NON-DIETARY PREDICTORS AND CONSEQUENCES OF OBESITY IN OLDER ADULTS IN CONGREGATE MEAL PROGRAMS

by

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(Under the Direction of Mary Ann Johnson)

ABSTRACT

The purpose of this study was to determine the relationship between obesity and non-dietary variables in older adults. Participants were recruited from Congregate Meal Programs in the northeast Georgia Area Agency on Aging [AAA, n = 95, mean (SD) age = 75 (7.4) y, 78.9% female, 54.7% white, 45.3% black, 42.1% obese (BMI $\geq$ 30 kg/m^2), mean WC in women = 37.1 (5.5) inches and in men = 40.4 (4.7) inches]. Data were collected using a questionnaire from the Geisinger Rural Aging Study (Dr. Gordon Jensen, personal communication, 2011). Five obesity classifications were created according to BMI, WC, (NHLBI, 2000) and WC thresholds (within BMI categories) associated with health risk (overweight, obese I, and obese II, Ardern et al 2004). Associations were seen between measures of obesity and non-dietary variables, which suggests a possible point of intervention for obesity in Congregate Meal Program participants in northeast Georgia.

INDEX WORDS: Older adult; Congregate Meal Program; OAANP; non-dietary; obesity; BMI; waist circumference

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CHAPTER 1

INTRODUCTION

The population of older adults is increasing as well as living longer (AoA 2012). Although life expectancy is increasing, the prevalence of chronic conditions, functional limitations, and obesity is also high in this population (AoA 2012, Flegal et al 2012). The older adult population in Georgia experiences similar complications with obesity and chronic conditions (DAS 2011). In combination, longer life expectancy, a large older adult population, and complications resulting from obesity, chronic conditions, and functional limitations present unique problems in the older adult population.

Obesity in older adults is related to a number of non-dietary variables. For example, diseases with well known relationships with obesity are chronic conditions such as hypertension, diabetes, heart disease, and cancer (NHLBI 2000). Other important variables related to obesity in older adults include watching television (Federal Interagency Forum 2010), use of an assistive device (Pressler and Ferraro 2010), and functional ability (Chen and Guo 2008) such as the ability to shop independently or prepare food without assistance. Information about the relationship between obesity and non-dietary variables in unique populations such as older adult participants in Congregate Meal Programs in northeast Georgia needs to be further developed.

The Older Americans Act Nutrition Program (OAANP) provides a congregate meal for older adults. The meal provides nutritious food, socialization, and aims to help older adults stay

independent longer (AoA 2012). In Georgia, Congregate Meal Program participants have a high incidence of obesity and food insecurity; functional limitations are related to food insecurity and obesity (Brewer et al 2010); and inappropriate eating behaviors are related to obesity (Porter and Johnson 2011). The purpose of this study was to increase knowledge and understanding of the relationship between obesity and non-dietary variables in this unique population. The overall hypothesis was that non-dietary predictors and consequences are related to obesity in participants in Congregate Meal Programs. The specific aims were to determine the relationship between obesity and non-dietary variables (television viewing, use of an assistive device, need for assistance while shopping for food or other necessities, and need for assistance while preparing food). The hypothesis was tested in participants of the Congregate Meal Program in senior centers in northeast Georgia.

Chapter 2 is a review of the literature about older adults, obesity and obesity assessment, the OAANP, potential predictors and consequences of obesity, the questionnaire that was used for data collection (Geisinger Rural Aging Study questionnaire), and the socio-ecological model.

Chapter 3 includes the methods, results, discussion of the study outcomes regarding the relationship of obesity with non-dietary variables, and data tables.

Chapter 4 is a summary of the major findings of the study.

CHAPTER 2

LITERATURE REVIEW

Older Adults

Older adults (persons 65 y and older) are the fastest growing segment of the population. In 2010 older adults comprised about 13.1% of the US population and this proportion is expected to reach almost 20% by 2030. Minority populations are also increasing in size. Minorities grew from 16.3% of the older adult population in 2000 to 20% of the older adult population in 2010. Older adult minorities are expected to increase 160% compared to a 59% increase in white older adults. In addition to increasing in size, the older adult population is living longer. Adults who reach the age of 65 y are expected to live an average of 18.8 additional y (20 y and 17.3 y for women and men, respectively). Since 1900, the number of adults 65 – 74 y, 75 – 84 y, and 85+ has increased by 10, 17, and 45 times, respectively (AoA 2012). Although the older adult population is growing and experiencing longer life expectancy, older adults face a myriad of health issues that pose health care complications in the future. Of note, about 39.7% (Flegal et al 2012) of older adults are obese and most chronic health conditions in older adults are directly or indirectly related to obesity (NHLBI 2000).

Related to the increased prevalence of chronic disease is the increase in health care use. Older adults average more frequent and longer hospital visits than their younger counterparts as well as more frequent physician visits. The older adult population also spends significantly more money on out-of-pocket health care costs than the average person (AoA 2012). Older adults in Georgia

who participate in the Older Americans Act Nutrition Program (OAANP) have unique health care utilization characteristics. Due to a high level of food insecurity in this population, some older adults are faced with the dilemma of choosing to spend money on healthy food or needed medical attention. Research in this population has demonstrated that food-insecure participants incur similar Medicare costs as their food-secure counterparts. However, out-of-pocket expenditures in food-insecure participants are significantly lower than food-secure participants. This relationship is consistent with the observation that food-insecure older adults are unable to pay for healthy food and medical expenses. Therefore, these older adults choose between meeting food or medical needs. Additionally, this relationship increases the risk of chronic disease exacerbation due to inadequate or inappropriate nutrient intake (Bhargava et al 2012). As the older adult population grows in size, a number of issues arise regarding health and lifestyle. Obesity in older adults is a possible point of intervention to increase health and quality of life. However, research is needed in special populations of older adults such as Congregate Meal Program participants.

Obesity Prevalence and Comorbidities

According to NHANES data collected in 2009 – 2010, 35.7% of adults in the United States are obese (Ogden et al 2012). The same report indicates that 39.7% (36.6% of men and 42.3% of women) of adults over 60 y are obese. Overall, adults 60 y and older are more likely to be obese than younger age groups (Ogden et al 2012).

Obesity and age related body composition changes are associated with an increased prevalence of chronic conditions. Accumulation of excess fat is related to fat accumulation in skeletal

muscle, liver, and pancreas tissues. This accumulation lessens insulin sensitivity and damages pancreatic β-cells thusly decreasing insulin secretion and promoting diabetes (DeCaria et al 2012). Fat accumulation in the kidney in combination with increased abdominal pressure from abdominal fat promotes arterial hypertension (DeCaria et al 2012). Other chronic conditions associated with obesity in older adults are heart disease, certain cancers (endometrial, colon, and postmenopausal breast cancer), asthma, osteoarthritis and disability (Onwudiwe 2011, Federal Interagency Forum 2010). Most older adults are diagnosed with one chronic condition and many older adults have numerous chronic conditions. Most common chronic conditions among older adults (eg, hypertension, arthritis, heart disease, cancer, and diabetes) are related to and exacerbated by overweight and obesity (AoA 2012, NHLBI 2000). Additionally, 5 of the 10 leading causes of death in older adults (heart disease, cancer, stroke, diabetes, and kidney disease) are chronic diseases related to obesity (Hoyert and Xu 2012). Obesity is also related to chronic pain in older adults; "pain that persists beyond normal tissue healing time, which is assumed to be three mo" (McCarthy et al 2009). The relationship between obesity and chronic pain may be related to additional weight on weight bearing joints and chronic inflammation that is associated with excess body fat. Obesity-related chronic pain could have implications for decreased physical ability and overall quality of life in older adults. The relationship between obesity and chronic conditions suggests that obesity in older adults is an important issue of concern (McCarthy et al 2009).

Finally, obesity in older adults appears to be protective against mortality in some studies. This seemingly beneficial to neutral effect of obesity on mortality is called the "obesity paradox" (DeCaria et al 2012). Obesity denoted by BMI is related to mortality in a "U-shaped" curve

where overweight and obesity in older men and women is associated with the lowest risk of mortality (DeCaria et al 2012). However, research that defines obesity using waist circumference (WC) indicates that a high WC has a three-fold greater relationship with increased mortality risk compared to BMI measurements in obese older adults. Therefore, WC as an indicator of body fatness is more sensitive to the deleterious effects of excess fat accumulation. Furthermore, excess fat accumulation is detrimental to older adult survival rates (Visscher et al 2001).

Obesity Assessment

According to the CDC (2010) overweight and obesity are defined as a weight that is greater than what is healthy for a given height. Regarding body composition, obesity is the unhealthy accumulation of excess body fat (Li and Heber 2012). For adults, obesity is determined by body mass index (BMI), which is calculated as weight (kg)/height squared (m^2). To estimate BMI using pounds and inches, use: [weight (pounds)/height (inches) ^{2}] x 703 (NHLBI 2000). A range of BMI classification is used to determine obesity because it is a good indicator of overall body fatness. Adult BMI classifications are as follows: < 18.5 kg/m^2 = underweight, 18.5 - 24.9 kg/m^2 = normal weight, 25 - 29.9 kg/m^2 = overweight, 30 - 34.9 kg/m^2 = class I obese, 35 - 39.9 kg/m^2 = class II obese, and ≥ 40 kg/m^2 = class III obese (NHLBI 2000).

Waist circumference (WC) is an indicator of abdominal fat and is also used to classify obesity in adults. WC measurements are taken using a tape measure that is placed at the uppermost border of the iliac crest. The measurement is taken when the tape measure, around the individual's waist, is firm without indenting the skin and at the individual's normal, minimal respiration (NHLBI 2000). WC measurements of 102 cm (40 inches) in men and 88 cm (35 inches) in women

indicate obesity related risks in individuals with a BMI between 25 kg/m^2 and 34.9 kg/m^2. Beyond a BMI of 35 kg/m^2 WC loses its incremental predictive power (NHLBI 2000).

NHLBI guidelines indicate one WC measurement as a threshold for risk of obesity related disease. Ardern et al (2004) determined clinically significant WC measurements within each BMI category for men and women (men: normal = ≥ 97 cm, overweight = ≥ 98 cm, class I obese = ≥ 109 cm, class II and III obese = ≥ 124 cm; women: normal = ≥ 79 cm, overweight = ≥ 92 cm, class I obese = ≥ 103 cm, class II and III obese = ≥ 115 cm). These WC thresholds have high sensitivity and specificity for predicting cardiovascular disease (Ardern et al 2004).

Some research indicates that BMI may not be an accurate determinant of fatness, particularly in older adults (Zamboni et al 2005). BMI classification can be distorted by age-related height loss and fat accumulation. Height loss by age 80 of 8 and 5 cm for women and men, respectively, may lead to overestimation of fatness via BMI. Conversely, increased fat and decreased lean muscle in conjunction with no change in weight could underestimate the fatness of an older adult by using BMI (Zamboni et al 2005). Regardless of physiological changes in older adults, Harris et al (2000) report that WC and BMI are good indicators for overall body fat. However, to determine fat deposition in specific regions of the body, more advanced measures such as DEXA and CT scans are required.

Older Americans Act Nutrition Program

The Older Americans Act Nutrition Program (OAANP) is a federally funded program that allocates grants to states based on the number of adults 60 y and older within each state. The

purpose of the nutrition program is to reduce hunger and food insecurity; promote socialization and wellbeing; and delay adverse health outcomes by providing access to nutrition and health promoting and disease prevention services (AoA 2012). The nutrition program targets older adults who are economically and socially at risk, such as rural dwelling or non-English speaking adults. The Congregate Nutrition Services is title IIIC1 of the Older Americans Act (OAA). The goal of the Congregate Meal Program is to provide healthy meals and nutrition services in a congregate setting to prevent the need for more costly medical services. The Congregate Meal Program also strives to help individuals at risk of institutionalization remain independent in the community. The Congregate Meal Program is provided to adults 60 y and older as well as their spouse (regardless of age). Additionally, the Congregate Meal Program sites provide nutrition screening and education; assessment and counseling; as well as meaningful social engagement and volunteer opportunities (AoA 2012).

In 2010 the Congregate Meal Program was the primary service provided by the OAANP. About 40% of the meals served through the nutrition program were served in a congregate setting and 67% of OAA nutrition program participants were served the congregate meal (AoA 2012).

Older Americans Act Nutrition Program in Georgia

Georgia has the fifth and twenty-fourth fastest growing 60+ and 85+ populations in the nation, respectively (DAS 2011). The population of Georgia experienced a 31.4% increase in the proportion of older adults between 2000 and 2010. Currently, about 11% of Georgia's population is adults over 65 y. In Georgia, the Congregate Meal Program is part of a larger initiative to increase health and wellness of older adults. The Division of Aging Services (DAS) in Georgia

established nutrition and wellness programs, as part of the Home and Community Based Services, to help older adults maintain the ability to remain living in their own homes. DAS and its many collaborators, including the University of Georgia, offer services such as nutrition education, nutrition counseling, physical fitness, congregate meal provision, and home delivered meals through programs at local senior centers and Area Agency on Aging (AAAs) in accordance with Older Americans Act state and local laws (DAS 2011).

While the services available to older adults in Georgia are beneficial (DAS 2011), research indicates that obesity is a pressing issue in this population of older adults. The percentage of obese participants in the Congregate Meal Programs in northeast Georgia is similar to the national average (about 40 – 50%, Porter and Johnson 2011). Additionally, increasing BMI and WC is associated with diabetes, hypertension, arthritis, and joint pain in these participants (Penn et al 2009). In spite of the high prevalence of obesity and related comorbidities, Clune et al (2010) report that less than half of the participants who meet criteria for weight loss recommendation according to the American Society for Nutrition and the North American Association for the Study of Obesity (ASN/NAASO) received recommendations to lose weight. These findings are discouraging due to research that suggests that older adults who lose weight report improvement in balance and mobility (Hergeneroeder et al 2011). Although there is a high prevalence of obesity among participants, there exists a food insecurity paradox. In a recent study conducted in 40 senior centers in Georgia, 19% were food insecure, which is more than twice the national average of households with an older adult (7.9%, Brewer et al 2010, Coleman-Jensen et al 2011). Additional research in these participants indicates other food related health issues. A plate waste study observed that among the 4 senior centers examined, Congregate Meal Program participants

have low intake of energy and important nutrients. The researchers speculate that some of the foods served during the meal have low acceptability among the participants, which may contribute to low intake of these foods (Peskoe 2010). O'Shea (2010) indicated that the senior centers that provide the congregate meals are characterized by obesogenic factors such as absence of wellness policies and vending machines with unhealthy food choices. Porter and Johnson (2011) report that obesity is strongly related to inappropriate eating behaviors, namely, cognitive restraint and emotional eating. These factors, as well as other non-dietary variables may be predictors and consequences of obesity.

Predictors of Obesity

Television

Adults over the age of 65 y spend about 30% of their day engaging in leisure activities. About 56% of their leisure time consists of watching television (Federal Interagency Forum 2010). Additionally, Depp et al (2010) observed that television viewing increases linearly after the age of 35 y, leading to the speculation that older adults may spend a considerable amount of time watching television. Johnson et al (2006) observed that women (ages 22 y to 96 y) who watched more than 2 h of television per day were 40% more likely to be obese than women who reported watching less than 2 h of television per day. In a population of Hispanic elders (> 60 y) researchers observed that each additional h spent watching television was associated with a 16% increase in risk of developing metabolic syndrome (Gao et al 2007). Thus, there is evidence that television as a past time contributes to adverse health outcomes including obesity, but little is known about this risk factor specifically among Congregate Meal Program participants.

Consequences of Obesity

In 2010, 37% of older adults reported some type of disability (vision, hearing, ambulation, self-care, independent living, or cognition). Reported disability increases with age and is also related to low social economic status and education attainment (AoA 2012). Obesity in older adults is related to higher prevalence of frailty, greater decline in physical function, and earlier onset of physical disability. It is estimated that 70 y obese men and women will spend one third and one half (respectively) of their remaining life expectancy disabled compared to one fifth and one third of 70 y non-obese men and women, respectively (Houston et al 2009).

Use of an assistive device

Assistive devices are characterized as "assistive technology" used by people with functional deficits to perform activities and tasks. Overall, the use of assistive devices is increasing especially for devices that aid walking, bathing, and toileting (Pressler and Ferraro 2010). The majority of people who use assistive devices are adults over the age of 65 y (Tomita et al 2004). In addition to age, obesity and lower body disability are strong predictors of assistive device use in older adults. Obesity is also a strong predictor for the use of more than one assistive device (Pressler and Ferraro 2010). The top 5 conditions associated with use of assistive devices that aid mobility in adults 65 y and older are osteoarthritis, cerebrovascular disease, cognitive impairment, orthopedic impairment of a lower extremity, and heart disease (Kaye et al 2000). Several of these conditions are related to obesity (CDC 2012). In a study by Tomita et al (2004) researchers found that a number of variables have a significant relationship with the use of an assistive device in older adults. The single strongest predictor of use is physical limitation. However, being white, living in the south, lower levels of depression, polypharmacy, and living

alone are also predictors. This research indicates that variables beyond physical health such as psychological health and social support are important to consider regarding assistive device use (Tomita et al 2004). As the population ages and more older adults rely on assistive devices to maintain functionality, it is increasingly important to understand the relationship between obesity and its potential consequences, especially in special populations such as Congregate Meal Program participants.

Functional decline: IADLs and ADLs

Activities of daily living (ADLs) are "basic personal activities which include bathing, eating, dressing, mobility, transferring from bed to chair, and using the toilet" (DHHS 2013). Instrumental activities of daily living (IADLs) are "Independent living tasks which include using the telephone, taking medications, money management, housework, meal preparation, laundry, and grocery shopping" (DHHS 2013). ADLs and IADLs are important indicators of functional ability especially in an older adult population. As adults age, the ability to complete ADLs and IADLs lessens; and this trend has serious implications for future caregiving and health care provision (Chen and Guo 2008). The nature of age-related body composition changes (described above) leads researchers to explore methods of measuring obesity that more accurately depict fat accumulation in older adults. The relationship between obesity and chronic disease is clear (CDC 2012). The relationship between obesity and functional limitation is less evident due to a number of confounding variables. A review of NHANES data indicates that obesity classified by WC is more significantly related to functional status than BMI in older women when controlling for chronic diseases. Obesity did indicate functional disability in older men, however, the relationship was less clear (Chen and Guo 2008). Research in special populations of older adults,

such as those who participate in Congregate Meal Programs in Georgia, indicates that there is a relationship between obesity (BMI and WC) and physical limitations (Brewer et al 2010). More research needs to be conducted in this population to determine the relationship between obesity and functional status, namely, the ability to perform ADLs and IADLs.

Geisinger Questionnaire

The Geisinger questionnaire is a data collection tool used in the Geisinger Rural Aging Study, which is a longitudinal study of older adults living in rural regions of Pennsylvania. The questionnaire collects demographic information such as age, race/ethnicity, gender, and level of education. It also inquires about other variables of interest such as the history of weight gain or weight loss, medication and supplement use, smoking status, physical activity level, eating habits, special diets, living environment, and television use. Additionally, the questionnaire includes questions about living arrangements such as alone or with family members and/or in a house, apartment, or assisted living home. The questionnaire also inquires about functional status, self reported health, utilization of health care facilities and hospitals, and diagnosed diseases. Finally, the questionnaire has a battery of questions that report the amounts, frequencies, and types of foods consumed. This questionnaire is a valid indicator of food consumption as determined by comparison of responses with serum biomarkers of micronutrient intake (Mitchell et al 2012). Other information collected by the questionnaire (television use, assistive device use, need for assistance while shopping for food or other necessities, and need for assistance while preparing food) is obtained with questions similar to those used in other surveys of older adults (OARS 2010). A complete copy of the questionnaire is in Appendix A.

Socio-ecological Model

The National Cancer Institute (NCI 2005) describes several theories of behavioral development with an emphasis on health outcomes. Of interest to the proposed research is the socio-ecological model and it will be summarized in this section. All information contained in this section comes from NCI (2005), unless otherwise indicated. The socio-ecological model emphasizes the importance of recognizing interactions between individuals and their physical and socio-cultural environment. The socio-ecological approach is characterized by two key concepts. The first concept is called multiple levels of influence and suggests that individual behavior affects and is affected by multiple levels of influence of a health problem. The second key concept is called reciprocal causation and posits that individual behavior shapes and is shaped by the social environment.

Expanding on the concept of multiple levels of influence, there are 5 commonly identifiable levels of influence on health related behaviors, namely: intrapersonal and/or individual factors, interpersonal factors, institutional and/or organizational factors, community factors, and public policy factors. The intrapersonal level is comprised of individual factors such as knowledge, attitudes, beliefs, and personality traits, which influence behavior. Interpersonal factors include family, friends, and peers (all of whom provide social identity, support, and role definition). Institutional factors are rules, regulations, policies, and informal structures that promote or hinder certain behaviors. Community factors are formal or informal social networks and standards that exist among individuals, groups, and organizations. Finally, public policy includes state and federal level policies or laws that regulate or support healthy actions regarding disease prevention, control, and management. Each of these 5 levels of influence can affect an

individual's behavior and ultimately contribute to health related behavior decisions that determine health outcomes. Each of these 5 levels should be considered together because they interact with and affect each other.

Regarding reciprocal causation, the socio-ecological model suggests that people influence, and are influenced by the people and environment around them. Individuals make decisions for their health based on the influence of people around them such as doctors, or family and friends. Additionally, an individual's actions can affect the environment such as purchasing healthy foods thereby increasing demands for those foods as well as their presence in a consumer setting. An important characteristic of the socio-ecological model is that the elements of this model can be categorized as individual (intrapersonal), interpersonal, and community level, which are broader concepts of the multiple levels of influence. To effectively have a positive influence on health related behaviors it is important to consider dominant traits of behavior at each of these levels. On the individual level, behavior is mediated by individual cognitions (what a person does is determined by what they know and think). Individual knowledge is necessary to implement behavior change, however; it is not sufficient by itself to produce behavior change. Finally, perceptions, motivations, skill acquisition, and social environment can influence individual behavior. At the interpersonal level, interactions experienced by an individual can influence their thoughts and actions. Additionally, their interactions can influence the thoughts and actions of others. Finally, a community is traditionally conceptualized as a geographic entity. However, according the socio-ecological model, communities can also be identified as people with common interests or values. Understanding behavior within the context of the socio-ecological model is helpful for promoting health by targeting areas that influence behavioral

decisions across all levels (individual, intrapersonal, and community) of factors that ultimately determine health outcomes.

An example of the socio-ecological model in older adults is a study that conceptualizes different factors influencing under eating in homebound older adults. The researchers identified potential areas related to under eating: medical, functional, economic, oral health, social, religious, and psychological factors (Locher et al 2008). According to the socio-ecological model, these factors can be further understood as operational aspects of individual, intrapersonal, and community level factors. Locher et al (2008) found several associations between under eating and these socio-ecological factors, which indicates that behaviors within these domains have an affect on an adverse health outcome. Looking beyond the association of the domains and the health outcome, the socio-ecological model enables researchers to conceptualize potential mediators of health outcomes as well as areas where interventions can influence behaviors and change health outcomes for the better. For example, within the community domain, public policy that supports aid to homebound older adults may reduce food insecurity in this population.

Because the present study was conducted in a community setting and concerns the relationships of obesity with non-dietary factors (television viewing, use of an assistive device, need for assistance while shopping for food or other necessities, and need for assistance while preparing food), it is important to conceptualize how the socio-ecological model helped guide this research. Individual influences such as personal identity, knowledge, beliefs and attitudes toward healthy lifestyle choices (such as engaging in sedentary activities like watching television as opposed to engaging in physical activity) directly affect an individual's health status. Interpersonal

influences such as family, friends, and social supports can either aid in the development of lifestyle choices or reinforce pre-existing lifestyle choices that affect health status. Institutional influences such as a senior center setting can affect individual health status through types of programs provided and whether or not these resources are implemented in a way that allows older adults to access them. Some examples are appropriate food or activities that are compatible with health needs, cultural beliefs, and personal desire. Community influences affect health status by influencing the dissemination of information to older adults that can benefit from health promoting programs; providing programs that are congruent with the target population's needs; and proximity or ability for older adults to travel to the site of program dissemination. Policy influences are related to the ability of senior centers to organize and implement programs that will affect older adult health in a positive way. Finally, all of the levels acting on the individual older adult are ultimately dependent on the older adult's desire, willingness, or ability to change to promote health and well-being. Based on this example it is clear that the individual influences and is influenced by all levels of the socio-ecological model, especially within a Congregate Meal Program.

Conclusion

In light of the growing older adult population, the obesity epidemic, and adverse outcomes associated with obesity in older adults, interventions that target healthy weight achievement and maintenance in older adults are needed. Several factors contribute to obesity in older adults. Some of these factors may be non-dietary factors. The relationship between non-dietary factors and obesity in older adults in the Congregate Meal Program in northeast Georgia needs to be explored further. A sound understanding of this relationship and application of the socio-

ecological model are helpful for promoting healthy weight and positive health outcomes in the Congregate Meal Program participants.

CHAPTER 3

NON-DIETARY PREDICTORS AND CONSEQUENCES OF OBESITY IN OLDER ADULTS IN CONGREGATE MEAL PROGRAMS

Introduction

Obesity is an ongoing problem in the United States affecting all segments of the population including older adults. About 39.7% of older adults are obese (Flegal et al 2012). Obesity is related to a myriad of lifestyle factors and adverse health conditions. The causal relationship between obesity and lifestyle factors or health conditions is not always clear. A lifestyle factor that is a potential predictor of obesity is television viewing. Of note, the amount of television viewing is related to obesity in adults (Johnson et al 2006) and older adults watch an average of 4.4 h per d, which is more than younger segments of the population (BLS 2012). Potential outcomes related to obesity, in addition to the development of chronic conditions, are inhibited mobility; impaired ability to perform instrumental activities of daily living (IADLs) and activities of daily living (ADLs); and the use of an assistive device such as a cane, walker, or wheel chair. Obesity and high WC in older adults is related to increased risk for disability and impairment of IADL and ADL completion (Chen & Guo 2008), as well as hindered mobility (Hergenroeder et al 2011). Physical disability is predictive of assistive device use (Tomita et al 2004). According to a report on mobility device use in the United States, 2 of the top 5 leading causes for mobility device use are cerebrovascular incident and heart disease (Kaye et al 2000), which are chronic diseases associated with obesity (CDC 2012).

The Older Americans Act Nutrition Program provides a congregate meal to adults 60 y and older (AoA 2012). In Congregate Meal Program participants of northeast Georgia, obesity is related to chronic conditions (Penn et al 2009), physical limitations (Brewer et al 2010), and inappropriate eating behaviors (Porter and Johnson 2011). Little research has been conducted regarding the relationship between obesity and non-dietary variables. The aim of this study was to determine the relationship between obesity and non-dietary variables in the Congregate Meal Program participants in northeast Georgia.

Methods

Study design

This was a cross-sectional study of 95 adults 60 y and older who participated in Congregate Meal Programs in 4 senior centers that are part of the northeast Georgia Area Agency on Aging. Data for this study were collected by a questionnaire from the Geisinger Rural Aging Study (Dr. Gordon Jensen, personal communication, 2011). The questionnaires were administered in the months of June and July of 2011 and read to each participant by a trained interviewer. The questionnaire has 25 questions including demographic information such as age, race/ethnicity, gender, level of education, and income. The questionnaire also includes questions about the participants' lifestyles and functionality, including the length of time spent watching television each day, the need for an assistive device (defined as a walker, a cane, or a wheel chair), the need for assistance while shopping for food or other necessities, and the need for assistance while preparing food. The average age of participants was 75 y, 78% were female and 54% were white. Non-participants included people who refused to answer the questionnaire, people who were absent from the congregate meal the day the questionnaire was administered, and people who

were not cognitively able to answer the questions as determined by the interviewer who administered the questionnaire. All methods 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 (Live Healthy Georgia, 2011-10844-1).

Anthropometric data

Height was measured by a trained interviewer in bare feet or light socks using a stadiometer (model IP0955; Invicta Plastics Limited, Leicester, England). Weight was measured with clothes on and without shoes using a portable digital scale (model HD-317; Tanita Inc., Tokyo, Japan). Based on the recorded height and weight of each participant BMI was calculated: BMI = (weight (pounds)/height (inches)^2) x 703 (NHLBI 2000). WC was measured according to NHLBI guidelines (NHLBI 2000). BMI was used to create obese [BMI $\geq$ 30 kg/m^2 (BMI-obesity)] and non-obese (BMI < 30 kg/m^2) categories. WC measurements were used to create 4 categories of obesity, 3 of which were chronic disease threshold risks within BMI categories (WC-overweight, WC-obesity I and WC-obesity II, developed by Ardern et al 2004), and one that was the WC cutoff from the NHLBI guidelines that suggest risk for chronic disease (WC-risk, NHLBI 2000).

The Geisinger Rural Aging Study questionnaire

The Geisinger questionnaire is a 49 item questionnaire that includes questions about lifestyle and eating patterns. For the purpose of this study, responses to the questions regarding lifestyle were investigated. Demographic information obtained included age, gender, race/ethnicity, and education. Health related questions included information about height, weight, weight change, medication or supplement use, smoking status, and eating habits. There are 5 questions about

eating habits that are similar to the USDA Food Security Module: Six-Item Short Form (USDA 2012). Of these 5 questions, 3 are specific to ability to purchase adequate amounts of food: “Do not have enough food to eat each day;” “often worry whether there will be enough food to eat;” and “unable or prefer not to spend money on food (less than $25-$30 per person spent on food each week)”. The other 2 questions could be related to the ability to afford food; however, the questions are not specific to purchasing power: “frequently skip breakfast altogether” and “do not eat anything on one or more days each month”. These questions could be related to purchasing power; however, they could also demonstrate changes in appetite or altered eating patterns related to health conditions. The questions from the USDA Food Security Module that measure constructs similar to the monetarily oriented questions in the Geisinger questionnaire are: “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more;” “In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food;” “In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food”. The USDA Food Security Module also includes a question that is similar to the Geisinger questions that are not specifically monetary: “In the last 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food”. Although the Geisinger questionnaire uses questions similar to questions used to assess food security, the primary objective of the Geisinger questionnaire is to develop a population specific food frequency questionnaire rather than determine food security (USDA 2013). Therefore, it is important to note that food security was not assessed in the present study. Other eating habits that were assessed by the Geisinger questionnaire include questions about eating alone, change in appetite, digestive problems, chewing or swallowing difficulty, alcohol intake, special diets for weight loss, and special diets

prescribed for chronic disease. Additionally, health was assessed via questions about functional status, use of an assistive device (cane, walker, or wheel chair), a subjective assessment of health (excellent, very good, good, fair, or poor), hospital stays, physician visits, frequency of falls, diagnosis and treatment of chronic diseases, emotional health, family history of overweight and obesity, and weight change patterns. Living environment questions included information about, television watching, type of household, composition of household, presence of utilities within the household, and the financial ability to pay for food. Specific variables of interest were the amount of time spent watching television (≥ 4 h per d). Functional status was assessed with two questions: "do you use an assistive device in daily activities (cane, walker, wheel chair) and "which of the following do you usually or always need assistance with?" (bathing, dressing, grooming, toileting, eating, walking or moving about, getting out of bed or a chair, traveling outside of the home, preparing food, shopping for food or other necessities). The complete questionnaire is available in Appendix A.

Statistical analysis

Descriptive statistics including means, standard deviations, medians, confidence intervals, percentages, and correlations, as well as chi-square analyses and multivariate logistic regression analyses were calculated (SAS, Version 9.1, Cary, NC). Five different classifications of obesity were used for analysis: obesity determined by a BMI ≥ 30 kg/m^2 (BMI-obesity), and 4 WC threshold categories associated with increased risk for chronic disease (WC-risk, WC-overweight, WC-obesity I, and WC-obesity II, NHLBI 2000, Ardern et al 2004). Chi-square analyses were used to compare the proportion of obese versus non-obese participants for non-dietary variables including television viewing habits (length of time spent watching television, snacking, or eating

a meal while watching television), level of physical activity, eating habits (having enough food to eat each day, worry about having enough food, eating alone, skipping breakfast, inability to spend more than $25-$30 per individual in the household on food each week), functional status (homebound; bed or chair bound; the ability to leave the home with assistance; assistive device use; presence of assistance if it is needed; use of stairs in daily activities; need for assistance with bathing, dressing, grooming, toileting, eating, walking, getting out of bed, traveling outside the home, shopping for food or other necessities, food preparation), household characteristics (live in a house, apartment, condominium, mobile home, assisted living/boarding care home, or a nursing home; concern for home security; inadequate heating or cooling in the home; absence of a stove or refrigerator), household composition (live alone, with a spouse, with a son or daughter, with another family member, or other resident), health care utilization (frequency of hospital and clinic visits, frequency of falls, frequency of falls requiring medical attention), patterns of weight gain (overweight since childhood, gained excess weight in middle age, gained excess weight since 50 y, had a yo-yo pattern of weight gain), and family history of obesity. Further chi-square analyses were used to compare obese versus non-obese participants within 5 demographic groups: Age (< 70 y, ≥ 70 y), gender (male, female), race/ethnicity (black, white), education [attainment of a GED or less (≤ GED) or years of school beyond a GED (> GED)], and low or high income (< $6,000 or ≥ $6,000 per individual per y, respectively) (Appendix B). Multivariate logistic regression analyses were used to identify the independent variables including television viewing, use of an assistive device, need for assistance while shopping for food or other necessities, and need for assistance while preparing food, when controlled for potential confounders (eg, age, gender, race/ethnicity, education, and income), that are associated with the dependent variable (obesity). The level of statistical significance was defined at $p < 0.05$.

Results

Participants

The characteristics of the study participants are shown in Table 1 (n = 95). The mean (SD) age was 75 (7.4) y, 79% were female, 55% were white, and 45% were black. The average BMI was 30 (6.6) and 42% were obese. The average WC was 40 (4.7) inches and 37 (5.5) inches in men and women, respectively. 72% of the participants reported a high school education or less and 23% of participants were low-income (< $6,000 per y per household resident).

Prevalence of non-dietary variables

Table 2 shows the prevalence of each non-dietary variable assessed in the Congregate Meal Program participants. Over 40% of the Congregate Meal Program participants reported engaging in each of the television variables (watching ≥ 4 h television/d, eating a snack while watching television, and eating a meal while watching television). 83% of the participants report engaging in physical activity in the past month. The most common dietary life style variables are eating alone (56.8%) and skipping breakfast (17.9). Between 11 and 18% of the participants report concerns about having enough food or adequate money to purchase food. The prevalence of functional limitation was low. No participants reported difficulty with eating or toileting. Less than 3% of the participants reported difficulty with bathing, dressing, grooming, and walking. Less than 6% reported being housebound, bed/chair bound, or needing assistance to leave their home. However, over 31.6% reported using an assistive device (cane, walker, or wheel chair), 20% reported needing assistance traveling outside of the home, 7.4% reported needing assistance preparing food, and 17.9% reported needing assistance shopping for food or other necessities. Between 2 and 7% of the participants reported concerns about adequate heating/cooling and

absence of a stove or refrigerator in their residence. 13.7% reported a concern for home security. 48.4% of the participants report that they live with other people in their household. The majority of participants report that they live in a house, apartment, condominium, or mobile home (94.7%). (one participant had missing data for this question, the missing item was coded to be house, apartment, condominium, or mobile home because it was the most frequent response.) 96.3% and 20% of participants reported visiting a physician's clinic or staying overnight in a hospital, respectively. 8.4% of the participants reported experiencing a fall that required attention from a doctor. The majority of the participants reported gaining excess weight since 50 y of age (42.1%). 36.8% of participants reported having obese family members (63.2% reported no obese family members). The prevalence of diabetes; high cholesterol; hypertension; arthritis; edema in the legs, ankles, or feet; and mental health problems was between 20 and 75%. The prevalence of lung disease, urinary problems, cancer, dementia, coronary heart disease, heart failure, angina, and history of myocardial infarction was between 1 and 18%.

Chi-square analyses

Table 3 shows the results of chi-square analyses between non-obese and obese participants according to BMI-obesity (BMI $\geq$ 30 kg/m^2) or WC thresholds (WC-risk, WC-overweight, WC-obesity I, WC-obesity II, NHLBI 2000, Ardern et al 2004). In all significant relationships, obese participants represented a higher proportion of affirmative responses to the variables of interest.

In the BMI-obesity category (BMI $\geq$ 30 kg/m^2), obese participants were more likely to watch $\geq$ 4 h television daily ($p < 0.05$); use an assistive device ($p < 0.05$); report being overweight since

childhood ($p < 0.01$); have hypertension ($p < 0.05$); have arthritis ($p < 0.05$); and edema in the legs, ankles, or feet ($p < 0.01$).

Participants with a high risk WC according to NHLBI (2000) guidelines (WC-risk) were more likely to watch ≥ 4 h television daily ($p < 0.05$). Additionally, these participants were more likely to use and assistive device ($p < 0.01$); have diabetes ($p < 0.05$); have arthritis ($p < 0.05$); and have edema in the legs, ankles, and feet ($p < 0.01$). Finally, these participants were more likely to be black ($p < 0.01$).

In the WC-overweight category, participants with a high risk WC were more likely to watch ≥ 4 h television daily ($p < 0.05$). These participants were also more likely to use an assistive device ($p < 0.01$); need assistance while shopping for food or other necessities ($p < 0.05$); and have diabetes ($p < 0.01$), arthritis ($p < 0.01$), and hypertension ($p < 0.05$). Additionally, obese participants in this category were more likely to be black and non-obese participants were more likely to be white ($p < 0.05$).

In the WC-obesity I category, obese participants were more likely to watch ≥ 4 h television daily ($p < 0.05$); report home security concerns ($p < 0.05$); live with at least one other person in the home ($p < 0.05$); live in a home health care, assisted living, or personal care home setting ($p < 0.05$); need assistance while shopping for food and other necessities ($p < 0.05$); stay over night in a hospital ($p < 0.05$); report excess weight gain in middle age ($p < 0.01$); have diabetes ($p < 0.001$); and report edema in the legs, ankles, and feet ($p < 0.001$). At risk participants in this WC category were also more likely to be < 70 y ($p < 0.01$).

Participants in the WC-obesity II category were more likely to watch ≥ 4 h television daily ($p < 0.05$). These participants were also more likely to report inadequate heating or cooling in their home ($p < 0.05$), report difficulty traveling outside of their home ($p < 0.05$), need for assistance preparing food ($p < 0.05$), and need for assistance with shopping for food or other necessities ($p < 0.001$).

Additional chi-square analyses between non-obese and obese participants according to BMI (BMI ≥ 30 kg/m^2) or WC thresholds (WC-overweight, WC-obesity I, WC-obesity II, WC-risk, Ardern et al 2004, NHLBI 2000) within 5 demographic categories (race/ethnicity, education, income, gender, and age) are shown in Appendix B.

Multivariate logistic regression

Multivariate logistic regression analyses with odds ratios were conducted to determine the independent association of each measure of obesity with selected non-dietary variables (television viewing, use of assistive device, need for assistance while shopping for food or other necessities, and need for assistance while preparing food) (Table 4). One model was created for each measure of obesity. Each model also included the non-dietary variables as well as potential confounders (age, gender, race/ethnicity, education, and income, Table 4). According to these analyses, participants who reported watching more than 4 h of television/d (OR 2.58, 95% CI 1.03, 6.46, $p < 0.05$) and using an assistive device such as a cane, a walker, or a wheel chair (OR 3.31, 95% CI 1.07, 10.2, $p < 0.05$) had an increased odds of BMI-obesity. Participants who reported needing assistance shopping for food or other necessities had increased odds of WC-

obesity II (OR 11.1, 95% CI 1.22, 99.9, $p < 0.05$). Needing assistance preparing food was not significantly related to obesity or any of the WC variables.

Discussion

The purpose of this study was to explore the relationship between obesity and non-dietary variables in older adult participants of the Congregate Meal Program in northeast Georgia. The hypotheses were that obesity would be significantly associated with non-dietary variables. The results of this study concluded that the relationships of obesity with television viewing, assistive device use, and need for assistance while shopping for food or other necessities are significant in this population. Although these relationships are significant, many aspects of the study need further consideration to better understand the implications of these relationships. The statistical approach of this study, namely exploring the relationship of several measures of obesity with non-dietary variables, were used based on previous obesity research and health recommendations, prevalence of non-dietary variables within the sample, and a theory based approach regarding functional decline. The relationships observed in this study are consistent with research in other populations. Additionally, findings in other adult and older adult populations related to obesity and non-dietary variables indicate potential areas of future research in Congregate Meal Program participants in northeast Georgia. The questionnaire used to collect data for this study was developed in another region of the country; therefore, the applicability of this instrument in Congregate Meal Program participants in northeast Georgia needs to be considered. Finally, the results of this study generate a better understanding of the types of barriers Congregate Meal Program participants face.

Variables of obesity

The present study used BMI (≥ 30 kg/m^2) and WC measurements recommended by NHLBI as indicators for obesity due to the ease of data collection and health implications of these measures. These measurements are easy and inexpensive to collect in a community setting. The equipment (stadiometer, scale, and tape measure) needed for these assessments are inexpensive and portable. Additionally, there is little inconvenience for the participants because the measurements are taken with clothing on. BMI and WC measurements were also used because they are important indicators of health. High BMI and large WC measurements are indicators of excess body fat which is related to chronic conditions such as heart disease, dyslipidemia, diabetes, and hypertension (NHLBI 2000). Finally, excess body fat is related to functional decline (Beavers et al 2013). In addition to BMI and the WC cut-off recommended by NHLBI, WC cut-offs within BMI categories were used to observe the relationships between non-dietary variables and progressively more severe obesity. The present study used the WC cut-offs determined by Ardern et al (2004) because of their sensitivity and specificity for indicating risk for heart disease. Additionally, research indicates that WC is more strongly related to adverse obesity-related outcomes than BMI (Janssen et al 2004). Anticipating the ability to observe stronger relationships, this study used WC measurements as a measure of obesity severity to detect relationships between non-dietary variables and obesity rather than more severe measures of obesity indicated by BMI. A final point of consideration regarding the obesity variables is the applicability of these measures in an older adult population. The WC indicated by NHLBI suggests risk of chronic disease for all adult populations (NHLBI 2000). The WC measures used to indicate health risk in the present study were determined in adults 20 to 65 y (Ardern et al 2004). Therefore, the two WC variables are comparable because they are used to indicate health

risk in a general adult population rather than a specific age group. The present study was conducted in an older adult population with unique characteristics. Ardern et al (2004) determined WC measures with increased sensitivity and specificity for detecting health related risks in adults ≥ 40 y. Although this age cut-off is not specific to older adults, it may be beneficial to validate WC measurements that indicate health risk in older adult populations.

Non-dietary variables

Four non-dietary variables were used in the multivariate logistic regression analysis: watching television for ≥ 4 h per d, using an assistive device, needing assistance shopping for food or other necessities, and needing assistance preparing food. The primary determinants for using these non-dietary variables were a theoretical approach based on the Disablement Process (Verbrugge and Jette 1994) as well as the prevalence of poor performance in these variables in the Congregate Meal Program participants. The prevalence of problems with non-dietary variables that creates barriers to a high quality of life for participants of the Congregate Meal Program demonstrates the concepts of the Disablement Process. Additionally, according to the theory of the Disablement Process, several non-dietary variables not explored in the present study may require further attention, such as eating, toileting, using stairs daily, and traveling.

The Disablement Process is one theory that describes the phases of change that older adults experience regarding obesity related functional decline. The Disablement Process accounts for chronic and acute conditions that lessen function in physical and mental domains as well as activities of daily living. This theory also identifies individual and environmental factors that affect the rate of disablement such as predisposition to a condition, additional exasperators, and

interventions to slow or prevent the rate of disablement. The Disablement Process consists of four main concepts that depict the trajectory and rate of functional decline as well as outside influences of chronic conditions. The first concept is pathology, which refers to physiological abnormalities that interrupt normal processes in an older adult's body. The second concept is impairment, which indicates significant dysfunction in one or more body systems such as mental, physical, or social domains. The third concept is functional limitation, which occurs when an older adult is unable to perform overall, fundamental physical or mental actions in daily life such as walking, hearing, or communicating. The final concept is disability, which is experienced when an older adult has difficulty performing activities in any domain of life such as ADLs (Verbrugge and Jette 1994).

In the context of the Congregate Meal Program participants, functional decline is comparable to lessened ability to complete the IADLs and ADLs assessed using the Geisinger questionnaire (Appendix A). Based on the initial analysis of all non-dietary variables, the prevalence of difficulty performing IADLs and ADLs was low (< 6%) with a few exceptions (needing assistance traveling outside the home, needing assistance shopping for food and other necessities, and needing assistance preparing food). Other prevalent characteristics or behaviors that could be related to obesity or functional decline included watching ≥ 4 h television per d; watching television while eating a snack or a meal; engaging in physical activity; eating alone; using an assistive device such as a cane, walker, or wheel chair; and rate of weight gain (overweight since childhood, gained excess weight in middle age, gained excess weight since 50 y, have a history of weight swings many times over the years). After assessing the overall prevalence of non-dietary variables in this population, chi-square analyses were used to determine the prevalence of

non-dietary variables among obese versus non-obese participants as well as whether there was a significant difference between obese and non-obese participants. Based on these tests, obesity and high WC was more consistently associated with decline in IADLs (using an assistive device, needing assistance shopping for food or other necessities, and needing assistance preparing food) as well as watching ≥ 4 h television per d (Table 3).

Based on the Disablement Process theory and the prevalence of non-dietary variables in the Congregate Meal Program participants, further multivariate logistic regression analysis was used to determine the relationship between obesity or WC and watching ≥ 4 h television per d; using an assistive device such as a cane, walker, or wheel chair; needing assistance shopping for food or other necessities; and needing assistance preparing food. The results of these analyses indicate that participants who reported this level of television viewing and functional decline are more likely to be obese or have a high WC. Functional decline affecting performance of IADLs (needing assistance shopping for food or other necessities) indicates increased odds for the most extreme measure of obesity (WC-obesity II). In the context of the Disablement Process, these results indicate that Congregate Meal Program participants in senior centers of northeast Georgia experience disability in the less severe stages of the Disablement Process (active pathology or impairment). Extremely obese participants were more likely to experience disability in later stages of the Disablement Process (functional limitation or disability). These findings indicate that prevalent disability is related to obesity. These findings established a relationship that is helpful for developing effective interventions as well as targeting participants who have the greatest need for interventions in the Congregate Meal Program participants in northeast Georgia. Namely those with the highest WC or most severe obesity could potentially benefit most from

interventions that assist the completion of IADLs. Finally, although only four non-dietary variables were used for multivariate logistic regression analyses, other indicators of functional decline should be explored, as there are reports of functional decline related to obesity in this population (Brewer et al 2010).

Obesity is related to sedentary behavior and functional decline

The results of the present study indicate a significant relationship between watching ≥ 4 h television per d, using an assistive device, and needing assistance shopping for food and other necessities. The relationship between these variables and obesity can be more broadly described as a relationship between obesity and sedentary behavior or functional decline in Congregate Meal Program participants in northeast Georgia. The findings of this study cannot be generalized to other populations; however, these results can be compared to findings in other adult and older adult populations.

Sedentary behavior can be a broad term that encompasses many behaviors such as watching television, using a computer, reading a book, or relaxing and thinking (Rhodes et al 2012, Federal Interagency Forum 2010). Many domains of life such as age, education, employment, and health indicators are related to time spent engaging in sedentary behaviors (Rhodes et al 2012).

Age is related to the type and amount of activities in which adults or older adults engage. Sedentary behaviors in adults and older adults, particularly television viewing, are an interesting area of research due to the established relationship between television viewing and obesity in

children. Previous research indicates that reducing the amount of television children watch is related to lower BMI, WC, triceps skinfold thickness, and waist to hip ratio (Robinson 1999). The mechanism of this relationship in children may be related to energy intake and expenditure (Robinson 1999). The relationship between obesity and television or other sedentary behaviors in adult populations is not clear and may be different than that of children. As adults age, older adults report that a greater proportion of their time is spent engaging in leisure activities (Federal Interagency Forum 2010). Additionally, older adult populations report the amount of time spent watching television increases with age (Federal Interagency Forum 2010). In a sample that is representative of the United States population, Depp et al (2010) reported that frequency and proportion of hours spent watching television increases with age. While age is positively related to television viewing, other sedentary behaviors depict different relationships with age. For instance, younger adults are more likely than middle-aged or older adults to spend time using a computer. Additionally, there is no relationship between age and the amount of time that is spent reading (Rhodes et al 2012). Although age is negatively associated with computer use and positively associated with television viewing, other factors such as education influence this relationship. Adults with higher education are more likely than lower education adults to spend time on a computer. Adults with higher education are also more likely to watch less television than adults with lower education (Rhodes et al 2012). Employment also influences the amount of time spent watching television. In a study of Japanese elders, television viewing was significantly related to working < 35 h per week (Kikuchi et al 2013). A longitudinal study followed French adults at the end of their careers and into retirement. This study indicated that television viewing increased significantly with the onset of retirement (Touvier et al 2010).

Therefore, as they age, older adults do increase the amount of time spent watching television and potentially the amount of time spent being sedentary.

Sedentary behavior, such as watching television, was previously conceptualized as an extreme on a continuum of physical activity. Research suggests that sedentary behaviors could have an effect on health and overall well-being separate from the lack of benefit of physical activity (Rhodes et al 2012). Fung et al (2000) report that television viewing and physical activity have independent effects on biomarkers of cardiovascular disease risk such as HDL. These researchers observed a positive relationship between physical activity and HDL across similar levels of television viewing. Additionally, there was a negative relationship between television viewing and HDL across similar levels of physical activity. These findings indicate that sedentary behavior may have an adverse effect on health separate from the positive impact of physical activity on health (Fung et al 2000). However, the effects of television viewing over time are not clear. Some researchers observed a cross-sectional relationship between television viewing and BMI, but they did not observe a significant relationship between television viewing and weight gain over time (Crawford et al 1999). Conversely, other research indicates that increasing television viewing over a 5 y period in an adult population is related to increased WC, diastolic blood pressure, and overall cardiometabolic risk (Wijndaele et al 2010). Based on the conflicting findings regarding television viewing over time, long-term associations between television viewing and health indicators in the Congregate Meal Program participants in northeast Georgia may be an important area of research and ultimately a point of intervention for improving health status and well-being.

The relationship between obesity and physical activity in older adults is complex. It is possible that body composition predicts physical activity rather than physical activity predicting body composition. In a longitudinal study by Ekelund et al (2008), body weight, BMI, and WC were predictive of sedentary time where as sedentary time did not predict indicators of body composition. The directionality of this relationship may also be related to functional decline. Previous research indicates abdominal and overall adiposity were primary factors for explaining functional decline over a 5 y period in the Health ABC study. Additionally, abdominal obesity confers the greatest risk of functional decline among the individual components of the metabolic syndrome (Beavers et al 2013). Ip et al (2013) explored the dynamic nature of functional decline in older adults by observing the transitional characteristics of function over a long period of time. Older adults who were physically active were less likely to transition from higher to lower levels of physical function. Additionally, older adults with low levels of function who engaged in physical activity were more likely than sedentary adults to regain function (Ip et al 2013). This research confirms the deleterious effects of sedentary behavior on older adults. Additionally, the present study demonstrates the complex relationships between obesity, sedentary behavior, and functional decline in Congregate Meal Program participants in northeast Georgia. These findings indicate that these relationships are complex, time sensitive, and non-linear. Although the disablement process depicts the overall progression of functional decline, the trajectory is complex and could also be considered in the context of the socio-ecological model.

The socio-ecological model and lifestyle choices

The socio-ecological model (described previously) illustrates the dynamic relationship of the individual with his or her surroundings that results in health outcomes. As previously discussed,

according to this model, on the individual level, older adults make lifestyle choices that promote or decrease health. These decisions are influenced by interpersonal relationships (family, friends, and neighbors), Institutional factors (environments within institutions such as senior centers that are conducive to health promoting activities), community influences (availability and older adults' ability to access health promoting resources within the community), and finally policy level influences (coordination and implementation of health promoting resources). Due to the inability to determine the directional relationship between obesity and non-dietary variables, as well as previous research that supports obesity as a predictor of sedentary behavior (Ekelund et al 2008), it is helpful to consider obesity within the socio-ecological model as a cause rather than a consequence for lifestyle factors that seemingly promote obesity.

The relationship between obesity and functional decline in older adults is established in the general population (Chen and Guo 2008) and in Congregate Meal Program participants in Georgia (Brewer et al 2010). Additionally, relationships between obesity and sedentary activities such as watching television are also observed among older adults (Johnson et al 2006). Finally, the relationship between age and increased time spent watching television is well known (Depp et al 2010). However, little research has been done to determine if older adults are obese because they spend a large amount of time engaging in sedentary activities, or if they engage in sedentary activities because they are obese and find it difficult or unpleasant to engage in other health promoting behaviors. According to Vincent et al (2012), fear of pain related to exacerbation of chronic conditions such as heart disease or chronic obstructive pulmonary disease decreases the likelihood of engaging in physical activity. Although the onset of these chronic conditions is associated with obesity (CDC 2013), older adults with these conditions may choose sedentary

lifestyles as a result of their condition rather than the condition originating as a result of obesity related to sedentary behavior. Further, if older adults choose to be sedentary as a consequence of their chronic disease or functional limitation, they increase the risk of perpetuating a cycle of muscle mass degradation and further decline (Vincent et al 2012). In the context of the socio-ecological model, the individual chooses sedentary behavior to avoid pain associated with physical activity. This could limit the individual's interpersonal interactions with family, friends and peers who are more functional. The institutional level, such as senior centers, affect the individual by the extent to which the individual can participate in programs based on accommodations for their limitations. The community influences the individual by the degree to which the individual is made aware of programs that are appropriate for his or her condition and the feasibility of transportation to such programs. Public policy influences the individual's experience by implementing and coordinating appropriate programs for engagement. Finally, the individual affects all other levels of the socio-ecological model by making personal decisions about his or her health status. Further research, especially in unique populations such as Congregate Meal Program participants, is needed in order to establish a clear relationship between lifestyle variables such as television viewing with obesity. Based on the relationships observed in the Congregate Meal Program participants as well as previous research by Ekelund et al (2008), it is likely that obesity begets sedentary behavior. The socio-ecological model is a useful tool for conceptualizing research methods that elucidate this ambiguous relationship.

Economic variables

Economic hardship creates barriers to overall well-being in older adults. According to the Georgia Division of Aging Services (DAS) about 26% of adults > 60 y need financial assistance,

20% need assistance shopping, and 18% need assistance with transportation. The DAS also recognizes a need for pest control, home repair for safety services, and heating or air conditioning services in rural areas of Georgia. In the present study, there was not a specific income variable, but rather an income cutoff variable of more or less than $6,000 per individual within the household. However, low-income is a prevalent challenge in this older adult population. Other economic related variables that portray economic hardship include concerns about home security, living in a home with inadequate heating and cooling, not having enough food to eat, often worrying whether there will be enough food to eat, and being unable or preferring not to spend money on food (<$25-$30 per person spent on food each week) (Table 2). The results of the present study indicate that the needs of the Congregate Meal Program participants are consistent with the needs of older Georgians addressed by DAS. Additionally, food insecurity is a prevalent economic problem in the Congregate Meal Program participants in Georgia (Brewer et al 2010). Brewer et al (2010) assessed food insecurity using the Six-item U.S. household food security survey. Although food security was not specifically assessed in this study, the Geisinger questionnaire used similar questions regarding economic status and eating habits (discussed previously). These economic variables were occasionally related to obesity. A better understanding of the nature of these relationships could be helpful in continued efforts toward meeting the needs of the Congregate Meal Program participants in northeast Georgia.

Rate of weight gain over the years

The prevalence of obesity in Congregate Meal Program participants in northeast Georgia could be related to functional decline as well as other health related problems. Interventions that prevent unhealthy weight gain or promote healthy weight loss could benefit these older adults.

The variable used to assess weight gain patterns over the years indicates that the most prevalent weight gain pattern in the Congregate Meal Program participants is gaining excess weight after age 50 y (42.1%). However, in participants with a BMI ≥ 30 or in the WC-obesity I category, obese participants or participants with a high WC were significantly more likely to report being overweight since childhood or gaining excess weight in middle age, respectively. Based on the results of this study, Congregate Meal Program participants are likely to be obese before they can access the programs at the senior centers. Research supports that promoting healthy weight loss in older adults, especially fat mass, can result in significant health benefits for conditions such as osteoarthritis, diabetes, cardiovascular disease, and physical function (Li and Herber 2012). However, Coakley et al (1998) indicate that a history of weight loss, smoking cessation, and unhealthy eating habits are strong predictors of weight gain in a population of men ≥ 65 y. Therefore, promoting healthy weight loss in an older adult population such as Congregate Meal Program participants needs to consider many factors that affect weight change such as history of weight loss attempts, smoking cessation, and food choices.

Geisinger questionnaire

A final point of consideration for the present study is the applicability of the questionnaire used to collect data. The Geisinger Rural Aging Study was implemented in rural areas of Pennsylvania and collected data from older adults in a Medicare-managed health maintenance organization. The participants were majority female, primarily white, and ≥ 65 y (Bailey et al 2007). In comparison to participants in the present study, older adults in the Geisinger Rural Aging Study are leaner, however their educational and gender characteristics are similar to this sample in Georgia (Ledikwe et al 2004). Some of the participants also live in rural areas of

Georgia (O'Shea 2010). Although culture and eating habits may differ between older adults in Georgia and Pennsylvania, the portion of the Geisinger questionnaire used for this study inquired about functionality and lifestyle factors with little room for misinterpretation based on difference among target populations. Additionally, the questions used to obtain this information are similar to those used in other surveys of older adults (OARS 2010).

Application of results

The present study demonstrated a relationship between obesity and television viewing as well as assistive device use. The results also demonstrate a relationship between the highest measured WC and needing assistance shopping for food or other necessities. Based on these findings as well as findings in other populations, the Congregate Meal Program participants may benefit from programs that promote healthy weight loss or maintenance, increases in physical activity and functionality, and a decrease in the amount of time spent watching television or being sedentary. The Congregate Meal Program participants have access to opportunities for healthy eating, physical activity, and overall healthy living. Emphasizing the need to find ways to be physically active is still an important priority in this population. Finally, it appears that the participants that experience the most functional decline are those with the most severe obesity. Participants who are the most obese may benefit the most from interventions for functional assistance such as providing help shopping for food and other necessities.

Strengths and limitations

There were some limitations to the present study. It was cross-sectional in design and therefore causal inferences regarding the relationships between obesity and non-dietary variables could not

be drawn. Additionally, the information collected from the questionnaire was historical information that relied on the participants' ability to recall information accurately. However, a strength of this study was that height, weight, and WC were measured by a trained interviewer for each participant. Another limitation to this study was the small sample size. The small number of participants potentially reduces the power of statistical analyses to detect relationships with small effect sizes. Finally, this study was conducted in a unique and specific population of older adults in northeast Georgia. Therefore, the results of the study cannot be applied to populations beyond the Congregate Meal Program participants. However, this study does add valuable knowledge to the relationships between non-dietary variables and functionality with obesity in these older adults.

Future research

Given that more than 1.7 million Americans receive meals from Congregate Meal Programs across the United States (AoA 2012), future research may include studies on a more representative population of the country as well as more longitudinal and developmental aspects of aging. NHANES data have demonstrated the ongoing obesity epidemic in the United States over the past several decades. Findings from NHANES data also indicate a relationship between obesity in older adults with functional decline (Chen and Guo 2008). While the present study supports this relationship, determining causal relationships between predictors of obesity as well as consequences of obesity is a priority for implementing appropriate health interventions in older adults as well as younger cohorts. Research efforts in the future may include using more longitudinal studies to observe the variables related to the development of obesity. Additionally, more advanced methods of measuring body composition may elucidate more conclusive

relationships between the type of fat deposition and body composition changes over time as they relate to functional decline.

Conclusions

The results of this study add to the growing body of knowledge surrounding obesity in older adult Congregate Meal Program participants in Georgia. Previous studies in this unique population have investigated the amount and types of foods accepted and eaten at congregate meals (Peskoe 2010), environmental factors of Congregate Meal Program sites affecting participants (characteristics that promote leanness or obesity, O'Shea 2010), relationships between functional limitation, food insecurity (Brewer et al 2010), inappropriate eating patterns (Porter and Johnson 2011), and obesity. While these studies have developed a meaningful understanding regarding nutrition related health of Congregate Meal Program participants as well as participant characteristics related to food access and consumption, the present study expands on the knowledge of obesity predictors and consequences in this population by exploring the non-dietary lifestyle and functional relationships with obesity.

Table 1 - Participant Characteristics[1]

Variable	n	Mean (SD) or %
Age		75 (7.4)
< 70 y	22	23.2%
≥ 70 y	73	76.8%
Gender		
Male	20	21.1%
Female	75	78.9%
Race/ethnicity[a]		
White	52	54.7%
Black	43	45.3%
Education[b]		
≤ GED	68	71.6%
> GED	27	28.4%
Income (per y per individual in household)		
< $6,000	22	23.2%
≥ $6,000	73	76.8%
BMI[c]		30.1 (6.6)
Normal	20	21.1%
Overweight	35	36.8%
Obese	40	42.1%
Waist circumference (inches)[d]		
Men		40.4 (4.7)
Women		37.1 (5.5)
Waist circumference categories (inches)[e]		
WC-risk[1]	62	65.3%
WC-overweight[2]	58	61.1%
WC-obesity I[3]	23	24.2%
WC-obesity II[4]	8	8.4%

[1]n = 95
[a]Race/ethnicity: Two participants were excluded for being race other than white or black
[b]Education: ≤ GED = completed 12 of school or GED, > GED = 2 years of college or technical school, 4 year degree, or graduate degree
[c]BMI: Normal = 18.5 – 24.9 kg/m^2, overweight = 25 – 29.9 kg/m^2, obese ≥ 30 kg/m^2
[d]Waist circumference risk determined by NHLBI (2000): 102 cm (40 inches) in men and 88 cm (35 inches) in women
[e]Waist circumference categories: [1]WC risk determined by NHLBI (2000), [2]WC-overweight = ≥ 100 cm (men), ≥ 90 cm (women); [3]WC-obesity I = ≥ 110 cm (men), ≥ 105 cm (women); WC-obesity II = ≥ 125 cm (men), ≥ 115 cm (women) (Ardern et al 2004)

Table 2 - Overall Prevalence of Non-dietary Variables

Non-dietary Variable[1]	n[2]	Percentage (%)
Television viewing[a]		
≥ 4 h television/d	45	47.4
Television snack[1]	52	54.7
Television meal[2]	37	40.0
Lifestyle variables[b]		
Physical activity[1]	79	83.2
Enough food[2]	13	13.7
Worry about food[3]	11	11.6
Eat alone	54	56.8
Skip breakfast	17	17.9
Housebound	5	5.3
Bed/chair bound	3	3.2
Go out with assistance[4]	4	4.2
Assistive device[5]	30	31.6
Help provision[6]	14	14.7
Use stairs daily[7]	12	12.6
Security[8]	13	13.7
Inadequate heat/cooling	6	6.3
Stove/refrigerator[9]	2	2.1
Money for food[10]	17	17.9
Household composition[c]		
≥ 1 member	46	48.4
Assistance[1]	4	4.2
Residence[d]		
House[1,*]	90	94.7
Assisted living[2]	5	5.3
ADLs/IADLs[e]		
Bathing	2	2.1
Dressing	2	2.1
Grooming	1	1.1
Walking[1]	1	1.1
Traveling[2]	19	20.0
Preparing food	7	7.4
Shopping[3]	17	17.9
Health care utilization[f]		
Hospital[1]	19	20.0
Clinic[2]	92	96.3
Fall needing doctor[3]	8	8.4
Rate of weight gain[g]		
Childhood[1]	5	5.3
Midage[2]	16	16.8
Since 50[3]	40	42.1
Yo yo[4]	6	6.3
Family history of obesity		

Non-dietary Variable[1]	n[2]	Percentage (%)
Obese	35	36.8
Not obese	60	63.2
Chronic conditions		
Diabetes	31	32.6
High cholesterol	60	63.2
Hypertension	72	75.8
Lung disease	11	11.6
Arthritis (knee)	45	47.4
Edema	30	31.6
Urinary	17	17.9
Mental	21	22.1
Cancer	1	1.1
Dementia	1	1.1
Coronary heart disease	12	12.6
Heart failure	7	7.4
Angina	7	7.4
Myocardial infarction	11	11.6

[1]All responses for variables defined below are affirmative responses
[2]n = 95
[a]Television viewing: [1]watch television while eating snacks each day, [2]watch television while eating at least one meal each day
[b]Lifestyle variables: [1]participation in physical activity in the past month, [2]do not have enough food to eat, [3]often worry whether there will be enough food to eat, [4]able to go outside of home with assistance, [5]use an assistive device (cane, walker, or wheel chair), [6]have no one to provide assistance or care at home if needed, [7]must go up/down a flight of stairs in daily activities, [8]concerned about home security, [9]do not have a stove or refrigerator, [10]unable or prefer not to spend money on food (<$25-$30 per person spent on food each week)
[c]Household composition: [1]home health care, assisted living, personal care home
[d]Residence: [1]house, apartment, condominium, or mobile home, *one participant had missing data for this question, the missing item was coded to be house, apartment, condominium, or mobile home because it was the most frequent response
[e]ADLs/IADLs: need assistance performing ADLs/IADLs, [1]need assistance walking or moving about, [2]need assistance traveling outside the home, [3]need assistance shopping for food or other necessities
[f]Health care utilization: [1]stayed overnight as a patient in a hospital at least once in the past 12 months, [2]visited a physician or clinic at least once in the past 12 months, [3]experienced a fall that required seeing a doctor in the past 6 months
[g]Rate of weight gain: [1]overweight since childhood, [2]gained excess weight in middle age, [3]gained excess weight since 50 y, [4]have a history of weight swings many times over the years

Table 3 – Chi-square Analyses of Obese Versus Non-obese Participants[1]

Dependent variable[3]	BMI-obesity[2] (%)		WC-risk[2] (%)		WC-overweight[2] (%)		WC-obesity I[2] (%)		WC-obesity II[2] (%)	
	No, n = 55	Yes, n = 40	No, n = 35	Yes, n = 60	No, n = 37	Yes, n = 58	No, n = 74	Yes, n = 21	No, n = 87	Yes, n = 8
Age										
< 70 y	45.4	54.6	31.8	68.2	31.8	68.2	54.6	45.4	90.9	9.1
≥ 70 y	61.6	38.4	35.6	64.4	41.1	58.9	82.2	17.8§	91.8	8.2
Race/ethnicity[a]										
White	57.7	42.3	46.2	53.8	48.1	51.9	78.8	21.2	96.2	3.8
Black	58.1	41.9	20.9	79.1‡	27.9	72.1‡	72.1	27.9	86.0	14.0
Gender										
Male	50.0	50.0	40.0	60.0	40.0	60.0	75.0	25.0	95.0	5.0
Female	60.0	40.0	33.3	66.7	38.7	61.3	76.0	24.0	90.7	9.3
Education										
≤ GED	58.8	41.2	30.9	69.1	36.8	63.2	77.9	22.1	89.7	10.3
> GED	55.6	44.4	44.4	55.6	44.4	55.6	70.4	29.6	96.3	3.7
Income[b]										
> $6,000 per y	60.3	39.7	35.6	64.4	39.7	60.3	78.1	21.9	94.5	5.5
< $6,000 per y	50.0	50.0	31.8	68.2	36.4	63.6	68.2	31.8	81.8	18.2
Television viewing[c]										
≥ 4 h television/d	38.2	60.0‡	33.3	54.8‡	32.4	56.9‡	41.7	65.2‡	43.7	87.5‡
Television snack[1]	52.7	57.5	51.5	56.4	48.6	58.6	*52.8*	60.9	54.0	62.5
Television meal[2]	38.2	40.0	45.4	35.5	40.5	37.9	34.7	52.2	37.9	50.0
Lifestyle variables[d]										
Physical activity[1]	16.4	17.5	21.2	14.5	21.6	13.8	18.1	13.0	17.2	12.5
Enough food[2]	12.7	15.0	9.1	16.1	10.8	15.5	11.1	21.7	12.6	25.0
Worry about food[3]	12.7	10.0	9.1	12.9	10.8	12.1	11.1	13.0	10.3	25.0
Eat alone	56.4	57.5	57.6	56.4	59.5	55.2	56.9	56.5	57.5	50.0
Skip breakfast	21.8	12.5	21.2	16.1	21.6	15.5	18.1	17.4	18.4	12.5
Housebound	7.3	2.5	9.1	3.2	8.1	3.4	5.6	4.4	4.6	12.5
Bed/chair bound	1.8	5.0	0.0	4.8	0.0	5.2	1.4	8.7	2.3	12.5
Go out with assistance[4]	3.6	5.0	3.0	4.8	5.4	3.4	5.6	0.0	4.6	0.0
Assistive device[5]	21.8	45.0‡	15.2	40.3‡	13.5	43.1§	26.4	47.8	29.9	50.0

Dependent variable[3]	BMI-obesity[2] (%)		WC-risk[2] (%)		WC-overweight[2] (%)		WC-obesity I[2] (%)		WC-obesity II[2] (%)	
	No, n = 55	Yes, n = 40	No, n = 35	Yes, n = 60	No, n = 37	Yes, n = 58	No, n = 74	Yes, n = 21	No, n = 87	Yes, n = 8
Help provision[6]	14.6	15.0	12.1	16.1	13.5	15.5	16.7	8.7	16.1	0.0
Use stairs daily[7]	10.9	15.0	12.1	12.9	10.8	13.8	12.5	13.0	13.8	0.0
Security[8]	10.9	17.5	9.1	16.1	8.1	17.2	9.7	26.1‡	12.6	25.0
Inadequate heat/cooling	5.4	7.5	3.0	8.1	5.4	6.9	4.2	13.0	4.6	25.0‡
Stove/refrigerator[9]	0.0	5.0	0.0	3.2	0.0	3.4	1.4	4.4	2.3	0.0
Money for food[10]	18.2	17.5	18.2	17.7	16.2	19.0	13.9	30.4	16.1	37.5
Household composition[e]										
≥ 1 member	50.9	45.0	42.4	51.6	43.2	51.7	51.4	39.1‡	49.4	37.5
Assistance[1]	1.8	7.5	3.0	4.8	2.7	5.2	1.4	13.0‡	3.4	12.5
Residence[f]										
House[1,*]	94.6	92.5	90.9	95.2	91.9	94.8	95.8	87.0	94.2	87.5
Assisted living[2]	5.4	7.5	9.1	4.8	8.1	5.2	4.1	13.0	5.8	12.5
ADLs/IADLs[g]										
Bathing	1.8	2.5	0.0	3.2	0.0	3.4	2.8	0.0	2.3	0.0
Dressing	1.8	2.5	0.0	3.2	0.0	3.4	2.8	0.0	2.3	0.0
Grooming	1.8	0.0	0.0	1.6	0.0	1.7	1.4	0.0	1.2	0.0
Walking[1]	1.8	0.0	3.0	0.0	2.7	0.0	1.4	0.0	1.2	0.0
Traveling[2]	16.4	25.0	12.1	24.2	10.8	25.9	16.7	30.4	17.2	50.0‡
Preparing food	7.3	7.5	3.0	9.7	2.7	10.3	5.6	13.0	5.8	25.0‡
Shopping[3]	14.6	22.5	9.1	22.6	8.1	24.1‡	12.5	34.8‡	13.8	62.5¶
Health care utilization[h]										
Hospital[1]	16.4	25.0	18.2	21.0	21.6	19.0	15.3	34.8‡	19.5	25.0
Clinic[2]	96.4	97.5	93.9	98.4	94.6	98.3	95.8	100	96.6	100
Fall needing doctor[3]	5.4	12.5	6.1	9.7	5.4	10.3	6.9	13.0	8.0	12.5
Rate of weight gain[i]										
Childhood[1]	0.0	12.5§	0.0	8.1	0.0	8.6	2.8	13.0	4.6	12.5
Midage[2]	10.9	25.0	9.1	21.0	8.11	22.4	9.7	39.1§	14.9	37.5
Since 50[3]	40.0	45.0	33.3	46.8	32.4	48.3	45.8	30.4	44.8	12.5
Yo yo[4]	5.4	7.5	3.0	8.1	2.7	8.6	5.6	8.7	5.8	12.5

Dependent variable[3]	BMI-obesity[2] (%)		WC-risk[2] (%)		WC-overweight[2] (%)		WC-obesity I[2] (%)		WC-obesity II[2] (%)	
	No, n = 55	Yes, n = 40	No, n = 35	Yes, n = 60	No, n = 37	Yes, n = 58	No, n = 74	Yes, n = 21	No, n = 87	Yes, n = 8
Family history of obesity										
Obese	30.9	45.0	30.3	40.3	35.1	37.9	33.8	47.8	37.9	25.0
Not obese	69.1	55.0	69.7	59.7	64.9	62.1	66.7	52.2	62.1	75.0
Chronic conditions										
Diabetes	25.4	42.5	18.2	40.3‡	16.2	43.1§	23.6	60.9¶	29.9	62.5
High cholesterol	58.2	70.0	57.6	66.1	51.3	70.7	59.7	73.9	63.2	62.5
Hypertension	67.3	87.5‡	66.7	80.6	64.9	82.8‡	72.2	87.0	77.0	62.5
Lung disease	10.9	12.5	15.2	9.7	13.5	10.3	9.7	17.4	11.5	12.5
Arthritis (knee)	38.2	60.0‡	33.3	54.8‡	29.7	58.6§	43.1	60.9	47.1	50.0
Edema	18.2	50.0§	15.2	40.3‡	21.6	37.9	22.2	60.9¶	29.9	50.0
Urinary	18.2	17.5	18.2	17.7	16.2	19.0	16.7	21.7	17.2	25.0
Mental	18.2	27.5	21.2	22.6	18.9	24.1	18.1	34.8	20.7	37.5
Cancer	0.0	2.5	0.0	1.6	0.0	1.7	0.0	4.4	1.2	0.0
Dementia	0.0	2.5	0.0	1.6	0.0	1.7	0.0	4.4	1.2	0.0
Coronary heart disease	10.9	15.0	9.1	14.5	13.5	12.1	12.5	13.0	12.6	12.5
Heart failure	5.4	10.0	6.1	8.1	5.4	8.6	8.3	4.3	8.0	0.0
Angina	5.4	10.0	6.1	8.1	5.4	8.6	5.6	13.0	6.9	12.5
Myocardial infarction	10.9	12.5	9.1	12.9	8.1	13.8	12.5	8.7	12.6	0.0

[1]n = 95

[2]BMI-obesity = BMI ≥ 30 kg/m^2, WC-risk = WC risk according to NHLBI (NHLBI 2000), WC-overweight = WC threshold within BMI overweight category, WC-obesity I = WC threshold within BMI obese I category, WC-obesity II = WC threshold within obese II category (Ardern et al 2004)

[3]All responses for variables defined below are affirmative responses

[a] Race/ethnicity: Two participants were excluded for being race other than white or black

[b]Income: > or < $6,000 per y per individual in household

[c]Television viewing: [1]watch television while eating snacks each day, [2]watch television while eating at least one meal each day

[d]Lifestyle variables: [1]participation in physical activity in the past month, [2]do not have enough food to eat, [3]often worry whether there will be enough food to eat, [4]able to go outside of home with assistance, [5]use an assistive device (cane, walker, or wheel chair), [6]have no one to provide assistance or care at home if needed, [7]must go up/down a flight of stairs in daily activities, [8]concerned about home security, [9]do not have a stove or refrigerator, [10]unable or prefer not to spend money on food (<$25-$30 per person spent on food each week)

[e]Household composition: [1]home health care, assisted living, personal care home

[f]Residence: [1]house, apartment, condominium, or mobile home, *one participant had missing data for this question, the missing item was coded to be house, apartment, condominium, or mobile home because it was the most frequent response

[g]ADLs/IADLs: need assistance performing ADLs/IADLs, [1]need assistance walking or moving about, [2]need assistance traveling outside the home, [3]need assistance shopping for food or other necessities

[h]Health care utilization: [1]stayed overnight as a patient in a hospital at least once in the past 12 months, [2]visited a physician or clinic at least once in the past 12 months,

Dependent variable[3]	BMI-obesity[2] (%)		WC-risk[2] (%)		WC-overweight[2] (%)		WC-obesity I[2] (%)		WC-obesity II[2] (%)	
	No, n = 55	Yes, n = 40	No, n = 35	Yes, n = 60	No, n = 37	Yes, n = 58	No, n = 74	Yes, n = 21	No, n = 87	Yes, n = 8

[3]experienced a fall that required seeing a doctor in the past 6 months

[i]Rate of weight gain: [1]overweight since childhood, [2]gained excess weight in middle age, [3]gained excess weight since 50 y, [4]have a history of weight swings many times over the years

Significance level: [‡]significant at $p < 0.05$, [§]significant at $p < 0.01$, [¶]significant at $p < 0.001$

Table 4 – Multivariate Logistic Regression Models Exploring Relationships Between Non-dietary Variables and Obesity[1]

	BMI-obesity[2] OR (95% CI)	WC-risk[2] OR (95% CI)	WC-overweight[2] OR (95% CI)	WC-obesity I[2] OR (95% CI)	WC-obesity II[2] OR (95% CI)
≥ 4 h television/day	2.58 (1.03, 6.46) ‡	2.08 (0.80, 5.44)	2.50 (0.97, 6.40)	2.69 (0.90, 8.05)	6.71 (0.62, 72.9)
Assistive Device[3]	3.31 (1.07, 10.2) ‡	2.43 (0.67, 8.78)	3.08 (0.88, 10.8)	1.31 (0.38, 4.52)	0.39 (0.04, 3.69)
Shopping[3]	1.36 (0.32, 5.73)	1.42 (0.24, 8.44)	1.81 (0.32, 10.3)	4.03 (0.85, 19.1)	11.1 (1.22, 99.9) ‡
Preparing Food[3]	0.27 (0.04, 2.08)	1.80 (0.11, 29.4)	1.33 (0.09, 20.1)	0.50 (0.06, 4.42)	2.17 (0.15, 31.3)

[1]n = 95; two participants were excluded for being race other than white or black
[2]BMI-obesity = BMI ≥ 30 kg/m^2, WC-risk = WC risk according to NHLBI (NHLBI 2000), WC-overweight = WC threshold within BMI overweight category, WC-obesity I = WC threshold within BMI obese I category, WC-obesity II = WC threshold within obese II category (Ardern et al 2004)
[3]Assistive Device = use an assistive device (cane, walker, or wheel chair), shopping = need assistance shopping for food or other necessities, preparing Food = need assistance preparing food
Significance level: ‡significant at $p < 0.05$, §significant at $p < 0.01$, ¶significant at $p < 0.001$

CHAPTER 4

SUMMARY

The purpose of this study was to determine the relationship between obesity and non-dietary variables in a special population, namely participants of Congregate Meal Programs in northeast Georgia. The findings of this study support a relationship between obesity and non-dietary variables. Specifically, bivariate analyses indicate that several obesity categories (BMI and four unique WC categories) are more consistently associated with watching television, assistive device use, needing assistance while shopping for food or other necessities, and needing assistance preparing food compared to the other non-dietary variables that were examined. Further exploration of these relationships via multivariate logistic regression analyses revealed that watching television or assistive device use were associated with BMI-obesity, while needing assistance while shopping for food or other necessities was more significantly related to WC-obesity II. Although these relationships are maintained after controlling for potential confounding variables (age, race/ethnicity, gender, education, and income), the direction or causality of the relationship between obesity and non-dietary variables remains unclear.

Chi-square analyses, multivariate logistic regression analyses were performed in order to determine individual associations between non-dietary variables and obesity classifications. The significant relationships observed in the chi-square analyses were used to guide model development for multivariate logistic regression. The variables used to create models were television viewing, assistive device use, need for assistance while shopping for food or other

necessities, and need for assistance while preparing food. When controlling for confounding variables (age, gender, race/ethnicity, education, and income), television viewing, assistive device use, and need for assistance while shopping for food or other necessities were associated with obesity. Watching ≥ 4 h television per d and using an assistive device were significantly associated with BMI-obesity. Needing for assistance while shopping for food or other necessities WC-obesity II. These significant relationships are supportive of findings in other older adult populations that indicate an association between television viewing and obesity (Johnson et al 2006), and age (Federal Interagency Forum 2010), as well as previously observed relationships between obesity and frailty, functional decline, and disability (Houston et al 2009). The results of this study are important because they add to the growing understanding of the relationship between obesity and non-dietary variables including lifestyle influences (television viewing) and disability (assistive device use and assistance with shopping for food or other necessities and preparing food) in Congregate Meal Program participants in northeast Georgia.

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APPENDICIES

Appendix A – Geisinger Rural Aging Study Questionnaire

Geisinger Health System

Help us keep our records up-to-date!

If any of the following apply, check the most appropriate box and return the blank survey to us in the envelope provided. Thank you!.
The person to whom the survey was addressed.

- ☐ No longer lives at this address.
- ☐ Moved to a skilled nursing facility.
- ☐ Is deceased.
- ☐ Declines to participate.

SURVEY INSTRUCTIONS-

1) Please check the appropriate box to let us know who filled out this survey.
Form filled out by: ☐ Self ☐ Caregiver, friend, or relative

Enter your age/birth date, and check race/ethnic group and gender.
Age (years)_____ Birth Date (month/day/year) ____ / ____ / ____

☐ White ☐ Non-Hispanic Black ☐ Mexican-American ☐ Other
☐ Female ☐ Male

2) Please fill in your height (measure without shoes) **and weight** (only light clothing).

Height: _____ feet _____ inches ☐ I do not know my height.

Weight: _____ pounds ☐ I do not know my weight.

Please check the boxes before any statements that are TRUE for the person to whom the survey was addressed.

3) Has there been any change in your Body Weight during the past 6 months? Check each that apply to you:

- ☐ Have **lost** weight during the last 6 months
  - ☐ Weight loss greater than 10 lbs
  - ☐ Weight loss between 5 and 10 lbs
- ☐ No weight loss
- ☐ Do not know
- ☐ Have **gained** weight during the last 6 months
  - ☐ Weight gain greater than 10 lbs
  - ☐ Weight gain between 5 and 10 lbs
- ☐ No weight gain
- ☐ Do not know

4) Medication and Supplements:

- ☐ Use 3 or more prescription drugs per day
- ☐ Take anti-depressant medication prescribed by a doctor
- ☐ Take a diuretic (water pill) prescribed by a doctor
- ☐ Take a daily multivitamin supplements
- ☐ Use herbal or other dietary supplements
- ☐ None of the above apply to me

5) What is the highest grade or year of school you completed? Mark one:

- ☐ Grade 1 - 8
- ☐ Grades 9 - 11
- ☐ 12 or GED
- ☐ College 2 years or technical school
- ☐ College 4 years
- ☐ Graduate degree

6) Do you smoke cigarettes every day, some days, or not at all ?

☐ Everyday ☐ Some Days ☐ Not at all

7) During the past month, other than any regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking - for exercise ?

☐ Yes ☐ No ☐ Do not know/not sure

8) Eating Habits:

- ☐ Do **not** have enough food to eat each day
- ☐ Often worry whether there will be enough food to eat
- ☐ Usually eat alone
- ☐ Frequently skip breakfast altogether
- ☐ Do **not** eat anything on one or more days each month
- ☐ Food intake has declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties
- ☐ Have more than one alcoholic drink per day (if woman); more than two drinks per day (if man)
- ☐ Have difficulty chewing or swallowing
- ☐ Have pain in mouth, teeth, or gums
- ☐ None of the above apply to me

9) Special Diets:

If you follow a weight reduction diet check all that apply:

- ☐ **Self-prescribed weight loss diet**
- ☐ **Doctor-prescribed weight loss diet**
- ☐ **Received dietitian counseling**
- ☐ **Focus is on cutting calories**
- ☐ **Focus is on eating less fat**
- ☐ **Focus is on eating less carbohydrates (example Atkins diet)**
- ☐ **Approach includes weight loss supplements or medications**
- ☐ **Approach includes increased physical activity / exercise**
- ☐ **Other weight reduction** diet **(please specify):**_____
- ☐ **None of the above apply to me**

If you follow a special diet for another medical problem (not for weight loss)
Check all that apply:

- ☐ **Low cholesterol or low fat diet**
- ☐ **Diabetic diet**
- ☐ **Low salt diet**
- ☐ **Another special diet (please specify):** _____
- ☐ **None of the above apply to me**

Continued on the next page

10) Living Environment:

- ☐ Live on an income of less than $6,000 per year (per individual in household)
- ☐ You are housebound (unable to leave home without assistance)
  - ☐ Bed or chair bound (unable to get out of bed or chair without assistance)
  - ☐ Able to get out of bed or chair, but not out of home
  - ☐ Able to go outside home **with** assistance
- ☐ Use an assistance device in daily activities (cane, walker or wheel chair)
- ☐ Have **no** one to provide assistance or care at home if needed
- ☐ Must go up / down a flight of stairs in daily activities
- ☐ You are concerned about home security
- ☐ Live in a home with inadequate heating or cooling
- ☐ Do **not** have a stove and/or refrigerator
- ☐ You are unable or prefer not to spend money on food (less than $25-$30 per person spent on food each week)
- ☐ None of the above apply to me

11) You watch television:

- ☐ Less than 4 hours daily
- ☐ 4 or more hours daily
- ☐ While eating snacks each day
- ☐ While eating at least one meal each day
- ☐ None of the above apply to me

12) Do you live: (check only one answer)

- ☐ Alone ?
- ☐ With spouse ?
- ☐ Other ? Explain: _____
- ☐ With a son or daughter ?
- ☐ With other family member ?

13) Do you live in: (check only one answer)

- ☐ A house, apartment, condominium, or mobile home
- ☐ An assisted-living apartment or boarding and care home
- ☐ A nursing home
- ☐ Other ? Explain: _____

14) Functional Status: with which of the following do you usually or always need assistance with: (check each that apply to you)

- ☐ Bathing
- ☐ Dressing
- ☐ Grooming
- ☐ Toileting
- ☐ Eating
- ☐ Walking or moving about
- ☐ Getting out of bed or chair
- ☐ Traveling (outside the home)
- ☐ Preparing food
- ☐ Shopping for food or other necessities
- ☐ None of the above apply to me

15) In general would you say your health is: (Check only one answer)

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor
- ☐ Not sure

16) In the previous 12 months, have you stayed overnight as a patient in a hospital (Check only one answer) ?

- ☐ Not at all
- ☐ One time
- ☐ Two or Three times
- ☐ More than three times

17) In the previous 12 months, how many times did you visit a physician or clinic (Check only one answer) ?

- ☐ Not at all
- ☐ One time
- ☐ Two or three times
- ☐ Four to six times
- ☐ More than six times

18) In the past 6 months, have you experienced one or more falls ?

☐ Yes ☐ No ☐ Not sure

If Yes:

Did any require seeing a doctor ?

☐ Yes ☐ No

Did any require admission to a hospital ?

☐ Yes ☐ No

19) Have you been told that you have or being treated for the following conditions (check all that apply) ?

- ☐ Diabetes or borderline diabetes
- ☐ High blood cholesterol or fats
- ☐ High blood pressure (hypertension)
- ☐ Lung disease or breathing problems (for example: emphysema, chronic bronchitis, sleep apnea, or asthma)
- ☐ Arthritis of the knee(s) or knee replacement surgery
- ☐ Fluid (edema) in your legs, ankles, or feet
- ☐ Urinary problems
- ☐ Mental health problems
- ☐ Cancer
- ☐ Dementia or Alzheimer's
- ☐ None of the above apply to me

20) Have you ever had (check all that apply):

- ☐ Coronary heart disease
- ☐ Heart failure
- ☐ Angina (heart related chest pain)
- ☐ Heart attack (myocardial infarction)

21) How do you currently feel (check all that apply)?

- ☐ Feel depressed, sad, downhearted, "in the dumps", or blue
- ☐ Feel tired, worn out, and lacking in energy
- ☐ None of the above apply to me

22) Do you consider yourself to be (check only one answer):

- ☐ Underweight for my height and age
- ☐ Desirable weight for my height and age
- ☐ Overweight for my height and age
- ☐ Not sure

23) Select the option that best describes your rate of weight gain over the years:

- ☐ I have been overweight since childhood (before age 18 years)
- ☐ I gained most of my excess weight in middle age (30-50)
- ☐ I have gained most of my excess weight since age 50 years
- ☐ I have a history of weight swings many times over the years ("yo-yo")
- ☐ None apply to me

24) Select the option that best describes your family:

- ☐ I have siblings, parents, or grandparents who are or were overweight or obese
- ☐ I do not have family members who are or were overweight or obese

Continued on the next page

1) How often do you usually eat fruit as a snack ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

2) How often do you usually eat whole grain breads ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

3) How often do you usually eat whole grain cereals ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

4) How often do you usually eat candy or chocolate ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

5) How often do you eat crackers, pretzels, chips, or popcorn ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

6) How often do you eat cakes or pies ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

7) How often do you eat cookies ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

Continued on the next page

8) How often do you eat ice cream?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

9) How often do you eat cold cuts, hot dogs, lunchmeats or deli meats?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

10) How often do you eat bacon or sausage?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

11) How often do you eat carrots, sweet potatoes, broccoli, or spinach?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 or more times a week

12) How often do you eat fruit (not including juice)? Please include fresh, canned or frozen fruit.

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 to 5 times a week
- ☐ Every day or almost every day

13) How often do you eat hot or cold breakfast cereal?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 to 5 times a week
- ☐ Every day or almost every day

14) How often do you drink some kind of juice at breakfast?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 to 5 times a week
- ☐ Every day or almost every day

Continued on the next page

15) How often do you eat chicken or turkey ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 to 5 times a week
- ☐ Every day or almost every day

16) How often do you drink a glass of milk ?

- ☐ Never
- ☐ Less than once a week
- ☐ 1 or 2 times a week
- ☐ 3 to 5 times a week
- ☐ Every day or almost every day
- ☐ More than once every day

17) Do you usually add butter or margarine to foods like bread, rolls, or biscuits ?

- ☐ Yes
- ☐ No

18) Do you usually add fat (butter, margarine or oil) to potatoes and other vegetables ?

- ☐ Yes
- ☐ No

19) Do you use gravy (when available) at meals ?

- ☐ Yes
- ☐ No

20) Do you usually add sugar or honey to sweeten your coffee or tea ?

- ☐ Yes
- ☐ No

21) How often do you eat fish or seafood that IS NOT fried ?

- ☐ Never
- ☐ Less than once a week
- ☐ Once a week
- ☐ More than once a week

Continued on the next page

22) How many servings of milk, cheese, or yogurt do you usually have each DAY?

- ☐ None
- ☐ One
- ☐ Two or more

23) Do you usually drink wine, beer, or other alcoholic beverages?

- ☐ Yes
- ☐ No

24) How many different vegetable servings do you usually have at your main meal of the day?

- ☐ None
- ☐ One
- ☐ Two
- ☐ Three or more

25) Which of the following best describes your nutritional supplement use?

- ☐ I don't use supplements
- ☐ I use a multivitamin/mineral preparation (e.g. Centrum)
- ☐ I use supplements other than vitamins and minerals
- ☐ Don't know

Appendix B – Results of Chi-square Analyses within Sociodemographic Categories

Results

Table 5 shows the results of chi-square analyses between non-obese and obese participants according to BMI (BMI ≥ 30 kg/m^2) or WC thresholds (WC-risk, WC-overweight, WC-obesity I, WC-obesity II, NHLBI 2000, Ardern et al 2004) within 5 demographic categories (race/ethnicity, education, income, gender, and age). In all significant relationships, obese participants represented a higher proportion of affirmative responses to the variables of interest.

In the BMI-obesity category (BMI ≥ 30 kg/m^2), participants with ≤ GED were more likely to watch ≥ 4 h television/d ($p < 0.05$). BMI-obesity participants who were < 70 y were more likely to have overweight or obese family members ($p < 0.05$). BMI-obesity participants who were black were more likely to use an assistive device and need assistance with shopping for food or other necessities ($p < 0.05$). BMI-obesity participants who had > GED or who were < 70 y were more likely to report staying overnight in a hospital in the last 12 months ($p < 0.05$).

For participants who had a high risk WC (WC-risk) versus a low risk WC according to NHLBI (2000), those who were white, those who had ≤ GED, or who were ≥ 70 y were more likely to watch ≥ 4 h television/d ($p < 0.05$). For WC-risk participants who were white, who were female, who had ≤ GED, who were < 70 y or who were ≥ 70 y ($p < 0.05$), or had high-income ($p < 0.01$), were more likely to use an assistive device. WC-risk participants who were black or who were female were more likely to visit a physician clinic in the past 12 months ($p < 0.05$).

For participants in the WC-overweight category who were females, who had ≤ GED, who had low-income, and those who were ≥ 70 y were more likely to watch ≥ 4 h television/d ($p < 0.05$). WC-overweight participants with a high-income were more likely to need assistance while shopping for food or other necessities ($p < 0.05$). WC-overweight participants who were Females, who had high-income ($p < 0.01$), who were white, who were < 70 y, who were ≥ 70 y, or who had ≤ GED were more likely to use assistive devices ($p < 0.05$).

For participants in the WC-obesity I category, those who had > GED were more likely to report a family history of obesity ($p < 0.05$). WC-obesity I participants who were white, who had a low-income, or who had ≤ GED were more likely to watch ≥ 4 h television/d ($p < 0.05$). WC-obesity I participants with a low-income were more likely to report inadequate heating in their home ($p < 0.01$). WC-obesity I participants who were black ($p < 0.001$), who had a high-income ($p < 0.01$), who had > GED, who were female, or who were ≥ 70 y were more likely to need assistance with shopping for food or other necessities ($p < 0.05$). WC-obesity I participants who were < 70 y were more likely to report staying over night in a hospital in the past 12 months and falling within the past 6 months ($p < 0.05$).

WC-obesity II participants with a low-income were more likely to watch ≥ 4 h television/d ($p < 0.05$). WC-obesity II participants with a low-income, who were female ($p < 0.05$), or who were ≥ 70 y were more likely to report inadequate heating within their home ($p < 0.01$). WC-obesity II participants who were black ($p < 0.001$), who had ≤ GED, who were female, who were ≥ 70 y ($p < 0.01$), who had > GED, who had a high-income, or who were male ($p < 0.05$) were more likely to need assistance in shopping for food or other necessities. WC-obesity II participants who had

> GED ($p < 0.01$), who were black, who had a low-income, or were male ($p < 0.05$) were more likely to need assistance in preparing food.

Discussion

Chi-square analyses between 5 classifications of obesity (BMI and four WC thresholds) and non-dietary variables within sociodemographic categories (age, gender, race, education, and income) consistently show a relationship with watching television, and functional limitations (use of assistive devices, need for assistance while shopping for food or other necessities, and need for assistance while preparing food) over other variables such as household utilities (presence of a stove or adequate heating in the home) and health care use (hospital and physician clinic visits). In the few instances that inadequate heating is significantly related to measures of obesity (obese I and obese II, $p < 0.05$), it is only significant within the low-income category, indicating that income could contribute to this relationship more significantly than obesity. Regarding health care use, older adults use health care services more frequently than their younger counterparts (AoA 2012). This relationship may be more closely related to age and pre-existing health conditions (CDC 2013). Additionally, relationships between all classifications of obesity and non-dietary variables that were non-significant, but approaching significance ($0.10 > p > 0.05$) were more likely to be watching more than 4 h television/d, use of an assistive device, and needing assistance while shopping for food or other necessities, and preparing food over other non-dietary variables of interest. These relationships indicate that there is an association between non-dietary variables and obesity in this unique population.

Conclusion

In the case of obesity and non-dietary variables in Congregate Meal Program participants in northeast Georgia, the direction of causality between non-dietary variables and obesity was difficult to predict. In such a situation, it is useful to consider these relationships in the context of the socio-ecological model (see above). However, the strengths of the relationships suggest the need for future research in this unique population as well as more representative populations to better understand the relationship between obesity and non-dietary variables in Congregate Meal Program participants.

Table 5 – Chi-square Analyses of Obese Versus Non-obese Participants Within Sociodemographic Categories[1,3]

	Race/ethnicity[a]				Education				Income[b]				Gender				Age			
	Black n = 43		White n = 52		≤ GED n = 68		> GED n = 27		> 6000 n = 73		< 6000 n = 22		Male n = 20		Female n = 75		< 70 n = 22		≥ 70 n = 73	
BMI-obesity[2] (n= no, yes)	(25, 18)		(30, 22)		40, 28		(15, 12)		(44, 29)		(11, 11)		(10, 10)		(45, 30)		(10, 12)		(45, 28)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Family history of obesity[c]	32.0	44.4	30.0	45.4	37.5	46.4	13.3	41.7	34.1	51.7	18.2	27.3	20.0	30.0	33.3	50.0	10.0	58.3‡	35.6	39.3
≥ 4 h television/d [d]	48.0	66.7	30.0	54.6	40.0	71.4‡	33.3	33.3	38.6	55.2	36.4	72.7	20.0	50.0	42.2	63.3	50.0	58.3	35.6	60.7
Physical activity[e]	84.0	94.4	83.3	72.73	90.0	85.7	66.7	75.0	79.6	86.2	100	72.7	80.0	90.0	84.4	80.0	70.0	91.7	86.7	78.6
Inadequate heat/cooling	12.0	16.7	n/a	n/a	7.5	10.7	n/a	n/a	6.8	0.0	0.0	27.3	n/a	n/a	6.7	10.0	0.0	8.3	6.7	7.1
Stove/refrigerator[f]	100	94.4	100	95.4	n/a	n/a	0.0	16.7	0.0	3.4	0.0	9.1	0.0	10.0	0.0	3.3	0.0	8.3	0.0	3.6
Shopping[g]	12.0	38.9‡	16.7	9.1	17.5	21.4	6.7	25.0	11.4	17.2	27.3	36.4	10.0	20.0	15.6	23.3	20.0	25.0	13.3	21.4
Preparing food[g]	8.0	11.1	6.7	4.6	7.5	3.6	6.7	16.7	6.8	3.4	9.1	18.2	10.0	20.0	6.7	3.3	10.0	16.7	6.7	3.6
Assistive device[h]	32.0	66.7‡	13.3	27.3	22.5	42.9	20.0	50.0	20.4	41.4	27.3	54.6	10.0	50.0	24.4	43.3	30.0	58.3	20.0	39.3
Hospital[i]	12.0	16.7	20.0	31.8	20.0	17.9	6.7	41.7‡	13.6	27.6	27.3	18.2	10.0	30.0	17.8	23.3	10.0	50.0‡	17.8	14.3
Clinic[j]	96.0	100	96.7	95.4	97.5	100	93.3	91.7	97.7	100	90.9	90.9	100	90.0	95.6	100	n/a	n/a	95.6	96.4
Fall needing doctor[k]	4.0	16.7	6.7	9.1	2.5	14.3	13.3	8.3	6.8	10.3	0.0	18.2	10.0	10.0	4.4	13.3	0.0	16.7	6.7	10.7
WC-risk[2] (n = no, yes)	(9, 34)		(26, 26)		(23, 45)		(12,15)		(28, 45)		(7, 15)		(10, 10)		(25, 50)		(7, 15)		(28, 45)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Family history of obesity[c]	44.4	35.3	26.9	46.2	39.1	42.2	16.7	33.3	32.1	46.7	28.6	20.0	20.0	30.0	36.0	42.0	14.3	46.7	35.7	37.8
≥ 4 h television/d [d]	44.4	58.8	26.9	53.9‡	34.8	62.2‡	25.0	40.0	32.1	53.3	28.6	66.7	20.0	50.0	36.0	58.0	42.9	60.0	28.6	55.6‡
Physical activity[e]	77.8	91.2	80.8	76.9	87.0	88.9	66.7	73.3	75.0	86.7	100	80.0	80.0	90.0	80.0	84.0	71.4	86.7	82.1	84.4
Inadequate heat/cooling	11.1	14.7	n/a	n/a	4.35	11.1	n/a	n/a	3.6	4.4	0.0	20.0	n/a	n/a	4.0	10.0	0.0	6.7	3.6	8.9
Stove/refrigerator[f]	0.0	2.9	0.0	3.8	n/a	n/a	0.0	13.3	0.0	2.2	0.0	6.7	0.0	10.0	0.0	2.0	0.0	6.7	0.0	2.2
Shopping[g]	11.1	26.5	11.5	15.4	13.0	22.2	8.3	20.0	7.1	17.8	28.6	33.3	10.0	20.0	12.0	22.0	14.3	26.7	10.7	20.0
Preparing food[g]	0.0	11.8	7.7	3.8	4.4	6.7	8.3	13.3	3.6	6.7	14.3	13.3	10.0	20.0	4.0	6.0	14.3	13.3	3.6	6.7
Assistive device[h]	33.3	50.0	7.7	30.8‡	13.0	40.0‡	16.7	46.7	10.7	40.0‡	28.6	46.7	10.0	50.0	16.0	40.0‡	14.3	60.0‡	14.3	35.6‡
Hospital[i]	0.0	17.7	23.1	26.9	21.7	17.8	8.3	33.3	14.3	22.2	28.6	20.0	10.0	30.0	20.0	20.0	14.3	40.0	17.9	15.6
Clinic[j]	88.9	100‡	96.2	96.2	95.6	100	91.7	93.3	96.4	100	85.7	93.3	100	90.0	92.0	100‡	n/a	n/a	92.9	97.8
Fall needing doctor[k]	0.0	11.8	7.7	7.7	0.0	11.1	16.7	6.7	7.1	8.9	0.0	13.3	10.0	10.0	4.0	10.0	0.0	13.3	7.1	8.9
WC-overweight[2] (n no, yes)	(12, 31)		(25, 27)		(25, 43)		(12, 15)		(29, 44)		(8, 14)		(8, 12)		(29, 46)		(7, 15)		(30, 43)	

	Race/ethnicity[a]				Education				Income[b]				Gender				Age			
	Black n = 43		White n = 52		≤ GED n = 68		> GED n = 27		> 6000 n = 73		< 6000 n = 22		Male n = 20		Female n = 75		< 70 n = 22		≥ 70 n = 73	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Family history of obesity[c]	50.0	32.3	28.0	44.4	44.0	39.3	16.7	33.3	34.5	45.4	37.5	14.3	12.5	33.3	41.4	39.1	14.3	46.7	40.0	34.9
≥ 4 h television/d[d]	41.7	61.3	28.0	51.9	36.0	62.8‡	25.0	40.0	34.5	52.3	25.0	71.4‡	25.0	41.7	34.5	60.9‡	42.9	60.0	30.0	55.8‡
Physical activity[e]	83.3	90.3	76.0	81.5	84.0	90.7	66.7	73.3	75.9	86.4	87.5	85.7	75.0	91.7	79.3	84.8	71.4	86.7	80.0	86.0
Inadequate heat/cooling	16.7	12.9	n/a	n/a	8.0	9.3	n/a	n/a	6.9	2.3	0.0	21.4	n/a	n/a	6.9	8.7	0.0	6.7	6.7	7.0
Stove/refrigerator[f]	0.0	3.2	0.0	3.7	n/a	n/a	0.0	13.3	0.0	2.3	0.0	7.1	0.0	8.3	0.0	2.2	0.0	6.7	0.0	2.3
Shopping[g]	8.3	29.0	8.0	18.5	8.0	25.6	8.3	20.0	3.4	20.4‡	25.0	35.7	0.0	25.0	10.3	23.9	14.3	26.7	6.7	23.3
Preparing food[g]	0.0	12.9	4.0	7.4	0.0	9.3	8.3	13.3	0.0	9.1	12.5	14.3	0.0	25.0	3.4	6.5	14.3	13.3	0.0	9.3
Assistive device[h]	25.0	54.8	8.0	29.6‡	12.0	41.9‡	16.7	46.7	10.3	40.9§	25.0	50.0	12.5	41.7	13.8	43.5§	14.3	60.0‡	13.3	37.2‡
Hospital[i]	16.7	12.9	24.0	25.9	28.0	14.0	8.3	33.3	20.7	18.2	25.0	21.4	12.5	25.0	24.1	17.4	14.3	40.0	23.3	11.6
Clinic[j]	91.7	100	96.0	96.3	96.0	100	91.7	93.3	96.6	100	87.5	92.9	100	91.7	93.1	100	n/a	n/a	93.3	97.7
Fall needing doctor[k]	0.0	12.9	8.0	7.4	0.0	11.6	16.7	6.7	6.9	9.1	0.0	14.3	12.5	8.3	3.4	10.9	0.0	13.3	6.7	9.3
WC-obesity I[2] (n = no, yes)	(31, 12)		(43, 9)		(54, 14)		(20, 7)		(59, 14)		(15, 7)		(15, 5)		(59, 16)		(14, 8)		(60, 13)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Family history of obesity[c]	32.3	50.0	34.9	44.4	40.7	42.9	15.0	57.1‡	37.3	57.1	20.0	28.6	26.7	20.0	35.6	56.2	21.4	62.5	36.7	38.5
≥ 4h television/d[d]	54.8	58.3	32.6	77.8‡	46.3	78.6‡	30.0	42.9	42.4	57.1	40.0	85.7‡	26.7	60.0	45.8	68.8	50.0	62.5	40.0	69.23
Physical activity[e]	87.1	91.7	79.1	77.8	88.9	85.7	65.0	85.7	81.4	85.7	86.7	85.7	80.0	100	83.0	81.2	78.6	87.5	83.3	84.6
Inadequate heat/cooling	9.7	25.0	n/a	n/a	5.6	21.4	n/a	n/a	5.1	0.0	0.0	42.9§	n/a	n/a	5.1	18.8	0.0	12.5	5.0	15.4
Stove/refrigerator[f]	0.0	8.3	2.3	0.0	n/a	n/a	5.0	14.3	0.0	7.1‡	6.7	0.0	6.7	0.0	0.0	6.2	0.0	12.5	1.7	0.0
Shopping[g]	9.7	58.3¶	14.0	11.1	14.8	35.7	5.0	42.9‡	8.5	35.7§	26.7	42.9	6.7	40.0	13.6	37.5‡	14.3	37.5	11.7	38.5‡
Preparing food[g]	6.4	16.7	4.6	11.1	5.6	7.1	5.0	28.6	5.1	7.1	6.7	28.6	6.7	40.0	5.1	6.2	7.1	25.0	5.0	7.7
Assistive device[h]	38.7	66.7	18.6	22.2	27.8	42.9	25.0	57.1	25.4	42.9	33.3	57.1	26.7	40.0	27.1	50.0	35.7	62.5	25.0	38.5
Hospital[i]	9.7	25.0	20.9	44.4	16.7	28.6	15.0	42.9	15.2	35.7	20.0	28.6	13.3	40.0	17.0	31.2	14.3	62.5‡	16.7	15.4
Clinic[j]	96.8	100	95.4	100	98.2	100	90.0	100	98.3	100	86.7	100	93.3	100	96.6	100	n/a	n/a	95.0	100
Fall needing doctor[k]	6.4	16.7	7.0	11.1	5.6	14.3	10.0	14.3	6.8	14.3	6.7	14.3	6.7	20.0	6.8	12.5	0.0	25.0‡	8.3	7.7
WC-obesity II[2] (n = no, yes)	(37, 6)		(50, 2)		(61, 7)		(26, 1)		(69, 4)		(18, 4)		(19, 1)		(68, 7)		(20, 2)		(67, 6)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Family history of obesity[c]	40.5	16.7	36.0	50.0	42.6	28.6	26.9	0.0	40.6	50.0	27.8	0.0	26.3	0.0	41.2	28.6	40.0	0.0	37.3	33.3
≥ 4h television/d[d]	51.4	83.3	38.0	100	49.2	85.7	30.8	100	43.5	75.0	44.4	100‡	31.6	100	47.1	85.7	50.0	100	41.8	83.3

	Race/ethnicity[a]				Education				Income[b]				Gender				Age			
	Black n = 43		White n = 52		≤ GED n = 68		> GED n = 27		> 6000 n = 73		< 6000 n = 22		Male n = 20		Female n = 75		< 70 n = 22		≥ 70 n = 73	
Physical activity[e]	86.5	100	80.0	50.0	88.5	85.7	69.2	100	82.6	75.0	83.3	100	84.2	100	82.4	85.7	85.0	50.0	82.1	100
Inadequate heat/cooling	10.8	33.3	n/a	n/a	6.6	28.6	n/a	n/a	4.4	0.0	5.6	50.0‡	n/a	n/a	5.9	28.6‡	5.0	0.0	4.5	33.3§
Stove/refrigerator[f]	2.7	0.0	2.0	0.0	n/a	n/a	7.7	0.0	1.4	0.0	5.6	0.0	5.3	0.0	1.5	0.0	5.0	0.0	1.5	0.0
Shopping[g]	13.5	83.3¶	14.0	0.0	14.6	57.1§	11.5	100‡	11.6	50.0‡	22.2	75.0‡	10.5	100‡	14.7	57.1§	20.0	50.0	11.9	66.7¶
Preparing food[g]	5.4	33.3‡	6.0	0.0	4.9	14.3	7.7	100§	5.8	0.0	5.6	50.0‡	10.5	100‡	4.4	14.3	10.0	50.0	4.5	16.7
Assistive device[h]	43.2	66.7	20.0	0.0	29.5	42.9	30.8	100	29.0	25.0	33.3	75.0	26.3	100	30.9	42.9	45.0	50.0	25.4	50.0
Hospital[i]	13.5	16.7	24.0	50.0	18.0	28.6	23.1	0.0	18.8	25.0	22.2	25.0	21.0	0.0	19.1	28.6	30.0	50.0	16.4	16.7
Clinic[j]	97.3	100	96.0	100	98.4	100	92.3	100	98.6	100	88.9	100	94.7	100	97.1	100	n/a	n/a	95.5	100
Fall needing doctor[k]	8.1	16.7	8.0	0.0	6.6	14.3	11.5	0.0	7.2	25.0	11.1	0.0	10.5	0.0	7.4	14.3	10.0	0.0	7.5	16.7

[1]n = 95

[2]BMI-obesity = BMI ≥ 30 kg/m^2, WC-risk = WC risk according to NHLBI (NHLBI 2000), WC-overweight = WC threshold within BMI overweight category, WC-obesity I = WC threshold within BMI obese I category, WC-obesity II = WC threshold within obese II category (Ardern et al 2004)

[3]All responses for variables defined below are affirmative responses

[a] Race/ethnicity: Two participants were excluded for being race other than white or black

[b]Income: > or < $6,000 per y per individual in household

[c]Reported family history of overweight or obesity

[d]Television viewing: [1]watch television while eating snacks each day, [2]watch television while eating at least one meal each day

[e]Participation in physical activity in the past month,

[f]Do not have a stove or refrigerator

[g]Needs assistance with shopping for food or other necessities or needs assistance with preparing food

[h]Use an assistive device (cane, walker, or wheel chair)

[i]Stayed overnight as a patient in a hospital at least once in the past 12 months

[j]Visited a physician or clinic at least once in the past 12 months

[k]Experienced a fall that required seeing a doctor in the past 6 months

Significance level: ‡significant at $p < 0.05$, §significant at $p < 0.01$, ¶significant at $p < 0.001$