite foods, do you find it difficult to keep from eating, even if you have just finished a meal?” This change was incorporated to improve measurement of the difficulty of controlling eating behavior when an external stimulus is present, and similar changes have been utilized in other studies (Anglé et al 2009). Previous research with congregate meal participants in northeast Georgia confirmed the validity of the TFEQ-R18 within the target population using Cronbach’s alpha analysis (cognitive restraint, alpha = 0.78; uncontrolled eating, alpha = 0.83; emotional eating, alpha = 0.83, Furman 2012). A copy of the questions included in the DASS-21 (no modifications) and the TFEQ-18, incorporating the modifications described above for the TEFQ-18, may be found in the Appendix (Anglé et al 2009; Antony et al 1998; de Lauzon et al 2004; Lovibond and Lovibond 1995; Porter and Johnson 2011).

Descriptive statistics including means, standard deviations, correlations, frequencies, odds ratios, and confidence intervals were calculated using the Statistical Analysis System (SAS Institute, Cary, NC). Spearman correlation analyses were used to assess associations of summary scores for depression, anxiety, and stress with summary scores for cognitive restraint, uncontrolled eating, and emotional eating (series 1: all variables continuous; series 2: mental health according to clinically accepted values for mild to extreme severity and eating behaviors at the tertile split; series 3: and mental health according to clinically accepted values for mild to extreme severity and eating behaviors at the quartile split). Spearman correlations were used because summary scores for mental health and eating behaviors were rank-ordered for severity. Chi-square analysis was performed with eating behaviors at the tertile split and the quartile split to assess

associations of demographics, mental health, and chronic diseases with eating behaviors. A series of multivariate regression models were used to assess the independent associations of depression, anxiety, and stress (dichotomized) with each eating behavior (at the tertile or the quartile split) when controlled for demographics (age, sex, race) and chronic diseases (diabetes, heart disease, high blood pressure, and arthritis). These analyses were controlled for demographics (age, gender, race) because research shows that prevalence of mental health symptoms is higher in females (Gan et al 2011) and prevalence of depressive symptoms increases with age (Theilke and Unutzer 2010; Woo et al 2006), as well as for chronic health conditions because chronic diseases are associated with increased prevalence of mental health problems (Angheel et al 2011; Mojtabai 2011; Robinson 2010; Teng et al 2012; Vogelzangs et al 2012; Woo et al 2006). Obesity was not controlled for in these regression analyses because of the established relationship between chronic disease and obesity (Leveille et al 2005; Vogelzangs et al 2012), and controlling for variables that are strongly related has the potential to confound the model. A similar rationale was the reason for not controlling for medications, as many of the medications used among participants are for chronic disease management. Food insecurity was not controlled for in these analyses, but the relationship of food security with eating behaviors is currently under evaluation by another member of the research team in the target population (Ms. TaMara Myles). A rho value of 0.16, corresponding to a p-value ≤ 0.05 with this sample size, was accepted as statistically significant.

Results

The characteristics of study participants are shown in Table 3.1 (n = 124). The average age was 75 y, 76% were female, and 44% were black, and 54% were obese (Porter and Johnson 2011).

The prevalence of chronic disease was 36% with diabetes, 73% with high blood pressure, 31% with heart disease, and 63% with arthritis. Mental health was characterized by 23% having depression, 23% having anxiety, and 7% having stress. Obesity was prevalent (54%, Porter 2012). By design, at the tertile split of eating behaviors, approximately one-third of participants practiced high cognitive restraint, emotional eating, and/or uncontrolled eating. At the quartile split, about one quarter of participants exhibited each eating behavior.

Table 3.2 shows the Spearman correlations of mental health with eating behaviors. Depression was consistently and positively correlated with emotional eating ($p \leq 0.001$ - 0.0001). Anxiety was associated positively with cognitive restraint and emotional eating (continuous or tertile split, $p \leq 0.01$ - $p \leq 0.0001$), but not at the quartile split. Stress was consistently and positively correlated with all three eating behaviors ($p \leq 0.05$ - $p \leq 0.0001$, except for one time). There were fewer significant correlations of mental health with eating behaviors when eating behaviors were dichotomized at the quartile split, suggesting that these associations occur over the range of mental health symptoms and eating behaviors.

Correlations of mental health and eating behaviors with demographics (age, race, sex) and chronic diseases are shown Table 3.3 (all variables continuous), table 3.4 (median split), tables 3.5 (top tertile of the distribution), and table 3.6 (top quartile of the distribution). When all variables were continuous, female gender and white race were related to depression ($p < 0.01$), anxiety was related to heart disease ($p < 0.001$) and arthritis ($p < 0.01$), stress was related to arthritis ($p < 0.05$), cognitive restraint was related to diabetes ($p < 0.05$), high blood pressure ($p < 0.001$), and arthritis ($p < 0.05$), uncontrolled eating was related to diabetes ($p < 0.05$), and

emotional eating was related to high blood pressure. At the median split of the distribution, the relationships were white race with depression ($p < 0.0001$), anxiety with heart disease ($p < 0.0001$), high blood pressure with cognitive restraint ($p < 0.01$) and emotional eating ($p < 0.05$), and uncontrolled eating with diabetes (0.01). At the top tertile and top quartile of the distribution, white race remained associated with depression ($p < 0.0001$), high blood pressure remained associated with heart disease ($p < 0.0001$), and relationships of diabetes with uncontrolled eating remained robust while other relationships of eating behaviors with the chronic diseases were attenuated compared to the previous analyses (median split or tertile split).

The results of bivariate associations of mental health measures and chronic disease with eating behaviors are given in Table 3.7 (median split), Table 3.8 (tertile split), and Table 3.9 (quartile split). At the median split, mild to severe stress in participants was associated with high cognitive restraint ($p < 0.05$) and high uncontrolled eating ($p < 0.05$), diabetes was related to uncontrolled eating ($p < 0.01$), and high blood pressure was related to both cognitive restraint ($p < 0.01$) and emotional eating ($p < 0.01$). At the top tertile split, participants with mild to severe anxiety exhibited high cognitive restraint ($p < 0.05$) and emotional eating ($p < 0.05$) compared to those with low or normal anxiety levels. Mild to severe stress was associated with high cognitive restraint ($p < 0.05$), uncontrolled eating ($p < 0.05$), and emotional eating ($p < 0.01$). Mild to severe depression was significantly associated with emotional eating behaviors ($p < 0.001$). Cognitive restraint was associated with having diabetes ($p < 0.05$) or high blood pressure ($p < 0.05$). Additionally, those with high blood pressure were more likely to experience emotional eating ($p < 0.05$). These associations of mental health with eating behaviors that were seen with the tertile split were attenuated or absent at the quartile split (Table 3.9).

Multivariate regression analysis, shown in Table 3.10 (tertile split) and 3.11 (quartile split), revealed several associations between mental health and eating behaviors when demographic variables (age, race, sex) were controlled, and when demographics and the presence of chronic disease (diabetes, high blood pressure, heart disease, arthritis) was controlled. Results of multivariate regression analysis at the median split showed a significant relationship of stress with uncontrolled eating only when chronic disease was controlled (OR = 10.2, 95% CI: 1.13 - 92.8, $p < 0.05$, c-statistic = 0.73); but no other relationships of the mental health variables with eating behaviors dichotomized at the median split were observed At the tertile split, depression was associated positively and significantly with emotional eating ($p < 0.01$). In model 1 (tertile split), anxiety was related positively and significantly to cognitive restraint ($p < 0.05$), and stress was positively related with cognitive restraint ($p < 0.05$), uncontrolled eating ($p < 0.05$) and emotional eating ($p < 0.05$). Generally, these associations were also seen when eating behaviors were dichotomized at the quartile split, except that associations of stress with cognitive restraint were no longer statistically significant (Table 3.11).

Discussion

The findings of this study support that mental health status may influence eating behaviors in community-dwelling older adults that are congregate meal participants in Northeast Georgia's Area Agency on Aging. However, it remains unclear whether mental health problems are causing the eating behaviors or if the eating behaviors are causing the mental health problems. Our results support previous findings that depression, anxiety, and stress influence eating behaviors (Capuron et al 2010; Gan et al 2011; Schneider et al 2010; Stewart-Knox et al 2012), and extend these conclusions to include an older adult population. Specifically, these results

generally support that depression is associated with emotional eating behaviors, anxiety is associated with cognitive restraint, and stress is associated with both uncontrolled eating and emotional eating in this sample.

The results of this study add relevant information concerning possible influencing factors that may be contributing to obesity in NEGA OAA congregate meal participants, a population in which obesity is related to high cognitive restraint and emotional eating behaviors and positively correlated with stress and anxiety (Porter and Johnson 2011). The findings of this study are distinctive in that they support relationships of mental health problems with obesogenic behaviors in community-dwelling older adults, whereas previous studies have focused on anorexia in young females (Gan et al 2011) and in elder long-term care settings (Philips et al 2011; Prado-Jean et al 2010). The mental health and demographic data of the study population is relevant due to their vulnerability from a high prevalence of depression and anxiety, female gender and African American race/ethnicity (Yancu et al 2011; Akincigil et al 2012). Previous research suggests that the prevalence of depression and anxiety is higher in older females (Administration on Aging 2012; Angheel et al 2011) and bear a stronger relationship to eating behaviors compared to males (Byers et al 2010; Costanzo et al 2001; Markus et al 2012; Wallis and Hetherington 2004), blacks have a higher prevalence of depression with a decreased prevalence of diagnosis and treatment (Akincigil et al 2012; Gonzalez et al 2010), and psychological stress is associated with higher prevalence of chronic health conditions in older black persons (Kim et al 2011; Teng et al 2012). Results of the logistic multivariate regression analysis in this study found that significant relationships of mental health with eating behaviors

remained robust when demographics (age, race, and gender) were controlled, strengthening the plausibility of these relationships.

The prevalence of chronic health conditions is high in older adults (American Psychological Association 2012; Elsner 2002), and much evidence supports associations of chronic disease with increased depression, anxiety, and stress (Lin et al 2011; El-Gabalawy 2011; Koopman 2011; Robinson 2010; Somerset et al 2011), particularly in older adults (Bailly et al 2012). Correlational analysis of mental health problems and of eating behaviors with chronic disease demonstrated that chronic disease plays is integrally related to mental health and eating behaviors. Associations of depression with emotional eating and of stress with emotional eating and uncontrolled eating remained robust when chronic disease was additionally controlled. The relationships observed among depression and stress with emotional eating were not attenuated at the quartile split, suggesting the robustness of the results. However, the c-statistic values were slightly higher at the tertile split of eating behaviors, suggesting that the tertile split is a better model of analysis.

There are several limitations to this study. Participants self-reported their answers to mental health and eating behavior questions, but previous studies have shown that these methods provide reliable information regarding measures of mental health (de Lauzon et al 2004) and eating behaviors (Antony et al 1998). The number of participants in the moderate to severe stress group was low (n = 9) and may make the relationships of stress with emotional eating and uncontrolled eating less robust. However, these relationships were significantly associated in the continuous correlation analysis, suggesting there is a correlation despite the low number of

clinically stressed individuals in this study. Several of the questions assessing anxiety on the DASS-21 may potentially be symptoms of obesity and may confound the results of analyses exploring anxiety and obesity (Porter 2012). The study population included both obese and non-obese persons, so future research could explore whether these associations differ depending in obese versus non-obese older adults. Additionally, participants in this study may not represent the older adult population in its entirety because consent was voluntary and there were 106 non-participants who differed slightly from participants in demographic characteristics. This study was limited to older adults participating in congregate meal programs at senior centers in northeast Georgia and cannot be generalized to all older adults. However, this study demonstrated the feasibility of our approach, and it provided valuable information that may aid health professionals in effective weight management interventions and offer pilot data for other researchers to use in similar studies.

Key Points

- In contrast to current research supporting a relationship between depression and anorexia in institutionalized older adults, our findings suggest that mental health problems may influence eating behaviors related to obesity in community-dwelling older adults.
- Depression was significantly associated with emotional eating.
- Stress was significantly associated with emotional eating and uncontrolled eating.
- Anxiety was significantly associated with cognitive restraint, but chronic disease status may potentially confound this relationship.

- Weight management interventions for older adults participating in congregate meal programs should address mental health problems in an attempt to improve eating behaviors and reduce obesity and disease risk in this population.

Table 3.1: Characteristics of participants

		Mean (SD) or %
Age (years)	n = 124	75
Gender	n = 124	
Male	n = 30	24
Female	n = 94	76
Race/ethnicity	n = 122	
White	n = 68	56
Black	n = 54	44
Chronic disease		
Diabetes	n = 45	36
High blood pressure	n = 90	73
Heart disease	n = 38	31
Arthritis	n = 78	63
Body mass index (kg/m^2, Porter and Johnson 2011)		31
Obesity (BMI $\geq$ 30, Porter and Johnson 2011)	n = 61	54
Eating behaviors (median)		
Cognitive restraint (6 items)	n = 65	52
Uncontrolled eating (9 items)	n = 65	52
Emotional eating (3 items)	n = 71	57
Eating behaviors (top tertile)		
Cognitive restraint (6 items)	n = 41	33
Uncontrolled eating (9 items)	n = 44	35
Emotional eating (3 items)	n = 44	35
Eating behaviors (top quartile)		
Cognitive restraint (6 items)	n = 28	23
Uncontrolled eating (9 items)	n = 32	26
Emotional eating (3 items)	n = 29	23
Mental health		
Depression (7 items)	n = 28	23
Anxiety (7 items)	n = 28	23
Stress (7 items)	n =9	7

Eating behaviors: median split (n $\geq$ 62, summary scores: cognitive restraint $\geq$ 10; uncontrolled eating $\geq$ 13; emotional eating $\geq$ 4; top tertile of distribution (n $\geq$ 83, cognitive restraint $\geq$ 13; uncontrolled eating $\geq$ 15; emotional eating $\geq$ 6.); top quartile of distribution (n $\geq$ 93, summary scores: cognitive restraint $\geq$ 15; uncontrolled eating $\geq$ 16; emotional eating $\geq$ 7). Mental health problems considered significant if mild to severe symptoms were present, defined by the clinically significant value according to the DASS-21 (depression $\geq$ 10; anxiety $\geq$ 8; stress $\geq$ 15). Two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size.

Table 3:2 Spearman correlations of depression, anxiety and stress with eating behaviors

Spearman correlations (all variables continuous)

	Cognitive restraint	Uncontrolled eating	Emotional eating
Depression	0.13	0.18‡	0.35¶
Anxiety	0.27§	0.17	0.38¶
Stress	0.20‡	0.27§	0.35¶

Spearman correlations (depression, anxiety, and stress: normal vs. mild to severe symptoms; eating behaviors: median split)

	Cognitive restraint	Uncontrolled eating	Emotional eating
Depression	0.09	0.13	0.20‡
Anxiety	-0.07	0.09	0.20‡
Stress	0.15	0.15	0.12

Spearman correlations (depression, anxiety, and stress: normal vs. mild to severe symptoms; eating behaviors: top tertile of distribution)

	Cognitive restraint	Uncontrolled eating	Emotional eating
Depression	-0.01	0.04	0.33‖
Anxiety	0.19‡	0.08	0.20‡
Stress	0.20‡	0.18‡	0.25§

Spearman correlations (depression, anxiety, and stress: normal vs. mild to severe symptoms; eating behaviors: top quartile of distribution)

	Cognitive restraint	Uncontrolled eating	Emotional eating
Depression	-0.06	0.12	0.43¶
Anxiety	0.17	0.17	0.16
Stress	0.07	0.19‡	0.29§

N = 124; rho values given in table; significance level: ‡significant at $p \leq 0.05$; §significant at $p \leq 0.01$; ‖significant at $p \leq 0.001$; ¶significant at $p \leq 0.0001$.

Table 3.3: Correlations of depression, anxiety, stress and eating behaviors with demographics and chronic disease

Spearman correlations (all variables continuous)

	Depression	Anxiety	Stress	Cognitive restraint	Uncontrolled eating	Emotional eating
Age (years) (0 = <70; 1 = ≥70)	-0.07	-0.11	-0.17	-0.02	0.03	0.01
Gender (0 = male; 1 = female)	0.26§	0.04	0.17	0.08	0.07	0.09
Race/ethnicity (1 = white; 2 = black)	-0.25§	-0.08	-0.17	0.10	0.15	-0.03
Chronic disease (0 = no; 1 = yes)						
Diabetes	-0.05	0.08	-0.06	0.21‡	0.28§	0.10
High blood pressure	0.11	0.13	0.26	0.24§	0.05	0.21‡
Heart disease	0.07	0.29‖	0.06	0.10	-0.10	0.03
Arthritis	0.00	0.24§	0.18‡	0.18‡	0.11	0.10

Rho values given in table; significance level: ‡significant at $p \leq 0.05$; §significant at $p \leq 0.01$; ‖significant at $p \leq 0.001$; ¶significant at $p \leq 0.0001$.
Two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size.

Table 3.4: Correlations of depression, anxiety, stress and eating behaviors with demographics and chronic disease

Spearman correlations (depression, anxiety, and stress: normal vs. mild to severe symptoms; eating behaviors: median split of participant summary scores)

	Depression	Anxiety	Stress	Cognitive restraint	Uncontrolled eating	Emotional eating
Age (years) (0 = <70; 1 = ≥70)	-0.06	-0.06	-0.02	0.03	-0.04	0.03
Gender (0 = male; 1 = female)	0.08	-0.06	0.16	0.03	0.07	0.12
Race/ethnicity (1 = white; 2 = black)	-0.38[¶]	-0.02	-0.10	0.02	0.14	0.05
Chronic disease (0 = no; 1 = yes)						
Diabetes	-0.05	0.07	-0.08	0.11	0.28[§]	0.11
High blood pressure	0.07	0.12	0.10	0.25[§]	-0.01	0.20[‡]
Heart disease	0.14	0.35[¶]	0.02	0.07	-0.07	0.08
Arthritis	0.02	0.18	0.02	0.17	0.10	0.11

Rho values given in table; significance level: [‡]significant at $p \leq 0.05$; [§]significant at $p \leq 0.01$; [||]significant at $p \leq 0.001$; [¶]significant at $p \leq 0.000$. At the median split ($n \geq 62$), eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 10; uncontrolled eating ≥ 13; emotional eating ≥ 4. Depression, anxiety, and stress are split according to clinical severity values of DASS-21 (no symptoms and mild to severe symptoms).Two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size.

Table 3.5: Correlations of depression, anxiety, stress and eating behaviors with demographics and chronic disease

Spearman correlations (depression, anxiety, and stress: normal vs. mild to severe symptoms; eating behaviors: top tertile split of participant summary scores)

	Depression	Anxiety	Stress	Cognitive restraint	Uncontrolled eating	Emotional eating
Age (years) (0 = <70; 1 = ≥70)	-0.06	-0.06	-0.02	-0.05	0.05	0.02
Gender (0 = male; 1 = female)	0.08	-0.06	0.16	-0.04	0.03	0.06
Race/ethnicity (1 = white; 2 = black)	-0.38[¶]	-0.02	-0.10	0.10	0.17	-0.09
Chronic disease (0 = no; 1 = yes)						
Diabetes	-0.05	0.07	-0.08	0.18[‡]	0.32[‖]	0.14
High blood pressure	0.07	0.12	0.10	0.20[‡]	0.00	0.19[‡]
Heart disease	0.14	0.35[¶]	0.02	0.13	-0.13	-0.02
Arthritis	0.02	0.18	0.02	0.05	0.05	0.12

Rho values given in table; significance level: [‡]significant at $p \leq 0.05$; [§]significant at $p \leq 0.01$; [‖]significant at $p \leq 0.001$; [¶]significant at $p \leq 0.0001$. At the top tertile of the distribution ($n \geq 83$), eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 13; uncontrolled eating ≥ 15; emotional eating ≥ 6. Depression, anxiety, and stress are split according to clinical severity values of DASS-21 (no symptoms and mild to severe symptoms).
Two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size.

Table 3.6: Correlations of depression, anxiety, stress and eating behaviors with demographics and chronic disease

Spearman correlations (depression, anxiety, and stress: normal vs. mild to severe symptoms; eating behaviors: top quartile split of participant summary scores)

	Depression	Anxiety	Stress	Cognitive restraint	Uncontrolled eating	Emotional eating
Age (years) (0 = <70; 1 = ≥70)	-0.06	-0.06	-0.02	-0.06	0.03	-0.09
Gender (0 = male; 1 = female)	0.08	-0.06	0.16	-0.01	0.13	0.05
Race/ethnicity (1 = white; 2 = black)	-0.38¶	-0.02	-0.10	0.06	0.05	-0.17
Chronic disease (0 = no; 1 = yes)						
Diabetes	-0.05	0.07	-0.08	0.11	0.21‡	0.02
High blood pressure	0.07	0.12	0.10	0.12	-0.01	0.08
Heart disease	0.14	0.35¶	0.02	0.14	-0.11	-0.04
Arthritis	-0.06	-0.06	-0.02	0.06	0.03	0.03

Rho values given in table; significance level: ‡significant at $p \leq 0.05$; §significant at $p \leq 0.01$; ||significant at $p \leq 0.001$; ¶significant at $p \leq 0.0001$.
At the top quartile of the distribution ($n \geq 93$), eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 15; uncontrolled eating ≥ 16; emotional eating ≥ 7. Depression, anxiety, and stress are split according to clinical severity values of DASS-21 (no symptoms and mild to severe symptoms).
Two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size.

Table 3.7: Bivariate characteristics: eating behaviors at the median split

		Cognitive restraint		Uncontrolled eating		Emotional eating	
		n = 59 low	n = 65 high	n = 59 low	n = 65 high	n = 53 low	n = 71 high
	n =124	%	%	%	%	%	%
Age (years)							
< 70	38	50	50	45	55	45	55
≥ 70	86	47	53	49	51	42	58
Gender							
Male	30	50	50	54	47	53	47
Female	94	47	53	46	54	39	61
Race/ethnicity							
White	68	49	51	54	46	46	54
Black	54	46	54	41	59	41	59
Depression							
No symptoms	96	50	50	45	54	85	72
Mild to extreme	28	39	61	54	46	15	28
Anxiety							
No symptoms	96	51	49	81	74	85	72
Mild to extreme	28	36	64	19	26	15	28
Stress							
No symptoms	115	50	50	98	88	96	90
Mild to extreme	9	11	89[§]	2	12[§]	4	10
Diabetes							
No	79	69	58	78	51	70	59
Yes	45	31	42	22	49[‖]	30	41
Heart disease							
No	86	73	66	66	72	74	66
Yes	38	27	34	34	28	26	34
High blood pressure							
No	34	39	17	27	28	38	20
Yes	90	61	83[‖]	73	72	62	80[§]
Arthritis							
No	46	46	29	42	32	43	32
Yes	78	54	71	58	68	57	68

Demographic variables (age, gender, sex); chronic disease variables include demographic variables and diabetes, heart disease, high blood pressure, and arthritis. At the median split (n ≥ 62), eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 10; uncontrolled eating ≥ 13; emotional eating ≥ 4. Significance level: [§]significant at $p \leq 0.05$; [‖]significant at $p \leq 0.01$; [¶]significant at $p \leq 0.001$.

Table 3.8: Bivariate characteristics: eating behaviors at the lowest two tertiles versus the top tertile split

		Cognitive restraint		Uncontrolled eating		Emotional eating	
		n = 83 low	n = 41 high	n = 80 low	n = 44 high	n = 80 low	n = 44 high
	n =124	%	%	%	%	%	%
Age (years)							
< 70	38	63	37	68	32	66	34
≥ 70	86	67	31	63	37	64	36
Gender							
Male	30	63	37	67	33	70	30
Female	94	68	32	64	36	63	37
Race/ethnicity							
White	68	71	29	72	28	62	38
Black	54	61	39	56	44‡	70	30
Depression							
No symptoms	96	77	78	79	75	88	59
Mild to extreme	28	23	22	21	25	12	41‖
Anxiety							
No symptoms	96	83	66	80	73	84	66
Mild to extreme	28	17	34§	20	27	16	34§
Stress							
No symptoms	115	96	85	96	86	98	84
Mild to extreme	9	4	15§	4	14§	2	16§
Diabetes							
No	79	70	51	75	43	69	55
Yes	45	30	49§	25	57¶	31	45
Heart disease							
No	86	73	61	65	77	69	70
Yes	38	27	39	35	23	31	30
High blood pressure							
No	34	34	15	28	27	34	16
Yes	90	66	85§	72	73	66	84§
Arthritis							
No	46	39	34	39	34	41	30
Yes	78	61	66	61	66	59	70

Demographic variables (age, gender, sex); chronic disease variables include demographic variables and diabetes, heart disease, high blood pressure, and arthritis. At the top tertile of the distribution, eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 13; uncontrolled eating ≥ 15; emotional eating ≥ 6. Significance level: §significant at $p \leq 0.05$; ‖significant at $p \leq 0.01$; ¶significant at $p \leq 0.001$.

Table 3.9: Bivariate characteristics: eating behaviors at the lowest three quartiles versus top quartile split

		Cognitive restraint		Uncontrolled eating		Emotional eating	
		n = 96 low	n = 28 high	n = 92 low	n = 32 high	n = 93 low	n = 29 high
	n =124	%	%	%	%	%	%
Age (years)							
< 70	38	74	26	76	24	71	29
≥ 70	86	79	21	73	27	79	21
Gender							
Male	30	77	23	77	23	80	20
Female	94	78	22	73	27	76	24
Race/ethnicity							
White	68	79	21	76	24	71	29
Black	54	74	26	72	28	85	15
Depression							
No symptoms	96	76	82	80	69	87	45
Mild to extreme	28	24	18	20	31	13	55[¶]
Anxiety							
No symptoms	96	81	64	82	66	81	66
Mild to extreme	28	19	34	18	34	19	34
Stress							
No symptoms	115	94	89	96	84	97	79
Mild to extreme	9	6	11	4	16[§]	3	21[‖]
Diabetes							
No	79	67	54	70	47	64	62
Yes	45	33	46	30	53[§]	36	38
Heart disease							
No	86	73	57	66	78	68	72
Yes	38	27	43	34	22	32	28
High blood pressure							
No	34	30	18	27	28	29	21
Yes	90	70	82	73	72	71	79
Arthritis							
No	46	39	32	38	34	38	34
Yes	78	61	68	62	66	62	66

Demographic variables (age, gender, sex); chronic disease variables include demographic variables and diabetes, heart disease, high blood pressure, and arthritis. At the top quartile of the distribution, eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 15; uncontrolled eating ≥ 16; emotional eating ≥ 7. Significance level: [§]significant at $p \leq 0.05$; [‖]significant at $p \leq 0.01$; [¶]significant at $p \leq 0.001$.

Table 3.10: Multivariate regression analysis: eating behaviors at the top tertile of distribution

	Variables	Cognitive Restraint C statistic	Cognitive Restraint OR (95% CI)	Uncontrolled Eating C statistic	Uncontrolled Eating OR (95% CI)	Emotional Eating C statistic	Emotional Eating OR (95% CI)
Model							
1	Depression	0.57	1.39 (0.50, 3.85)	0.62	1.93 (0.69, 5.40)	0.64	4.51§ (1.64, 12.42)
2	+ chronic disease	0.66	1.12 (0.39, 3.27)	0.72	2.19 (0.72, 6.65)	0.73	5.08§ (1.70, 15.19)
1	Anxiety	0.64	3.01‡ (1.22, 7.43)	0.62	1.56 (0.63, 3.87)	0.62	2.37 (0.97, 5.80)
2	+ chronic disease	0.66	2.64 (0.99, 7.09)	0.73	2.04 (0.70, 5.97)	0.71	2.52 (0.91, 6.97)
1	Stress	0.64	8.75‡ (1.60, 47.38)	0.65	8.29‡ (1.48, 46.58)	0.60	5.79‡ (1.09, 30.38)
2	+ chronic disease	0.71	9.82‡ (1.68, 57.49)	0.76	12.05§ (1.96, 74.30)	0.72	6.15‡ (1.09, 34.90)

n = 122; two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size. Dependent variable is eating behavior. At the top tertile of the distribution ($n \geq 83$), eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 13; uncontrolled eating ≥ 15; emotional eating ≥ 6. Depression, anxiety, and stress are split according to clinical severity values of DASS-21 (no symptoms and mild to severe symptoms). Significance level: ‡significant at $p \leq 0.05$; §significant at $p \leq 0.01$; ‖significant at $p \leq 0.001$; ¶significant at $p \leq 0.0001$. Model 1 is adjusted to age, race, and sex. Model 2 is adjusted for age, race, sex, and self-reported presence of chronic disease (diabetes, high blood pressure, heart disease, arthritis).

Table 3.11: Multivariate regression analysis: eating behaviors at top quartile of distribution

	Variables	Cognitive Restraint C statistic	Cognitive Restraint OR (95% CI)	Uncontrolled Eating C statistic	Uncontrolled Eating OR (95% CI)	Emotional Eating C statistic	Emotional Eating OR (95% CI)
Model							
1	Depression	0.57	0.83 (0.25, 2.72)	0.61	2.27 (0.78, 6.65)	0.76	7.99‖ (2.65, 24.03)
2	+ chronic disease	0.65	0.67 (0.20, 2.28)	0.68	2.59 (0.83, 8.10)	0.77	9.22‖ (2.85, 29.80)
1	Anxiety	0.59	2.70‡ (1.04, 6.97)	0.60	2.32 (0.91, 5.93)	0.67	2.16 (0.81, 5.76)
2	+ chronic disease	0.68	2.16 (0.77, 6.11)	0.70	3.30‡ (1.09, 9.98)	0.71	2.40 (0.81, 7.13)
1	Stress	0.58	2.36 (0.50, 11.06)	0.62	6.02‡ (1.28, 28.31)	0.70	10.75§ (1.91, 60.53)
2	+ chronic disease	0.64	2.48 (0.51, 12.13)	0.70	7.67‡ (1.52, 38.65)	0.72	10.69§ (1.87, 61.02)

n = 122; two participants who were Asian were excluded from analyses involving race/ethnicity because of this small sample size. Dependent variable is eating behavior: At the top quartile of the distribution ($n \geq 93$), eating behaviors were considered high when TFEQ-R18 values were: cognitive restraint ≥ 15; uncontrolled eating ≥ 16; emotional eating ≥ 7. Depression, anxiety, and stress are split according to clinical severity values of DASS-21 (no symptoms and mild to severe symptoms). Significance level: ‡significant at $p \leq 0.05$; §significant at $p \leq 0.01$; ‖significant at $p \leq 0.001$; ¶significant at $p \leq 0.0001$. Model 1 is adjusted to age, race, and sex. Model 2 is adjusted for age, race, sex, and self-reported presence of chronic disease (diabetes, high blood pressure, heart disease, arthritis).

CHAPTER 4

SUMMARY

The primary goal of this study was to determine the associations of depression, anxiety, and stress with eating behaviors (cognitive restraint, emotional eating, uncontrolled eating) in congregate meal participants in northeast Georgia's Area Agency on Aging (n = 124, mean age = 75 years, 76% female, 44% African American). This population has a high prevalence of depression (23%) and obesity (54%), and relationships of obesity with eating behaviors were previously documented in this population (Porter and Johnson 2011). Although the participants typically have access to one healthy meal per weekday that is required to meet 1/3 the Recommended Daily Allowances and the Dietary Guidelines for Americans 2010, the participants have an alarming obesity prevalence, suggesting that other factors besides this daily meal may be significantly contributing to the weight problems in congregate meal participants. However, the relationships of the mental health problems with the eating behaviors had not yet been examined, and examining such relationships was an important contribution to a larger research project that aimed to determine the interrelationships of depression, anxiety, and stress, eating behaviors, dietary patterns, and obesity. Analyzing the associations of depression, anxiety, and stress with previously identified obesogenic eating behaviors in older adults with a high prevalence of mental health problems provided a valuable opportunity to better understand how to appropriately target underlying psychological issues in attempts to reduce obesity and improve weight management within this population.

The initial hypotheses for this study were that depression and stress will have a strong association with cognitive restraint and that depression, anxiety, and stress will have a strong association with emotional eating. Two of the initial hypotheses were supported by the findings of this study that robust relationships exist for depression and stress with emotional eating. Additional significant results included a strong relationship of anxiety with cognitive restraint, and of stress with uncontrolled eating.

This research study added relevant information to the current literature addressing mental health relationships with eating behaviors, which previously have focused on younger female populations with eating disorders (Gan et al 2011) or older adults with severe depression and subsequent anorexia. The little research previously conducted within this area for community-dwelling older adults with high prevalence of obesity and associated risk factors (e.g., chronic disease, low socio-economic status, and food insecurity), has yielded unclear results.

The outcomes of this study demonstrate the feasibility of analyzing mental health problems and eating behaviors in older adults using validated questionnaires (Three Factor Eating Questionnaire Revised 18-Item and the Depression, Anxiety, Stress Scale-21 de Lauzon et al 2004, de Lauzon et al 2004; Antony et al 1998) and support novel findings suggesting that mental health problems in community-dwelling older adults may increase susceptibility to eating behaviors promoting obesity. Although the causal pathways of the identified relationships are still uncertain, the results of this study provide some evidence for addressing mental health problems in weight management programs aimed at vulnerable older adult populations in order to improve the outcomes of weight management interventions.

The results of this study support other research showing improved weight management outcomes in interventions that use non-traditional approaches to target eating behaviors and/or improve mental health and self-acceptance. Previous successful weight management interventions have focused on improving eating behaviors through promoting self-awareness of cognitive cues (Beck et al 2013; Smith and O'Neil 1999), improving self acceptance (Bacon et al 2005), and discussing and counseling participants according to how their eating behaviors may be influenced by hyper-arousal of emotions (Hernandez-Hons and Wooley 2012; Hertz et al 2012; Malkina-Pykh 2012; Rapoport et al 2000) or negative psychological feelings, such as shame, guilt, depression, low self-worth, and anxiety (Karhunen et al 2012). Focusing on eating behaviors rather than following rigid diets is more successful in long-term weight loss than promoting adherence to rigid diet plans (Bacon 2005; Roosen et al 2012). Thus, the findings of this study, indicating that mental health is related to eating behaviors, support that integrating mental health assessment and therapy into the aforementioned intervention techniques may further improve the outcomes of weight management programs.

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APPENDICES

Depression Anxiety Stress Scale-21 (Antony et al 1998, Lovibond and Lovibond 1995)

DASS-21 Stress Scale
1. I was intolerant of anything that kept me from getting on with what I was doing
2. I felt I was rather touchy
3. I found it difficult to relax
4. I found myself getting agitated
5. I felt that I was using a lot of nervous energy
6. I found it hard to wind down
7. I tended to over-react to situations
DASS-21 Depression Scale
8. I felt that life was meaningless
9. I felt that I had nothing to look forward to
10. I couldn't seem to experience any positive feeling at all
11. I was unable to become enthusiastic about anything
12. I felt that I wasn't worth much as a person
13. I felt down-hearted and blue
14. I found it difficult to work up the initiative to do things
DASS-21 Anxiety Scale
15. I was aware of the actions of my heart in the absence of physical exertion
16. I experienced difficulty breathing
17. I experienced trembling
18. I felt I was close to panic
19. I felt scared without any good reason
20. I was worried about situations in which I might panic and make a fool of myself
21. I was aware of dryness of the mouth

For all questions, participants responded according to the following scale:
0 = did not apply to me at all; 1 = applied to me to some degree or some of the time; 2 = applied to me a considerable degree or a good part of the time; 3 = applied to me very much or most of the time.

Three Factor Eating Questionnaire R-18 (de Lauzon et al 2004; Porter and Johnson 2011)

Cognitive Restraint
1. Do you deliberately take small helpings as a means of controlling your weight?
2. Do you consciously hold back at meals in order not to gain weight?
3. Do you not eat some foods because they make you fat?
4. How frequently do you avoid "stocking up" on tempting foods?
5. How likely are you to consciously eat less than you want?
6. Do you feel you are restrained in your eating?
Uncontrolled Eating
7. 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?
8. Sometimes when you start eating, do you feel you just can't stop eating once you seem to start?
9. Being with someone who is eating often makes you hungry enough to eat also?
10. When you see a real delicacy, do you often get so hungry that you have to eat it right away?
11. Do you get so hungry that your stomach often seems like a bottomless pit?
12. Are you always hungry so it's hard for you to stop eating before you finish the food on your plate?
13. Are you always hungry enough to eat at any time?
14. How often do you feel hungry?
15. Do you go on eating binges even though you are not hungry?
Emotional Eating
16. When you feel anxious, do you find yourself eating?
17. When you feel blue, do you often overeat?
18. When you feel lonely, do you console yourself by eating?

Questionnaire response categories for each question, as delivered by Dr. Kathryn (Porter) Starr and team included the following: 1 = never; 2 = rarely; 3 = sometimes; 4 = always.