THE APPLICABILITY AND USAGE OF THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF) TO ADDRESS OBESITY AMONG U.S. WOMEN

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Background: Over the past two decades, obesity among women has significantly increased, with women having the highest prevalence in the United States. Obesity prevention programs and interventions focusing on women have traditionally included individual-level approaches although obesity is a multi-level problem. The research literature has cited numerous factors that contribute to obesity—behavioral, personal, psychological, sociodemographic, environmental, biological, and childbearing. As a result, recent public health efforts have shifted away from individual approaches to those that handle multiple factors.

Methods: While multiple factors have been associated with obesity among women, the degree and variability of the factors have not been determined in the literature. These three studies seek to explore the effects of the multiple factors on BMI in U.S. women using the International Classification of Functioning, Disability and Health (ICF) Core Sets for Obesity, developed by the World Health Organization and data from the National Health and Nutrition Examination Survey (NHANES). Linear regression was used in the analyses.

Results: Significant factors of obesity were sociodemographic information (age, income, and race), body weight perceptions, coexisting health conditions, physical functioning, and engaging in physical activity and proper nutritional practices.

Conclusions: Obesity prevention and treatment programs for U.S. women should focus on the most significant factors identified in these studies to decrease obesity incidence and prevalence.

Public Health Relevance: The information garnered from this study can be used to further identify the most important characteristics needed for future obesity prevention programs for women.

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1.0 INTRODUCTION

1.1 IMPORTANCE OF THE STUDY

Obesity has become a serious public health issue affecting the United States (U.S.). Due to significant increases in the prevalence of obese individuals over the past two decades, approximately two-thirds of adults are either overweight or obese (Zhang & Wang, 2004a). Obesity incidence in adults is increasing approximately 1% annually (Pi-Sunyer & Kris-Etherton, 2005). Many efforts have begun to combat this increase including the *Healthy People 2010* initiative, a set of national health objectives to be achieved over the first decade of the century (DHHS, accessed 10/2/2006). *Healthy People 2010* identified obesity as 1 of 10 leading health indicators (Hedley, Ogden, Johnson, Carroll, Curtin, & Flegal, 2004). Further, *Healthy People 2010*, Objective 19-2, seeks to reduce the proportion of U.S. adults who are obese to 15% (DHHS, accessed 10/2/2006).

Results from the 1999-2002 National Health and Nutrition Examination Survey (NHANES) indicate that approximately 65% of adults 20 years of age and older are classified as either overweight or obese and 30% as obese. According to these results, instead of decreasing, the prevalence of obesity among adults has increased by 7% since the 1988-1994 NHANES. Approximately 67% of men were overweight, 28% were obese, and 3% were severely obese in 1999-2000 [American Obesity Association (AOA), accessed 10/4/2006]. About 62% of women

were overweight, 34% were obese, and 6% were severely obese in 1999-2000 (AOA, accessed 10/4/2006). In addition, an increase in obesity prevalence is related to mortality risks. At a BMI of 30, the risk of mortality increases by 30% and at a BMI of ≥ 40, mortality risks increases by 100% or more (Wadden, Brownell, & Foster, 2002).

Women have the highest prevalence of obesity and extreme obesity in the U.S. Among women, there are racial/ethnic differences with non-Hispanic African American (AA) and Mexican American women having higher prevalence of overweight and obesity than non-Hispanic White women (Flegal, Carroll, Ogden, & Johnson, 2002; Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). In fact, AA women have the highest prevalence among all women. Although obesity prevalence has increased significantly among all women in the past two decades, obesity has increased by more than 75% since 1980 among AA women (Patt, Yanek, Moy, & Becker, 2004). However, even though obesity prevalence has been increasing, according to a trend analysis of NHANES data from 1999-2004, there has not been an increase of obese women over the six-year period of 1999-2004. This suggests obesity incidence among women may be leveling off (Ogden et al., 2006). Nevertheless, because obesity prevalence remains highest among women, they are an important group to whom obesity prevention efforts should be focused.

At the individual level, obesity prevalence is higher among groups with low education and low income. At a societal level, the highest obesity rates are in lower-income U.S. states, lower-income congressional districts, as well as the most deprived areas. The proportion of families living in poverty has been found to be strongly associated with higher neighborhood obesity rates (Drewnowski & Darmon, 2005; Khaodhiar, McCowen, & Blackburn, 1999).

Obese persons typically suffer forms of discrimination in various settings—educational, occupational, and medical (Latner, Stunkard, & Wilson, 2005). Obesity has been linked with being less likely to be accepted into high-ranking colleges despite equivalent academic qualifications, less likely to be married, lower household incomes, higher rates of household poverty (Khaodhiar et al., 1999), and prejudice in healthcare (Wyatt, Winters, & Dubbert, 2006). Obese women suffer more prejudice and discrimination because of their weight compared to obese men. Obesity has been associated with unemployment among women. Interestingly, the unemployment rate decreased from 84% to 64% among women who had surgery to reduce their weight. Obese girls have been found to have completed significantly fewer months of high school despite receiving equal grades when compared to nonobese girls (Wadden, Brownell, & Foster, 2002). Obese women also report attending fewer years of college and receiving support for higher education compared to non-obese women (AOA, accessed 10/4/2006). Healthcare professionals who work on improving the nutritional practices of women, have associated obesity with poor hygiene, dishonesty, family problems, lack of intelligence, physical inactivity, and lack of will power; thus, affecting treatment decisions (Wyatt et al., 2006).

Obese women may face significant societal barriers given the overwhelming emphasis on thinness as a symbol of attractiveness (AOA, accessed 10/4/2006). These barriers may lead to psychological disorders or emotional distress although research remains inconclusive as to the exact effect that overweight and obesity may have. The psychological impact of stigmatization can affect self-esteem and body image (Latner et al., 2005). Some studies (Khaodhiar et al., 1999; Sarwer, Allison, Gibbons, Markowitz, & Nelson, 2006) have reported higher incidences of depression and binge eating among obese persons and those seeking assistance in weight-loss programs although the mechanisms are unknown.

1.2 CLARIFICATION OF TERMS

1.2.1 Overweight and Obesity

Because certain words have different meanings from one academic discipline to another and are often used interchangeably, it is necessary to clarify and define certain terms used in this study. Although overweight and obesity are often paired together in the research and literature among public health researchers, and share many of the same risk factors, their association with morbidity and mortality differs. A moderately elevated body weight has been associated with an increased risk of death. However, the health risks linked to being overweight versus being obese are considered mildly increased and have been controversial (Adams et al., 2006; Caterson & Gill, 2002; Flegal, 2005). Thus, this study will focus exclusively on obesity and its related health consequences.

Overweight develops into obesity when excess fat has accumulated in adipose tissue to an extent that may adversely affect health (Caterson & Gill, 2002; O'Brien & Dixon, 2002). Body fat normally accounts for between 20-25% of weight in women and 18-23% in men. However, women with over 30% body fact and men with over 25% body fat are considered obese (Lee, 2007; Wadden, Brownell, & Foster, 2002). Obesity is the most common form of malnutrition in which there is an imbalance of the nutrients needed for optimal health (Boogerd, Alverdy, Kumar, Olson, & Schwenk, 2002). Further, obesity results from an imbalance between caloric intake and energy expenditure (Stunkard, 1996) in which caloric intake exceeds energy expenditure (Wyatt et al., 2006).

1.2.2 Measuring Obesity

A diagnosis of obesity should be made on the basis of direct demonstration of an increase in body fat, which requires measurement of body composition (Boogerd et al., 2002). The optimal method of measuring overall body fat (Khaodhiar et al., 1999) is underwater weighing where the person is submerged under water and the underwater weight is measured (Wyatt et al., 2006). The body density is then used to estimate the percentage of body fat (Wyatt et al., 2006). Other direct methods of measuring overall body fat consist of dual energy x-ray absorptiometry, bioimpedance analysis, deuterium oxide dilution, skinfold thickness, magnetic resonance imaging, and computed tomography (Boogerd et al., 2002; Khaodhiar et al., 1999). However, these methods are impractical when used on a daily basis in clinical settings (Boogerd et al., 2002; Khaodhiar et al., 1999) as they can be expensive and are not easily accessible (Wyatt et al., 2006). As such, BMI[1], or body mass index, is commonly used to estimate overall body fat and measurements of waist circumference,[2] or sagittal depth, to estimate abdominal fat (Cogswell, Perry, Schieve, & Dietz, 2001).

BMI is useful for monitoring weight status by classifying individuals into broad categories of overweight and obesity (DHHS, 2000). For adults, overweight is defined as those individuals with a BMI of ≥25, obesity is classified as a BMI of ≥30, and extreme obesity as a BMI of ≥40 (Centers for Disease Control (CDC), accessed 10/2/2006). In addition, obesity is also measured in classes. A BMI of 30.0-34.9 is considered Class I obesity, a BMI of 35.0-39.9 as Class II obesity, and a BMI of ≥40 as Class III obesity (Hu, 2003).

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[1] BMI is a calculation of body weight in kilograms divided by body height in meters squared.
[2] Waist circumference is the narrowest circumference between the lower border of the ribs and the upper border of the iliac crest, taken from the side (Caterson & Gill, 2002).

BMI is the preferred method of classifying obesity due to the strong relationship between BMI and mortality (Wadden, Brownell, & Foster, 2002). Nevertheless, the use of BMI as a standard for all individuals has been very controversial in recent years as BMI has been found to be unreliable in certain cases (Bell, Adair, & Popkin, 2002). In fact, there is no reliable evidence that suggests that morbidity and mortality occur at similar BMI cutoffs (Bell et al., 2002). As a result, there has been conjecture about the appropriateness of BMI in certain ethnic groups due to differences in body type (Caterson & Gill, 2002). BMI has also been deemed inaccurate in persons of extreme age and height, physically fit individuals with muscular builds (Caterson & Gill, 2002), and in persons with edema, and muscular wasting (DHHS, 2000). However, the use of BMI provides a better measure of total body fat compared to body weight alone.

Waist circumference is useful in determining central adiposity, which is associated with metabolic diseases such as type 2 diabetes mellitus, hypertension, and dyslipidemia (Caterson & Gill, 2002). Researchers believe that obesity-related health risks are linked more with central obesity rather than total obesity (Ashwell & Hsieh, 2005). The World Health Organization (WHO) has proposed waist circumference cut points for White, Asian, and Chinese populations (Caterson & Gill, 2002). However, these cut points are not explicitly stated for AA populations. These cutoff points for the waist circumference criteria were based upon data from White adults, primarily from European countries (Misra, Wasir, & Vikram, 2005). As a result, certain researchers (Misra et al., 2005) believe that diagnoses of abdominal obesity are not uniformly applicable to all populations and ethnic groups. Nevertheless, the use of waist circumference is helpful in assessing obesity-related health risks in individuals categorized as normal or overweight that would not normally have been discovered using BMI because waist circumference predicts risk independent of BMI (DHHS, 2000).

1.3 FOCUS OF THE STUDY

The high prevalence of obesity among women underscores the importance of focusing prevention and treatment efforts on this group. Although the causes and effects of obesity among women have been well-documented (Stunkard, 1996), researchers differ regarding the best methods to prevent and treat obesity in women (Kumanyika, 2001). As a result, more research is needed to determine the crucial areas to address obesity when designing interventions for women.

The following chapters will review the conceptual models of disability, disease, and health conditions (Chapter 2), the models and theoretical frameworks that have been utilized in preventing and controlling obesity (Chapter 2), a review of the obesity literature (Chapter 3), and the methodology that guided this research (Chapter 4). This dissertation consists of three manuscripts. The first manuscript (Chapter 5) explores the extent to which the components of the International Classification of Functioning, Disability and Health (ICF) predict BMI in U.S. women and how well the ICF explains the variance in BMI among U.S. women. The second manuscript (Chapter 6) examines the effect of age, income, and race on a component of the ICF. The third manuscript (Chapter 7) provides recommendations to public health researchers for the most important characteristics that should be integrated and emphasized in obesity prevention programs and interventions among different subsets of U.S. women. In addition, the third manuscript provides suggestions to the medical community to aid their understanding of treatment and prevention of obesity in women.

2.0 STATEMENT OF THE PROBLEM

2.1 CONCEPTUAL MODELS AND FRAMEWORKS OF DISABILITY, DISEASE, AND HEALTH CONDITIONS

Conceptual models and frameworks of disability, disease, and health conditions have been used by clinicians and researchers to describe, assess, and measure individual and population health. They provide a common understanding of human functioning and health by offering clear, concise communication that can guide clinical care and research. Although there are many conceptual models and frameworks utilized by various professional disciplines, several have been influenced by three important models: *medical, social, and biopsychosocial model* (Jette, 2006).

The traditional method of conceptualizing disability, disease, and health conditions and identifying intervention strategies has been dominated by two competing models that were merged together to form a third model in 1980 (Borrell-Carrio, Suchman, & Epstein, 2004). The dominant of these models, the *medical or biomedical model,* views the health condition or disease as a personal attribute directly caused by the disease, trauma, or other health condition, which requires professional medical care. In contrast, the *social or psychosocial model,* visualizes the health condition as a socially-created problem rather than based upon an individual's actions. A combination of the two models formed the *biopsychosocial model*, which

would consider both the individual's biological components of health and the individual and social contexts of a person's health (Allan, Campbell, Guptill, Stephenson, & Campbell, 2006; Jette, 2006). Interest regarding an integration of both models led to the development of the International Classification of Functioning, Disability and Health (ICF) (Ustun, Chatterji, Bickenbach, Kostanjsek, & Schneider, 2003).

2.1.1 Medical Model

The medical model attributes disability as a problem within the body or mind of the individual. In this model, responsibility rests with the individual to seek the expertise of medical professionals. The medical model served as the framework for the predecessor of the ICF, World Health Organization's (WHO) 1980 International Classification of Impairments, Disabilities and Handicaps (ICIDH). Impairments are "abnormalities of body or organ structures and functions." Disabilities are described as "the reduction of an individual's abilities to perform basic tasks as a consequence of the abnormalities" (Landsman, 2001). Although the use of this model has begun to be discouraged among the medical and research communities, it is believed to be prevalent and used widely among physicians and other health care professionals (Byock, 1999).

2.1.2 Social Model

In the social model, the disability or health condition is an attribute of society, not the individual. The health condition is the result of an "unaccommodating or inflexible environment" caused by characteristics of the social and physical environment. The social model demands social action

and political advocacy to address the disability or health condition (Jette, 2006; Landsman, 2001; Ustun, Chalterji, Bickenbach, & Kosbrysekatal, 2003).

2.1.3 Biopsychosocial Model

The biopsychosocial model, formulated by George Engel in 1977, integrates concepts from both the medical and social models to offer a holistic view of disability, disease, and health (Barrell-Carrio, Suchman, & Epstein, 2004; Jette, 2006; Ustun et al., 2003). In the biopsychosocial model, the disability or health condition is seen as a consequence of biological, personal, and social factors, which causes the health condition (Jette, 2006). This model is the preferred method of conceptualizing disabilities, disease, and health conditions (Jette, 2006; Ustun et al., 2003) although the extent of its usage in the research and medical communities is unclear (Suls & Rothman, 2004). However, the biopsychosocial model is being utilized more frequently and is finding increasing acceptance in those communities. In fact, the model has been integral in the formation and basis of multilevel, multisystem approaches of human functioning (Suls & Rothman, 2004) such as the ICF framework (Ustun et al., 2003).

2.1.4 The International Classification of Functioning, Disability and Health (ICF)

Health professionals have long utilized the WHO's International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, (ICD-10) to report morbidity and mortality in human populations. However, this system does not capture overall individual health status (Ustun et al., 2003). Thus, with an emphasis on disability and integrating the biomedical and psychosocial models, the WHO has developed a comprehensive classification and coding

system of the health conditions that affect individuals' lives to be used in conjunction with the ICD-10 (Allan et al., 2006; Feldman, 2005; Ustun et al., 2003).

The ICF is a globally agreed upon framework and classification system to define and measure the typical spectrum of symptoms and problems in functioning of patients with disability. The ICF has primarily been used in clinical settings to assess and treat disability. However, due to obesity becoming an increasingly significant cause of disability and decreased quality of life and its multifactorial nature, the ICF has been applied to the condition in the exploration of the interactions between genetic, metabolic, environmental, and personal aspects (Stucki et al., 2004; Stucki et al., 2006).

The ICF conceptual framework (Figure 1) is divided into two parts: 1) Functioning and Disability; and 2) Contextual Factors. The ICF posits that the first part, Functioning and Disability, consists of two components: 1) Body Functions and Structures; and 2) Activities and Participation. Body Functions and Structures are the physiological functions of body systems as well as the anatomical parts of the body, i.e., organs and limbs (WHO, 2001). They include mental and sensory functions as well as digestive and musculoskeletal functions. Activities are the individual's execution of tasks or actions (WHO, 2001). Activities include learning, communication, mobility, and self-care. Participation is the involvement in life situations, which consists of interpersonal interactions and community and civic life (WHO, 2001; Perenboom & Chorus, 2003).

The second part of the ICF conceptual framework, Contextual Factors, includes Environmental and Personal factors, which influence an individual's health state and functioning. Environmental Factors comprise the physical, social, and attitudinal environment in which a person lives. Personal Factors consist of an individual's age, gender, race, health

conditions, disease coping style, education, social background, lifestyle habits, past and current experiences, and work experience (Allan et al., 2006), but are not classified in the ICF (Jette, 2006; Perenboom & Chorus, 2003) due the social and cultural variance that is associated with these factors (WHO, 2001). The model shows the dynamic interaction among the health conditions and its component of functioning (Feldman, 2005) demonstrating that the relationships between the components are complex, interactive, and dynamic (Allan et al., 2006).

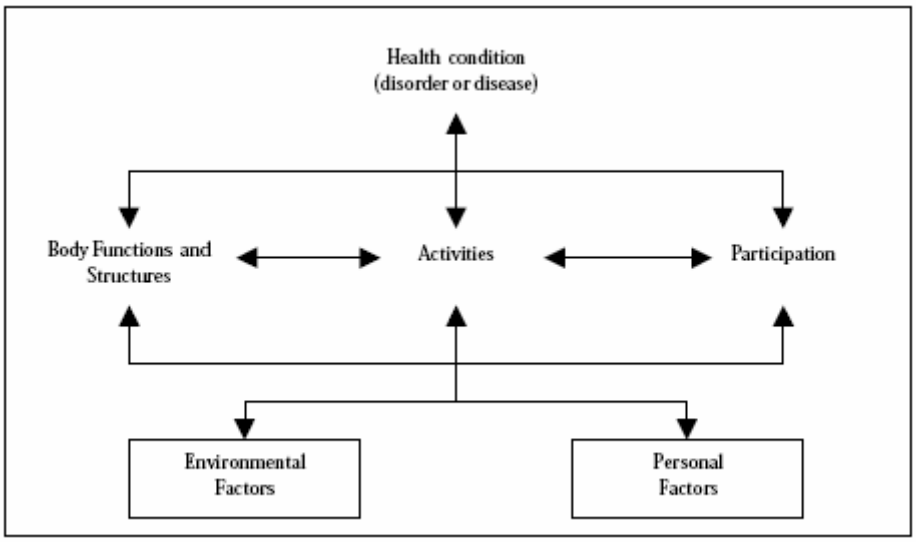

Figure 1. Illustration of the interaction of components in the International Classification of Functioning, Disability and Health (ICF). (WHO, 2001)

With the introduction of the ICF, the WHO seeks to provide a common conceptual understanding of patient-oriented outcome measures (Cieza et al., 2005) regarding numerous health conditions. The WHO argues that common language of disease and disability facilitates collaboration among health professionals and researchers in various fields (Allan et al., 2006; Ustun et al., 2003). As such, the WHO has developed specific classification methods, core sets for the ICF, to define the typical spectrum of problems in functioning for patients with specific

conditions. Core sets for the ICF have been applied to diabetes, stroke, arthritis, as well as numerous other diseases and health conditions, including obesity.

The development of an ICF Core Set specifically for obesity involved a formal decision-making and consensus process performed by international experts, including physicians of different specializations and physical therapists, to decipher the most relevant ICF categories for obese persons. The end result was a Brief ICF Core Set and a Comprehensive Core Set on obesity. The Brief ICF Core Set for Obesity provides a concise list of categories of the typically encountered problems by obese persons. The Comprehensive Core Set includes a comprehensive list of the ICF categories needed to undertake a multidisciplinary assessment of the usually identified issues for obese persons (Cieza et al., 2004).

The WHO envisions five application areas for the ICF including statistical, clinical, research, social policy development, and educational. Currently, the ICF has been used mainly in clinical applications including needs assessment, intervention studies, quality care assessment, and rehabilitation treatment strategies, and outcome evaluation. However, the WHO believes the ICF has far-reaching capabilities to become a common language among various professions and health disciplines and provide common ground for international communication (Allan et al., 2006; Ustun et al., 2003). WHO visualizes the ICF capturing the entire range of health status as well as the personal and societal experiences of vulnerable populations. Consequently, WHO foresees the ICF playing a part in social policy development and education (Ustun et al., 2003).

2.2 THEORIES AND THEORETICAL FRAMEWORKS USED IN ADDRRESSING OBESITY

Although many researchers acknowledge multiple factors in the causation of obesity (Kumanyika, 2001; Wyatt et al., 2006), the prevention, diagnosis, and treatment of obesity does always reflect this viewpoint (Kumanyika, 2001). The prevailing obesity paradigm in the U.S. rests on the individual context rather than changes at the environmental, organizational, and governmental levels (Visscher & Seidell, 2001). Recent public health efforts have shifted away from an exclusive focus on individual-level approaches toward approaches that address multiple factors (Yancey et al., 2004).

Pairing physical activity and better nutrition habits is the optimal approach to controlling obesity (Alfano et al., 2002; Jakicic et al., 2002). Interventions focusing on physical activity and improved nutrition practices, individually and collectively, account for a number of studies that have addressed obesity among women (Banks-Wallace & Conn, 2002; Dunn, Andersen, & Jakicic, 1998). The transtheoretical model (TTM) has been used as a basis and theoretical framework in designing obesity interventions and programs for women (Bull, Eyler, King, & Brownson, 2001; Hawkins, Hornsby, & Schorling, 2001). TTM conceptualizes the process of behavior change as occurring through a set of distinct stages each characterized by various constructs, processes, and behaviors (Sutton et al., 2003). The TTM consists of five stages—precontemplation, contemplation, preparation, action, and maintenance—in addition to constructs within the stages. Precontemplation involves no intension to engage in the healthy behavior; those in contemplation intend to engage in the healthy behavior; preparation involves making small changes to engage in the healthy behavior; those in the action stage are actively engaging in the healthy behavior; and individuals in the maintenance stage are working to

prevent relapsing and continue the healthy behavior. Constructs and processes such as self-efficacy and decisional balance (Fahrenwald & Sharma, 2002) play a role in movement forward or backward on the continuum of change. Decisional balance is the potential benefits and costs of engaging in the healthy behavior while self-efficacy is an individual's belief in the ability to engage in healthy behavior (Fahrenwald & Sharma, 2002; Krummel, Semmens, Boury, Gordon, & Larkin, 2004).

In a study using a physical activity intervention for mothers in the Women, Infants, and Children (WIC) nutrition program, Fahrenwald and Sharma (2002) used the TTM and social support to guide WIC mothers through the stages of change to the action stage where the mothers were actively engaging in physical activity. These researchers concluded the TTM worked extremely well in determining efficacy. Keller and colleagues (2006) tested the extent to which the TTM and social support explained exercise initiation and weight maintenance in postpartum women. They concluded that the TTM could enhance physical activity by identifying the effect that the women's weight has on others as well as increasing knowledge regarding health effects of obesity. Hawkins and colleagues (2001) used the TTM to determine whether the model was generalizeable to weight loss intention among a community-based sample of overweight young adult, rural AA women and to identify predictors of stages of change. The researchers concluded that the TTM was successful in assessing stages of change among this group of AA women and should be applied to other populations of rural AA women.

Another study (Bull et al., 2001) used the TTM to assess readiness to exercise among an ethnically diverse U.S. sample of women and to compare self-reporting of stage to self-reporting of actual exercise behavior. They found that AA women were less likely to be in the action stages and more likely to be either precontemplators or contemplators. In relation to the TTM,

self-efficacy was used to predict weight change in AA women concluding that it was an important component of weight loss (Martin, Dutton, & Brantley, 2004).

Other theoretical models have also been utilized to address physical activity and obesity. Combinations of the Social Learning Theory and the stage theory of innovation to reduce cardiovascular disease risks in a rural area have been used. Healthy cooking demonstrations along with the formation of exercise groups were conducted to encourage healthy behaviors (Brownson et al., 1996). Concepts from the Social Cognitive Theory such as "outcome expectancies" and "perceived difficulties" were used to examine whether weekly changes in measures of those constructs were associated with weekly changes in weight and physical activity. The participants exercised less during weeks in which greater difficulties were reported compared to weeks where fewer difficulties were reported (Carels et al., 2005). Mayer-Davis and colleagues (2001) combined research-based weight loss interventions with continuous quality programming (CQP) to facilitate weight loss and improve health among individuals with type 2 diabetes living in rural, medically underserved communities. They found moderate success in affecting weight loss.

An increasingly popular approach used in public health to address obesity is the use of the social ecological model. The social ecological model is believed to be well-suited to address systematic determinants of nutritional practices and physical activity patterns in at-risk populations for obesity (Peterson et al., 2002) because of its focus on the interrelationship between the individual and their environment (Stokols, 1992). An individual's health status is influenced by the multiple facets of the physical environment, the social environment, and personal factors including biological, psychological, and behavioral (Stokols, 1992). The social ecological model focuses on influencing behavior change at many levels: intrapersonal,

interpersonal, community, and organizational (McLeroy, Bibeau, Steckler, & Glanz, 1988). The social ecological model has been used to design a study to evaluate whether U.S. Department of Agriculture's Expanded Food and Nutrition and Education Program model produced greater change in dietary intake, physical activity, and pregnancy-related weight changes at 12 months postpartum and after 6 months of maintenance compared to WIC care alone (Peterson et al., 2002). The social ecological model has also been applied to the calcium and dairy nutritional practices of AA's, which was shown to be helpful in understanding environmental change, behaviors, and policies that affect the AA diet (Bronner al., 2006).

2.3 STUDY RATIONALE

Although the ICF demonstrates a complex interaction between functioning, activities and participation, environmental, and personal factors that have been used in the disability and rehabilitation fields, the applicability of the model for obesity has not been widely tested (Stucki et al., 2004). The purpose of the ICF is to provide a global basis of standardization of data regarding all aspects of human functioning and disability (Ustun et al., 2003). Utilization of the ICF for obesity assumes that interactions between the concepts in the framework is the same for all individuals and also that the interactions reflect that of individuals with disability. In addition, utilizing the ICF for obesity demonstrates the complexity of the problem as well as the potential variation in the factors.

While personal, psychological, sociodemographic, environmental, biological, and childbearing factors have all been associated with obesity among women (Adams-Campbell et al., 2000; Addy et al., 2004; Felton et al., 2002; Gordon-Larsen et al., 2006; Winkleby et al.,

1998), the degree and variability of these factors has not been well-documented in the literature. Additionally, while the ICF has acknowledged the inclusion of contextual factors in determining health status and function and identified classification of environmental factors, they have not provided a scheme in which to classify an individual's personal factors (Jette, 2006; Perenboom & Chorus, 2003). Thus, by excluding classification of personal factors, the extent to which personal factors have on obesity cannot be adequately determined using the ICF. Demonstrating the effect of each of the aforementioned factors and their interactions on different subgroups of obese women can help in identifying areas of concentration for prevention and treatment efforts. Looking at the interactions between the factors may also show differences or similarities in the variables used in explaining certain factors among the subgroups of obese women.

Due to the influence and complexity that personal, psychological, sociodemographic, environmental, biological, and childbearing factors have in inhibiting physical activity and healthy nutritional practices (Adams-Campbell et al., 2000; Addy et al., 2004; Felton et al., 2002; Gordon-Larsen et al., 2006; Winkleby et al., 1998), it is believed that these factors will be important in explaining and predicting the prevalence of obesity among U.S. women. Therefore, using the Comprehensive ICF Core Set on Obesity, the following areas will be examined: 1) Determine the impact of ICF components—Body Functions and Structures, Activities and Participation, Environmental Factors, and Personal Factors—on BMI in women; 2) Assess the applicability of the framework for use in addressing obesity; and, 3) Ascertain and provide recommendations of the most important aspects of the ICF framework for public health interventions among women based upon data from the NHANES 1999-2004.

2.4 RESEEARCH QUESTIONS AND HYPOTHESES

In order to assess the applicability of the Comprehensive International Classification of Functioning, Disability and Health (ICF) when addressing obesity among U.S. women, the following research questions and hypotheses were explored:

1) Do the components of the Comprehensive International Classification of Functioning, Disability and Health (ICF) Core Sets for Obesity—Body Functions and Structures, Activities and Participation, Environmental Factors, and Personal Factors—predict BMI in U.S. women?

   Hypothesis #1: The Environmental Factors component of the ICF classification will better predict BMI in U.S. women than the other components in the framework.

2) Do the components of the Comprehensive ICF Core Sets for Obesity explain the variance in the framework for BMI in U.S. women?

   Hypothesis #2: The Environmental Factors will account for the most significant portion of the variance in the framework for obesity among U.S. women.

   Hypothesis #3: The variance in the ICF framework for BMI among women differs most by education.

3.0 LITERATURE REVIEW

3.1 EFFECTS OF OBESITY

Obesity has been linked to increased morbidity and mortality (Wyatt et al., 2006) and associated with shortened life expectancy (O'Brien & Dixon, 2002). Obesity has been estimated to cause a decrease in life expectancy at birth by 0.2-1.1 years with a possibility of rising to 2-5 years in the subsequent decades (DelParigi, Pannacciulli, Le, & Tataranni, 2005). Those individuals considered overweight and obese are at increased risk of developing many medical problems (Khaodhiar et al., 1999) in addition to exacerbating others (O'Brien & Dixon, 2002). In particular, obese women have been found to be more reluctant compared to normal weight woman to seek health screening (Visscher & Seidell, 2001). Further, numerous comorbid conditions are significantly associated with obesity of which the most serious among women will be discussed. Comorbidities include metabolic syndrome (insulin resistance, hypertension, and dyslipidemia), type 2 diabetes mellitus, coronary heart disease, cardiovascular disease (CVD), stroke, gallbladder disease, infertility, hyperuricemia and gout, osteoarthritis, sleep apnea, and certain cancers such as endometrial, breast, colon, gall bladder, and prostate (CDC, accessed 10/2/2006; Garber, 2004; O'Brien & Dixon, 2002; Sarwer et al., 2006; Visscher & Seidell, 2001). Some of these effects lead to disability (Stucki et al., 2006), decreased physical function and energy, and increased bodily pain (Hu, 2003).

3.1.1 Metabolic Syndrome

Abdominal obesity is the foundation of metabolic syndrome (Garber, 2004), a syndrome characterized by metabolic abnormalities such as low HDL-cholesterol, and high triglycerides, abnormal fasting glucose levels, and hypertension (Bray & Champagne, 2004; Isomaa, 2003; Visscher & Seidell, 2001). Weight gain and lack of physical activity are connected with the development of metabolic syndrome (Isomaa, 2003). However, there has not been consensus regarding a definition of metabolic syndrome thereby affecting prevalence estimates. Using the National Cholesterol Education Program definition and the 1988-1994 NHANES III data, the prevalence of metabolic syndrome is high and increases with age among women (Bray & Champagne, 2004). It is estimated the prevalence of metabolic syndrome exceeds the number of Americans with diabetes and is higher in minorities (Garber, 2004). Approximately 1 in 4 U.S. adults meet the criteria for metabolic syndrome (Zhu, St-Onge, Heshka, & Heymsfield, 2004). Metabolic syndrome prevalence is approximately 6% for women aged 20-29 years, 14% for those 30-39 years, 20% for those 40-49 years, 32% for those 50-59 years, and 43% for women over 60 years (Bray & Champagne, 2004). Metabolic syndrome is associated with morbidity and mortality (Isomaa, 2003) and is the primary risk factor for diabetes and CVD (Garber, 2004; Goodpaster et al., 2005). Detection and treatment of metabolic syndrome is being used as a way to lower the risk of or prevent CVD and diabetes (Janssen, Katzmarzyk, & Ross, 2004; Zhu et al., 2004).

3.1.2 Cardiovascular Risks

Cardiovascular risks have been associated with obesity. In general, the relationship between BMI, diabetes, and coronary heart disease is stronger for women than men (Hu, 2003). Central obesity is linked to greater cardiovascular risk with each rise in BMI being reflected in an increase in unstable angina and myocardial infarction (Houston et al., 2005). Modest weight gains of <10 kg after 18 years of age can increase cardiovascular risk in middle-aged women (Hu, 2003). Cardiovascular risk is 1.2 times greater in people with a BMI of 22 and increases to a risk of 4.6 times greater at higher BMI levels (Houston et al., 2005). In addition, heart disease mortality risk increases significantly with age in women (Casper et al., 2000).

3.1.3 Diabetes

Obesity is most directly associated with diabetes (Hu, 2003; Richardson & Vinik, 2005; Weinstein et al., 2004). Risk of type 2 diabetes mellitus is 20 times greater among individuals with a BMI >35 (Boogerd et al., 2002). AA adults experience a higher prevalence of diabetes compared to White adults (Sullivan, Morrato, Ghushchyan, Wyatt, & Hill, 2005) with AA women having the highest prevalence (CDC, accessed 10/2/2006). Current estimates of diabetes are 6-8% for diagnosed adults with obesity and about 10% for both diagnosed and undiagnosed cases. Diabetes prevalence has increased by 5% over the last decade with incidence affecting more than 5 million U.S. adults. It is estimated for every 1-kg increase in weight, diabetes prevalence increases by 9% (Sullivan et al., 2005).

3.1.4 Cancers

Increases in obesity among the middle-aged and older groups in the U.S. may have affected recent trends in cancer incidence rates, particularly among women (Polednak, 2003). In women, cancer risk due to obesity can be modified by menopausal status (Morimoto, White, Chen, Chlebowski, Hays, et al., 2002) due to increased levels of the estrogen hormone (Calle & Thun, 2004; Slattery, Sweeney, Edwards, Herrick, Baumgartner, et al., 2006). It is suggested that higher BMI levels in young adulthood increase the risk of developing premenopausal ovarian cancer (Fairfield et al., 2002). In contrast, weight gain after 18 years of age has been found to be unrelated to breast cancer incidence before menopause but was positively related to breast cancer incidence postmenopause (Hu, 2003). In women, visceral obesity increases the risk of developing endometrial and breast cancer (Boogerd et al., 2002). Breast cancer risk can also be affected by weight cycling or change, body fat distribution, lifetime weight history, and onset age of obesity (Morimoto et al., 2002; Slattery et al., 2006). Moreover, AA women with breast cancer tend to have higher BMI's than White women (Cui et al., 2002). In addition to ovarian and breast cancers, obesity has also been associated with colorectal, endometrial, kidney, esophageal, pancreatic, gallbladder, cervical, liver, and hematopoietic cancers in women, although studies are inconclusive about the extent of the risk of some of these cancers (Calle & Thun, 2004).

3.1.5 Health-Related Quality of Life

The high prevalence of obesity has been associated with decreased quality of life and functioning due to numerous comorbidities; thus, a relationship between obesity and disability has been

noted (Stucki et al., 2006). In fact, quality of life is considered as one of the most important factors in managing obesity due to it increasingly becoming a significant cause of disability (Pi-Sunyer & Kris-Etherton, 2005; Stucki et al., 2006; Stucki et al., 2004). Currently, 30 million women are estimated to have disabilities in the U.S. (Jones & Bell, 2003), which includes arthritis and other rheumatic conditions and chronic health conditions, (Hootman & Helmick, 2006; Jia & Lubetkin, 2005). Additionally, women, minorities, and individuals with less education, low income, and unemployed are more likely to report fair or poor health, physically and mentally unhealthy days, and activity limitation days (Zahran, Kobau, Moriarty, Zack, Holt, & Donehoo, 2005). Women are also more likely to suffer sleep-related problems and report anxiety symptoms and pain-related activity difficulties (Strine, Chapman, Kobau, & Balluz, 2005; Strine, Hootman, Chapman, Okoro, & Balluz, 2005)

Obesity increases functional decline in the later years of life although the exact functional consequences are unclear (Lee, Sobal, Frongillo, Olson, & Wolfe, 2005). Disability increases with age leading to the belief that if current trends in obesity continue, disability rates will increase by one percent per year more in the 50 to 69 year age group than if there were no further weight gains in that group (Sturm, Ringel, & Andreyeva, 2004). Although much of the quality of life research has been conducted primarily among elderly populations, rates of disability among U.S. adults 18 to 59 years of age appear to also be increasing (Lakdawalla, Bhattacharya, & Goldman, 2004). It is estimated that by the year 2030, 64% of adults with arthritis-attributable activity limitations will be women (Hootman & Helmick, 2006).

3.2 CAUSES OF OBESITY

Obesity is a multi-level problem with numerous attributing causes believed to play a central role in its development and progression (Stunkard, 1996). Behavioral, personal, psychological, environmental, and biological factors as well as childbearing have all been associated with obesity among women (Adams-Campbell et al., 2000; Addy et al., 2004; Felton, Boyd, Bartoces, & Tavakoli, 2002; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Winkleby, Kraemer, Ahn, & Varady, 1998). These causes of obesity have been well documented in the literature, albeit some causes contribute more to obesity among women than others. Thus, the causes that are most attributed to obesity and are significant based on the literature will be discussed further.

3.2.1 Behavioral Factors

The optimal approach to controlling obesity involves the pairing of both physical activity and better nutrition habits (Alfano, Klesges, Murray, Beech, & McClanahan, 2002; Jakicic, Wing, & Winters-Hart, 2002). Although improving nutritional practices alone can result in weight loss, physical activity is needed to maintain the weight loss (Orzano & Scott, 2004). Consuming a diet high in fruits and vegetables lowers risk for numerous comorbidities and is essential for weight control (Glanz & Yaroch, 2004; Serdula et al., 2004). Studies have shown that physical activity can also have a positive effect on decreasing risks for many diseases such as cardiovascular disease, diabetes, and cancer (Wilbur et al., 2003). Also, combining physical activity and nutrition results in a greater weight loss compared to either improved nutrition or physical activity alone (Orzano & Scott, 2004).

3.2.2 Personal Factors

Excessive body weight, fatigue, and health status, have also been cited as barriers to engaging in physical activity (Adams-Campbell et al., 2000) thereby leading to obesity. Excessive body weight increases the workload required for various forms of physical activity causing poor activity performance (Patt et al., 2004). Health status has been found to be a significant problem in women with the highest BMI classifications of obesity (Patt et al., 2004). Women suffer disproportionately from diseases attributed to obesity because of health-related quality of life (Muenning, Lubetkin, Jia, & Franks, 2006). Additionally, although health status has been linked to overweight and obesity in AA women, little is known of this relationship (Patt et al., 2004).

3.2.3 Psychological Factors

Psychological factors include body perceptions and images of ideal or normal weight. Psychological factors are believed to be driven by gender, social, and cultural influences, which then impact personal behaviors such as nutritional practices and physical activity (Cachelin, Rebeck, Chung, & Pelayo, 2002; Paeratakul, White, Williamson, Ryan, & Bray, 2002). Some of these factors have been found to be mediated by age, body weight, and SES whereby all influence body dissatisfaction (Cachelin et al., 2002) although the specific relationship among these factors is complex (Paeratakul et al., 2002).

Cultural differences in perceptions of body weight are well documented in the literature (Cachelin et al., 2002; Caldwell et al., 1997; Paeratakul et al., 2002). There has been some evidence that self-perception of body image or body satisfaction may influence obesity among women although there is some discrepancy as to whether ethnicity, race, or class influences

body-size preference (Cachelin et al., 2002; Paeratakul et al., 2002). AA women tend to be more satisfied with their weight and are less affected by societal emphasis on thinness compared to White women (Caldwell, Brownell, & Wilfley, 1997) despite higher body weights (Cachelin et al., 2002; Fitzgibbon, Blackman, & Avellone, 2000). Additionally, White women have experienced body image discrepancies at lower levels of BMI whereas AA women did not report discrepancies until they were overweight (Fitzgibbon et al., 2000).

Other research suggests differing views in body perceptions and images reflect differences in class rather than race (Cachelin et al., 2002). Nonetheless, gender, social, and cultural influences do not necessarily suggest obesity tolerance in women, rather possibly variations in reporting of body dissatisfaction, higher levels of self-esteem, cultural acceptance of particular body sizes and/or men's preferences for certain female shapes. AA women generally have higher self-esteem, perceive themselves to be thinner then they actually are, consider themselves attractive, report more positive attitudes towards obesity (Cachelin et al., 2002), and have more positive accepting attitudes regarding obesity among themselves and others when compared to women from other racial/ethnic groups (Latner et al., 2005).

3.2.4 Sociodemographic Factors

Sociodemographic factors—age, ethnicity, gender, level of education, low-income, and socioeconomic status (SES)—have been associated with obesity although linkages differ according to race and ethnicity (Dekkers et al., 2004; Lee et al., 2005; Patt et al., 2004; Winkleby et al., 1998; Zhang & Wang, 2004a). SES has been shown to impact energy intake and energy expenditure thereby affecting body fat storage (Zhang & Wang, 2004b) and obesity. Direct relationships have been made between SES and physical activity (Keller, Allan, & Tinkle, 2006).

Age is a major factor in obesity prevalence among women. The greatest weight gains are in the early to mid-twenties and obesity prevalence increases with age (Lewis et al., 2000; Peterson et al., 2002; Wyatt et al., 2006). However, AA women tend to gain weight at earlier ages and have higher BMIs when compared to White women of the same age group (Buffington & Marema, 2006). Despite this fact, both AA and White adults report decreased levels of physical activity as they age with AA women being one of the least active segments of the population, (Adams-Campbell et al., 2000; Felton et al., 2002; Wilcox, Castro, King, Housemann, & Brownson, 2000).

There have been differing viewpoints among researchers regarding the relationship between SES and obesity (Chang & Christakis, 2005; Chang & Lauderdale, 2005). SES is usually expressed in terms of an individual's income, education, and occupation (Zhang & Wang, 2004a). Generally, obesity prevalence varies with SES (Dekkers et al., 2004). In the past, obesity prevalence has been significantly linked with SES particularly in women (Patt et al., 2004). Studies have reported no significant associations between obesity and SES in AA women but found differences in White women (Patt et al., 2004). However, trends in the association between obesity and SES in U.S. adults using NHANES data from 1971-2000 demonstrated that the disparity in SES has decreased in the past three decades (Zhang & Wang, 2004a) with obesity increasing at all levels of income (Chang & Lauderdale, 2005). Among AA women, the largest increases in BMI are not seen in poor AA women, but in middle-income AA women suggesting that groups below the national poverty line may not be the correct group to focus for obesity prevention and intervention efforts (Chang & Lauderdale, 2005).

3.2.5 Environmental Factors

Environmental factors play a major role in inhibiting physical activity and healthy nutrition practices (Gordon-Larsen et al., 2006) among women. The environment can be considered in many ways—built environment, food environment, and an individual's personal environment. The built environment includes urban design, land use, the transportation system, and patterns of activity within the physical environment (Handy, Boarnet, Ewing, & Killingsworth, 2002). The built environment can hinder physical activity because of poor street patterns, lack of pedestrian amenities, inaccessible community facilities and locations (Gordon-Larsen et al., 2006; Lopez, 2004), traffic volume, unattended dogs, crime, and untrustworthy neighbors (Addy et al., 2004) as well as good nutritional practices due to the lack of or poor quality of grocery stores (Popkin, Duffey, & Gordon-Larsen, 2005).

There have been documented differences in physical activity among urban and rural areas in which inactivity was highest in rural areas (CDC, 1998; Wilcox et al., 2000). Thus, residents of rural areas tend to experience health inequalities, lower socioeconomic status, and have less access to healthcare. These barriers are more pronounced in women, older adults, those of lower socioeconomic status and ethnic minorities (Wilcox et al., 2000). The term "urban sprawl" has been used to describe the effect of urbanization. There is much conjecture about the definitions of urban sprawl including the pattern of development across metropolitan areas where large portions of the population live in lower-density residential areas (Lopez, 2004). Another definition of urban sprawl refers to a rapid expansion of metropolitan areas corresponding to a complex pattern of land use, transportation, and social and economic development (Frumkin, 2002). Despite these definitional issues, urban sprawl has been associated with being overweight

and/or obese in several studies (Frumkin, 2002; Lopez, 2004). In contrast, approximately, one-quarter of the U.S. population lives in rural areas.

The food environment is an instrumental factor in obesity incidence and prevalence. Access to and availability of healthier food choices such as fruits and vegetables have been associated with being overweight in women (Oberholser & Tuttle, 2004). The food environment includes types and amounts of foods consumed, eating locations (i.e., restaurants), food production and distribution (Popkin et al., 2005), and accessibility and affordability of food (i.e., food security)—all of which are associated with obesity (Cummins & Macintyre, 2006; Townsend, Peerson, Love, Achterberg, & Murphy, 2001). Access to and availability of food in grocery stores and supermarkets may be an important factor in the relationship between the environment, nutritional practices, and obesity such that the presence of food access and availability has been associated with lower prevalence of obesity (Cummins & Macintyre, 2006).

Food insecurity has become a major issue in discussions regarding environmental factors that may impact individual lifestyles, thereby affecting obesity in the U.S. The lack of nutritionally adequate foods or available food sources results in food insecurity, which has a direct relationship to obesity (Drewnowski & Specter, 2004). Lack of money has been noted as a frequent reason given for experiencing food insecurity (Oberholser & Tuttle, 2004). This is important because there is an inverse relationship between healthy foods and cost (Drewnowski & Darmon, 2005), where recommended diets have been found to cost more and diets high in fats and sweets represent a lower cost option for consumers (Drewnowski, Darmon, & Briend, 2004).

The types of foods most often linked to obesity prevalence are low-cost, energy-dense, high caloric foods. Increasing energy dense diets among women have been linked to having a higher BMI (Howarth, Murphy, Wilkens, Hankin, & Kolonel, 2006). This relationship

combined with increased food portion sizes, availability and accessibility to fast food restaurants, which are dominant in many low-income neighborhoods, as well as the lack of grocery stores or supermarkets can have a detrimental effect on nutritional practices and physical activity (Popkin et al., 2005) thus affecting obesity among women. There is an increase in the amount and consumption of foods that are more completely prepared that influence an individual's food selection practices (Tillotson, 2004). Therefore, access and availability to food in grocery stores and supermarkets may be an important factor in the relationship between the environment, nutritional practices, and obesity such that their presence has been associated with lower prevalence of obesity (Cummins & Macintyre, 2006). Currently, almost half of total annual food purchases in the U.S. are for foods fully prepared and consumed outside the home or brought into the home for consumption (Tillotson, 2004). In addition, foods prepared away from the home account for one-third of calories for the average adult and are generally less healthy compared to foods prepared in the home (Wootan & Osborn, 2006).

An individual's personal environment includes interpersonal factors such as their social support system—family and friends. The personal environment has been found to be an important influence in performing and sustaining physical activity (Brownson et al., 2001; Keller et al., 2006). Social support can involve direct influence where individuals receive physical assistance in exercising like driving to an exercise class or babysitting children or discussing physical activity and encouragements to continue. Personal environment variables that have impacted physical activity are areas where many people are exercising, having loved ones who encourage exercising, and having a friend to exercise with (Brownson et al., 2001). These all have been shown to positively influence patterns of physical activity (Keller et al., 2006).

3.2.6 Biological Factors

Biological factors may play an important role in obesity incidence and prevalence. Although specific obesity genes have not been identified, there are likely to be numerous genes that potentially interact with one another (Wadden et al., 2002). Certain individuals are thought to have a genetic predisposition to gain weight (Gunderson et al., 2004; Lyon & Hirschhorn, 2005; Stunkard, 1996). Hereditary is believed to play a strong causal role in obesity given that obesity has been shown to aggregate in families (DelParigi et al., 2005). Obesity has occurred even in families in which the members do not live in the same residence or have the same levels of exercise and dietary intake (Lyon & Hirschhorn, 2005). Heritability is related to factors such as body fat distribution, physical activity, metabolism, and changes in energy expenditure due to overeating, eating behavior, and food preferences (DelParigi et al., 2005).

Genetics is estimated to account for 25% to 40% of the difference in people's body weight (Daniels, 2006; Rosenbaum, Leibel, & Hirsch, 1997) as well as resting metabolic rate, weight gain in response to overfeeding, and body fat distribution (Wadden et al., 2002). It is thought that the rise in obesity prevalence occurred too rapidly for alterations to the population genetic make-up (Caterson & Gill, 2002). Consequently, there have been no major changes in the national gene pool during the period of increased obesity prevalence (Pi-Sunyer & Kris-Etherton, 2005). This has led to the conclusion that body weight reflects the interaction of biological development and environment with genotype (Rosenbaum et al., 1997) where the environmental determinants of weight gain are nutritional practices and physical inactivity (Pi-Sunyer & Kris-Etherton, 2005).

3.2.7 Childbearing

Childbearing has been demonstrated to contribute to obesity among women through excessive weight gain during pregnancy (Cogswell et al., 2001; Lee et al., 2005; Rosenberg et al., 2003). In 2003-2004, approximately 29% of all women of childbearing age, 20 to 39 years, were obese and 8% were extremely obese. Prevalence differs by race and ethnicity with 24% of White women aged 20 to 39 years considered obese and 6% extremely obese. In contrast, AA women of childbearing age had a 50% prevalence of obesity and 16% prevalence of extreme obesity (Ogden et al., 2006).

The increase in weight during pregnancy is more common in first pregnancies compared to subsequent pregnancies. Additionally, a substantial proportion of women exceed the recommendations for adequate weight gain, which is believed to contribute to the development of obesity among childbearing women (Sarwer et al., 2006). However, weight retention is more common in certain racial groups than others in which women become overweight after pregnancy. There have been documented racial differences of postpartum weight retention in AA women, particularly of higher parity (multiple pregnancies), demonstrating greater weight retention (Lee et al., 2005).

The biological, sociodemographic, and behavioral factors linked to postpartum weight retention among women are associated with ethnicity, lower socioeconomic status, marital status, living in non-metropolitan areas, lack of physical activity, lack of sleep, smoking, and heavy alcohol consumption. Other issues related to postpartum weight gain and contribute to postpartum obesity are oral contraception usage, parity, breastfeeding, interval between births, mode of deliveries, length of gestation, energy intake, eating disorders, and dieting (Keller et al., 2006; Lee et al., 2005; Sarwer et al., 2006). Conversely, younger age, returning to work after

pregnancy, smoking, aerobic exercise, and lactation are associated with lower postpartum weight retention. However, the extent to which these factors contribute to or protect against obesity is not clear (Keller et al., 2006; Lee et al., 2005).

3.3 THE ECONOMIC IMPACT OF OBESITY

The economic costs attributed to obesity are substantial (Finkelstein, Ruhm, & Kosa, 2005). Predictions forecast obesity will become the leading cause of death and most expensive disease in developed countries such as the U.S. in the 21st century surpassing the tobacco-related illnesses. Specifically, obesity is associated with increased healthcare costs (Martin, Robinson, & Moore, 2000; Stucki et al., 2004). Obese adults 18 to 65 years incur annual medical costs 36% higher than expenditures of normal-weight individuals (Finkelstein et al., 2005). The estimated direct costs of obesity are approximately 6-8% of all the total healthcare costs in the U.S. (Pi-Sunyer & Kris-Etherton, 2005; Vissher & Seidell, 2001). Estimates of national costs attributed to both overweight and obesity accounted for 9.1% of total U.S. medical expenditures in 1998 (CDC, accessed 10/2/2006).

Obese individuals have more physician visits, more inpatient days, and more pharmacy dispenses including diabetes and cardiovascular medications compared to those individuals of normal weight. Obesity is also associated with loss of productivity and higher levels of work absenteeism resulting in 239 million restricted activity days and 89.5 million bed days in 1995 (Finkelstein et al., 2005; Pi-Sunyer & Kris-Etherton, 2005). The rate of work limitations in obese younger workers is similar to limitations in normal-weight middle-aged workers, and the rate of work limitations in middle-aged obese workers is similar to limitations in normal-weight

older workers (Hertz, Unger, McDonald, Lustik, & Biddulph-Krentar, 2004). Obesity also affects one's personal finances. The discretionary money spent on treatment and prevention of obesity is more than any other medical treatments with obese individuals utilizing more healthcare resources than the general population (Martin et al., 2000).

3.4 CONCEPTUALIZING OBESITY AND IMPLICATIONS FOR PRACTICE

Public health goals and interventions to combat obesity in the U.S. are not new; rather, they stem from a renewed interest in higher obesity rates thereby placing obesity into the forefront of public health prevention and control efforts (Finkelstein et al., 2005; Kumanyika, 2001; Visscher & Seidell, 2001). Historically, obesity was looked upon as a rare phenomenon in which the majority of the population was more likely to suffer from weight deficits. Thus, increased body weight was typically associated with improved health. Currently, a minority (<35%) of adults in the U.S. have a healthy BMI (Hill, Thompson, & Wyatt, 2005). As such, the view of obesity's rarity has been altered in the last two decades corresponding with the continual increase of overweight and obese individuals in the United States. In the U.S., obesity prevalence has risen rapidly during the past two decades and more than doubled in the past 25 years (Finkelstein et al., 2005; O'Brien & Dixon, 2002). Consequently, decreasing the prevalence of obesity has become a significant focus in research and prevention efforts.

Along with an increased interest, numerous labels have been placed upon obesity by public health, the medical field, as well as the media. Obesity has been referred to as an epidemic, a pandemic (Tillotson, 2004), societal disorder, an illness (AOA, accessed 10/4/2006), a condition, an addiction (Volkow & Wise, 2005), and currently as a chronic disease

(Kumanyika, 2001; Stunkard, 1996) and disability (Stucki et al., 2004). These labels have a profound effect on the ways in which obesity is perceived, treated, and the policies that are developed as a response to the obesity issue (Campos, 2004; Campos, Saguy, Ernsberger, Oliver, & Gaesser, 2006).

Definitions of epidemics vary among epidemiology textbooks. According to one definition, an epidemic is defined as an "occurrence of a higher rate of a health state than would be expected, based on past experience" (Slome, Brogan, Eyres, & Lednar, 1986). In contrast, another textbook defines an epidemic as "any disease, infectious or chronic, occurring at a greater frequency than usually expected" (Hennekens & Buring, 1987). These definitions imply different meanings that underlie the controversies regarding whether obesity truly is a problem, and if so, is it as dire as the forecasts imply?

A significant portion of the obesity problem stems from a continual debate on whether obesity is actually a public health issue. Although many researchers consider obesity a major public health problem (Martin et al., 2000; O'Brien & Dixon, 2002; Paeratakul et al., 2002; Townsend, 2006), certain researchers (Kumanyika, 2001) believe because death rates cannot be attributed directly to obesity, a problem does not exist. There are other researchers (Campos, 2004; Campos et al., 2006) and special interest groups such as The Center for Consumer Freedom (accessed 10/4/2006) who argue that obesity is based upon the perception of a crisis by the public health and medical fields rather than accurate data to support this claim. Those who doubt obesity is a public health crisis believe that obesity only becomes an issue among those with a BMI ≥35, corresponding to approximately 7% of all U.S. women, 6% of White women, and 15% of AA women aged 20 years and older using data from NHANES 2003-2004 (Ogden et

al., 2006)[3]. These researchers and special interest groups contend that obesity is instead a cultural and political issue (Campos, 2004).

Ambiguity over the attributable risk of obesity has become increasingly obvious in recent debates over the number of persons estimated to be obese in the U.S. and the relationship of obesity to morbidity and mortality. In a CDC study (Mokdad, Marks, Stroup, & Gerberding, 2004), excess weight was calculated to cause 400,000 deaths in the U.S. annually. However, this statistic was highly debated and CDC issued a retractment citing data limitations and computation and methodological errors. As a result, Mokdad and colleagues (2005) issued a correction to their previous article where they stated excess weight actually accounts for 26,000 deaths annually. In response to these debates regarding obesity prevalence and associated risks of morbidity and mortality, the CDC has begun to highlight the negative correlations and attributes of obesity rather than dwell on arguments of the precise figures of obese individuals in the U.S. given the extensive number of comorbidities associated with obesity (Mokdad, Marks, Stroup, & Gerberding, 2005; MSN, accessed 10/4/2006).

The labels given to obesity—epidemic, pandemic (Tillotson, 2004), societal disorder, illness, condition (Stucki et al., 2004), addiction (Volkow & Wise, 2005), chronic disease (Kumanyika, 2001; Stunkard, 1996), and disability (Stucki et al., 2004)—may have an affect on the methods in which public health, medicine, and the government deal with obesity. Epidemic and pandemic implies the extent of a problem beyond what is considered normal in multiple countries (Egger & Swinburn, 1997), which in turn increases resources and attention applied to obesity (Campos, 2004; Campos et al., 2005). The terms societal disorder, illness, condition, addiction and chronic disease all entail individual contexts dealt with by altering lifestyle

[3] The prevalence statistics are for women with a BMI of ≥40 only. Data are not available for women with a BMI of ≥35.

behaviors such as improved nutritional practices and physical activity or medication or surgical treatment (Daniels, 2006; Stunkard, 1996; Volkow & Wise, 2005).

The question of whether obesity is a public health problem and the labels placed upon obesity impacts the policies implemented to counteract obesity. Behavioral therapies, drugs, and surgeries have become more widely used methods to counteract overweight and obesity (Rosenbaum et al., 1997). However, some of these treatments are not recognized by many insurance companies causing them to be either too expensive to maintain as well as dangerous or available only to those persons with the financial means to select these treatments as potential options. These problems with obesity treatments other than altering individual lifestyles are a major reason why the American Obesity Association as well as the WHO, National Institutes of Health, CDC, and the American Dietetic Association have been so determined to define obesity as a disease. Currently, obesity is officially recognized as an illness by Medicare, which allows for some coverage for obesity treatments that have been demonstrated to be reasonable, effective, and improve patient outcomes such as stomach surgery or nutrition therapy (AOA, accessed 10/9/2006; Gregoire, 2004). Although Medicare did not officially declare obesity as a disease, it removed language from its rules and regulations stating that obesity is not a disease (AOA, accessed 10/9/2006). In contrast, many private insurers have not followed suit of Medicare and will pay for conditions related to obesity but not obesity itself (AOA, accessed 10/9/2006). In declaring obesity a disease rather than a condition, the goal is to promote acceptance of obesity treatments by health management companies, private insurers, and the government. Labeling obesity as a condition based on presence of other diseases, such as heart disease or diabetes, prevents obesity from being treated independently as a disease in its own right (Stern, Kazaks, & Downey, 2005).

Similar to obesity treatments, governmental and public health policies have thus far centered on programs targeting changes in individual risk factors (Tillotson, 2004). One policy focusing on individual risk factors is the Nutrition Labeling and Education Act (NLEA), which increased the availability of nutrition information on packaged foods and led to changes in food labeling (Burton, Creyer, Kees, & Huggins, 2006; Schneeman, Trumbo, Ellwood, & Satchell, 2006). While restaurants are exempt from NLEA, some make nutrition information available on websites, brochures, or menus (Burton et al., 2006). Since consumption of food prepared outside the home has increased, it is believed that presentation of nutrition information on menus can raise awareness regarding the healthiness of food and possibly reduce consumption of unhealthy food leading to decreased obesity prevalence (Burton et al., 2006).

Although individual factors—physical activity and improved nutritional practices—are important to controlling obesity, there are numerous factors that affect obesity (Wyatt et al., 2006). However, there has been relatively little exploration of the influence of agricultural and economic public policies on the food environment and obesity in the U.S (Tillotson, 2004). The high prevalence of obesity suggests more than simple individual changes in eating behavior and lifestyles as the answer to the puzzle of the continual increase of obese individuals (Visscher & Seidell, 2001).

Overweight and obesity have been influenced by the industrialization of the food supply and the general industrialization of the U.S. economy as well as the upsurge of nutritional knowledge of the relationship between diet and health which did not occur simultaneously thus complicating the policy making process. For that reason, policies do not always reflect the nutritional knowledge resulting in increased amounts of processed foods. Greater quantities of processed foods lead to easier accessibility and affordability of inexpensive foods (Davey, 2004).

The imbalance between nutritional knowledge and nutritional policies leads to the current dietary issues associated with obesity (Tillotson, 2004).

Central to the issue of industrialization of the food supply, is the effect that altered nutritional practices may have on agricultural and food businesses and the government. It is suggested that obesity as a political issue has surpassed obesity as a health issue (Tao & Glazer, 2005). A combination of the changing of nutritional policies having detrimental effects on these sectors along with ineffective and impractical application of increased nutritional knowledge leads to tension between the food sector and government public policy makers. Added to this tension are the huge roles that the agricultural and food sectors play in the national economic structure further complicating the problem of obesity.

It has been suggested that agricultural subsidies given to U.S. farmers have contributed significantly to the obesity problem. Historically, agricultural subsidies have been distributed to farmers as a method to stabilize crop prices, provide a constant economy for farmers, and be a reliable and affordable food source for U.S. citizens (Fields, 2004). There are arguments that due to U.S. governmental policy focusing on agricultural efficiency and farmers being most efficient at producing wheat, soybeans, and corn, the production of other crops such fruits, vegetables, and other grains is ignored (Tillotson, 2004). This is particularly problematic since wheat, soybeans, and corn form the basis of many processed foods. In contrast, there have been other arguments that place the brunt of the obesity problem with the consumers, citing supply is only matching the demand for the foods; thereby, farmers are simply growing what consumers want (Fields, 2004). These debates regarding the extent of the influence of policy on obesity demonstrate that in order to decrease the high levels of overweight and obesity in the U.S., we

need to look beyond simply focusing on nutrition policies to also focusing on the agricultural, industrial, and economic policies that directly impact the nation's food supply (Tillotson, 2004).

4.0 METHODOLOGY

Using the Comprehensive International Classification of Functioning, Disability and Health (ICF) Core Set for Obesity as a guide, the objectives of the studies described in the next chapters are to: 1) Determine the impact of personal, psychological, sociodemographic, environmental, biological, and childbearing factors on obesity among women; 2) Explore the applicability of the framework for use in public health; and 3) Provide recommendations of the most important aspects of the framework for public health interventions among African American, Hispanic, and White women based upon data from the National Health and Nutrition Examination Survey (NHANES). Data used in the study are from the NHANES conducted between 1999 and 2004 by the National Center for Health Statistics (NCHS) for the CDC.

4.1 RESEARCH DESIGN

4.1.1 NHANES

NHANES is one of the most common data sources used to report obesity prevalence in the U.S. (Wyatt et al., 2006). Data from the NHANES demonstrate increases in obesity prevalence across different racial/ethnic groups and educational classifications (Kumanyika, 2001). NHANES is a nationally representative survey to assess the health and nutritional status of U.S. adults and

children. NHANES includes objective measures of BMI in addition to demographic, socioeconomic, dietary, and health-related information through a combination of interviews and physical examinations (CDC, 2005; Wyatt et al., 2006).

The NHANES is a stratified, multistage probability sample of the civilian, noninstitutional U.S. population. The survey oversamples low-income individuals, adolescents 12-19years of age, persons aged 60 and above, African Americans, and Mexican Americans. Since 1999, the NHANES has been conducted continuously and annually, interviewing approximately 7,000 individuals in their home and via the telephone. Physical examinations are completed in mobile examination centers (MEC) by trained health professionals or at the participant's home if they are unable to leave the home (CDC, 2005).

Trained interviewers survey the participants using a computer-assisted personal interview (CAPI) system. Survey participants sign an interview consent form. Upon completion of the interview, participants are asked to complete the physical examination component. Of the approximate 7,000 individuals who are interviewed annually, about 5,000 complete the health examination component (CDC, 2005).

4.1.2 ICF

The components of the ICF include Body Functions and Structures, Activities and Participation, Environmental Factors, and Personal Factors and are comprised of various domains (Table 1).

Table 1: The ICF Components and Domains

	Part 1: Functioning and Disability		Part 2: Contextual Factors	
Components	Body Functions and Structures	Activities and Participation	Environmental Factors	Personal Factors*
Domains	Body functions Body structures	Life areas (tasks, actions)	External influences on functioning and disability	Internal influences on functioning and disability

*Personal Factors are not coded within the ICF; (WHO, 2001)

Within each domain, there are categories that are the units of classification. The categories combined with numeric qualifiers are then used to classify an individual's health and health-related state and the magnitude of the functioning or disability in that category.

For the purposes of this study, the domains and categories for each component were used as a guide to categorize the NHANES questions into 4 groups corresponding with the following Comprehensive ICF Core Set on Obesity components: 1) Body Functions and Structures; 2) Activities and Participation; 3) Environmental Factors; and 4) Personal Factors. Thus, this study looked broadly at health and the impact of various factors on heath. Although the researcher was unable to classify an individual's health and health-related state because individual health varies, she was, however, able to describe and make inferences on the spectrum of various influences and restrictions on a representative sample's health, disability, and functioning including both internal and external effects.

4.2 STUDY POPULATION

Eligible participants consisted of U.S. adult women, aged 18 years and older who completed both the interview and physical examination component of NHANES (N=8,307). Women who did not complete the MEC exam for the body measures component were excluded. After excluding cases with missing data of the variables of interest including BMI, age, race, income, education, and smoking status, the final study sample was 6,910 women (Table 2).

Table 2: Descriptive Statistics of the Study Sample

Characteristic	Number (N=6,910)	Percentage
BMI Categories		
Underweight	130	1.9
Normal weight	2,152	31.1
Overweight	2,151	31.1
Obese	2,447	35.8
BMI Classes		
Not obese	4,433	64.2
Class I	1,340	19.4
Class II	664	9.6
Class III	473	6.8
Age, y		
20-29	1,414	18.4
30-39	1,261	16.5
40-49	1,119	16.2
50-59	844	12.2
≥60*	2,269	32.8
Race/Ethnicity		
Non-Hispanic White	3,472	50.3
Non-Hispanic Black	1,319	19.1
Mexican American	1,538	22.3
Other Hispanic	322	4.7
Other Race§	259	3.7
Household Income		
$0 to $4,999	323	4.7
$5,000 to $9,999	584	8.5
$10,000 to $14,999	790	11.4
$15,000 to $19,999	590	8.5
$20,000 to $24,999	650	9.4
$25,000 to $34,999	823	11.9
$35,000 to $44,999	607	8.8
$45,000 to $54,999	513	7.4
$55,000 to $64,999	356	5.2
$65,000 to $74,999	284	4.1
> $75,000	1,010	14.6
Education		
<High School	2,112	30.5
High School including GED	1,662	24.1
>High School	3,125	45.2

Table 2 continued

Country of Birth		
Born in 50 U.S. States or D.C.	5,402	78.2
Born in Mexico	858	12.4
Born Elsewhere	638	9.2
Missing	12	0.2
Had Pregnancies w/ live births		
Yes	5,162	74.7
No	260	3.8
Missing	1,488	21.5
Smoking 100 cigarettes in lifetime		
Yes	2,680	38.8
No	4,230	61.2
Coexisting health conditions		
Heart Disease		
Congestive Heart Failure	180	2.6
Coronary Heart Disease	200	2.9
Heart Attack	208	3.0
Angina Pectoris	230	3.3
Stroke	597	3.1
Hypertension	2,210	32.0
Cancer	597	8.6
Disability		
Arthritis	1,963	28.4
Asthma	898	13.0
Diabetes/Borderline Diabetes	734	10.6
How do you consider your weight		
Underweight	237	3.4
Right weight	2,416	35.0
Overweight	4,241	61.4

*****No 80-84 year olds are included.
[§]Including Multi-Racial.

4.3 RESEARCH METHODS

The components of the Comprehensive ICF Core Set on Obesity were demonstrated using NHANES data. The following variables were selected as they related to the ICF's classification components (Table 1).

4.3.1 Outcome Variable

The outcome of interest was log of body mass index, or BMI, which was obtained from a data transformation of BMI. BMI[4] is commonly used to estimate obesity. The log of BMI, rather than BMI, ensured a straight line adequately describing the relationship between the outcome and independent variables. BMI was taken from the NHANES body measures component variable acquired during the MEC exam. BMI was classified as underweight (<18.5), normal weight (18.5-24.9), overweight (25.0-29.9), obese (≥30.0), and extremely obese (≥40.0). BMI was determined by a calculation of the body weight in kilograms divided by body height in meters squared.

4.3.2 Independent Variables

The following sections, Body Functions and Structures, Activities and Participation, Environmental Factors, and Personal Factors, describe the kind of variables that were grouped with the ICF components using the NHANES 1999-2004 questions. Because the variables used were numerous, descriptions of the variables are provided.

[4] BMI is a calculation of body weight in kilograms divided by body height in meters squared.

Body Functions and Structures

Approximately 200 questions (NHANES, 2005, 2006, 2007) pertaining to Body Functions and Structures were based upon the physiological and psychological functions of the body systems, the anatomical parts of the body, and impairments that cause problems in the body's functioning. The NHANES questions that correspond to the categories of the Body Functions and Structures included the following:

1) Functions of the brain including temperament and personality, energy and drive, sleep, emotional, and experiences of self and time functions
2) Sensations of pain
3) Functions involved with the cardiovascular, haematological, immunological, respiratory, metabolic, and endocrine systems
4) Genitourinary, reproductive, neuromuscular, movement-related, and skin and skin-related functions
5) Functions associated with the digestive system including body weight maintenance
6) The anatomical structures and systems that complement the preceding functions and impairments

Activities and Participation

Approximately 57 questions (NHANES, 2005, 2006, 2007) corresponding to the categories of Activities and Participation included the participants' execution or difficulty in executing

activities and problems with being involved in life situations. The NHANES questions that match these criteria pertained to the following:

1) Ability to handle stress and other psychological demands
2) Ease or difficulties in mobility including changing and maintaining basic body position, moving, lifting and carrying objects, and moving using transportation
3) Ability to care for one's self
4) Ability to handle domestic life including acquiring necessities, performing household tasks, and caring for or assisting others with the household
5) Basic interpersonal interactions and informal social relationships
6) Creating and maintaining family and intimate relationships
7) Education, work and employment, economic, community, social, and civic life

Environmental Factors

The 16 questions (NHANES 2005, 2006, 2007) pertaining to the categories of Environmental Factors involved the facilitating or hindering impact of features of the physical, social, and attitudinal world of the participant's immediate environment. The NHANES questions that addressed these factors involved:

1) Products and technology used by the participant, which includes food, drugs, equipment, mobility and transportation, communication, education, employment, culture, recreation, sport, and religion
2) Design and construction of buildings for public and private use
3) Policies regarding the design, planning, and development of space and land

4) Individual assets, i.e., financial, tangible, and intangible
5) Natural and human-made changes to the environment, including geography, climate, population, light, sound, time-related changes, natural and human-caused events, vibration, and air quality
6) Support and relationships including the amount of support of immediate family and friends
7) Attitudes of others due to the participants' customs, practices, ideologies, values, norms, and beliefs
8) Individual, community, organizational, regional, national, and international services, systems, and policies

Personal Factors

Questions related to Personal Factors are not coded in the ICF classification system. However, according to the ICF classification, personal factors demonstrate the impact of personal attributes. Therefore, the NHANES questions (NHANES, 2005, 2006, 2007) regarding the sociodemographic information of the participants was used: 1) age; 2) race/ethnicity; 3) education; 4) income; and 5) smoking status.

4.3.3 Potential Confounders

Potential confounders were age, race, ethnicity, income, education, parity, smoking status, and self-reported coexisting health conditions (i.e., heart disease, stroke, hypertension, cancer, and disability). Age was used both continuously and in five-year intervals. Race and ethnicity were

combined to include non-Hispanic white, non-Hispanic black, and Mexican American. Total family income ranged from less than $10,000 to greater than $75,000 annually. Income was divided into $5,000 and $10,000 increments. Participants noted their highest level of education completed, which was recoded into three categories: 1) less than high school; 2) high school diploma (including GED); and 3) more than high school. Pregnancy history was determined by questions asking if the participant had ever been pregnant, the amount of times the participant had been pregnant, the number of pregnancies resulting in live births, the age at the first live birth, and the age at the last live birth. Smoking status was based upon whether the participants had smoked at least 100 cigarettes in their lifetime. Coexisting health conditions were assessed by questions regarding the participants ever having been told that they had heart disease, stroke, hypertension, or cancer. Disability was determined by the existence of arthritis, asthma, and diabetes, which impact functioning.

4.4 DATA ANALYSIS

Analyses were accomplished using Stata SE 9.2 statistical software (StataCorp LP, College Station, Texas) to account for the NHANES complex sampling scheme. All analyses included sample weights to account for unequal selection probability, oversampling, and non-response biases. The sampling weights provided in the NHANES were used to calculate population estimates for the covariate variables. The NHANES questions were grouped according to the ICF components, Body Functions and Structures, Activities and Participation, Environmental Factors, and Personal Factors as previously described.

4.4.1 Descriptive Analysis

Frequency distributions and summary statistics were reviewed for all variables. Means and frequencies were used to describe the study population.

4.4.2 Bivariate Analysis

Chi-square tests were conducted to examine differences and make comparisons among obesity categories and classes and BMI. Additionally, interactions between variables and component groups and BMI were analyzed to find potential confounders.

4.4.3 Multivariate Analysis

Multiple linear regression was used in the analyses. The dependent or outcome variable, log of BMI, was continuous. Linear regression is appropriate when the dependent variable is continuous. Multiple linear regression was used to determine if and to what extent the ICF components were independently associated or were interrelated with log of BMI. The regression analysis was used to assess the variance of the ICF components in predicting BMI. The questions that were grouped according to the ICF components were analyzed for the contribution that these variables make to U.S. women's BMI.

Analysis is described according to each research question and the respective hypotheses:

Research Question #1: Do the components of the Comprehensive International Classification of Disease and Functioning, Disability and Health (ICF) Core Sets for Obesity—

Body Functions and Structures, Activities and Participation, Environmental Factors, and Personal Factors—predict BMI in U.S. women?

H_{o1}: The Environmental Factors component of the ICF classification will not better predict BMI in U.S. women than the other components in the framework.

Multiple linear regression was performed to determine the extent that the variables in each component of the ICF Core Sets for Obesity independently contribute to the prediction of log of BMI. A significant p-value of the t statistic was used to decide if the H_{o1} will be rejected.

Research Question #2: Do the components of the Comprehensive ICF Core Sets for Obesity explain the variance in the framework for BMI in U.S. women?

H_{o2}: The Environmental Factors will not account for the most significant portion of the variance in the framework for BMI among U.S. women.

H_{o3}: The variance in the ICF framework for BMI among women does not differ most by education.

Multiple linear regression was conducted to quantitatively measure how well the components of the Comprehensive ICF Core Sets for Obesity predict BMI. The value R^2 informs of the amount (%) of variation in BMI that is explained by the regression model. R^2 lies between 0 and 1, with values of 1 being a perfect model. If R^2 is closest to 1 for the environmental factors component, then H_{o2} was rejected. If the addition of education alters R^2 statistically, then H_{o3} was rejected.

4.4.4 Additional Analyses

Other analyses conducted include multicollinearity and the effect of influential observations. Multicollinearity occurs when one or more of the independent variables can be determined by other independent variables. Multicollinearity analyses were done to ensure the questions within the groups are not accounting for the same variable (Kleinbaum, Kupper, Muller, & Nizam, 1998). Analyses looking for influential observations were conducted although the NHANES researchers do so in their data cleaning process.

5.0 MANUSCRIPT ONE: USE OF THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF) IN PREDICTING BMI AMONG U.S. WOMEN

Manuscript in Preparation

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5.1 ABSTRACT

Background: Over the past two decades, obesity among women has significantly increased, with women having the highest prevalence in the U.S. Obesity prevention programs and interventions focusing on women have traditionally included individual-level approaches although obesity is a multi-level problem. The research literature has cited numerous factors of obesity—behavioral, personal, psychological, sociodemographic, environmental, biological, and childbearing. As a result, recent public health efforts have shifted away from individual approaches to those that handle multiple factors.

Methods: While multiple factors have been associated with obesity among women, the degree and variability of the factors have not determined in the literature. This study seeks to explore the effects of the multiple factors on BMI in U.S. women using the International Classification of Functioning, Disability and Health (ICF) Core Sets for Obesity, developed by the World Health Organization and data from the National Health and Nutrition Examination Survey (NHANES). Linear regression was used in the analyses.

Results: Significant factors were sociodemographic information (age, income, and race), body weight perceptions, coexisting health conditions, physical functioning, and engaging in physical activity and proper nutritional practices.

Conclusions: Obesity prevention and treatment programs for U.S. women should focus on the most significant factors identified in this study to decrease obesity incidence and prevalence.

Public Health Relevance: The information garnered from this study can be used to further identify the most important characteristics needed for future obesity programs with U.S. women.

5.2 INTRODUCTION

Obesity has become an important public health issue due to the significant increase in obese individuals during the past two decades. The majority of adults (65%) in the United States (U.S.) are either overweight or obese (Pi-Sunyer & Kris-Etherton, 2005). From 2000 to 2005, the proportion of severe or extremely obese adults rose by 24% (Sturm, 2007). Of the obese adults in the U.S., women have the highest prevalence of obesity (34%) and extreme obesity (6%), with the highest obesity prevalence rates occurring among Mexican American and African American women (Flegal, Carroll, Ogden, & Johnson, 2002; Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006).

Efforts to stem the rise in obesity in recent years have been impaired by the complex nature of obesity. That is, obesity is a multi-level problem with numerous attributing causal factors and resulting health effects (Stunkard, 1996). Behavioral, personal, biological, psychological, environmental, sociodemographic, and childbearing factors have all been associated with obesity among women (Adams-Campbell, Rosenberg, Washburn, Rao, Kim & Palmer, 2000; Addy, Wilson, Kirtland, Ainsworth, Sharpe, & Kimsey, 2004; Felton, Boyd, Bartoces, & Tavakoli, 2002; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Winkleby, Kraemer, Ahn, & Varady, 1998). Obesity prevalence has also been linked to increased morbidity and mortality (Wyatt, Winters, & Dubbert, 2006). Some of the health effects linked to obesity in women include metabolic syndrome (insulin resistance, hypertension, and dyslipidemia), type 2 diabetes mellitus, coronary heart disease, cardiovascular disease, stroke, gallbladder disease, infertility, hyperuricemia and gout, osteoarthritis, sleep apnea, and certain cancers such as endometrial, breast, colon, and gall bladder (Garber, 2004; O'Brien & Dixon, 2002; Sarwer, Allison, Gibbons, Markowitz & Nelson, 2006). The health effects of obesity have

received considerable attention given the progression of obesity can lead to disability (Stucki, Borchers, Stucki, Cieza, Amann, & Ruof, 2006), decreased physical function, and increased bodily pain (Hu, 2003), which results in elevated healthcare costs and loss of work productivity (Finkelstein, Ruhn, & Kosa, 2005; Martin, Robinson, & Moore, 2000; Pi-Sunyer & Kris-Etherton).

In order to counteract the increase in obesity prevalence, emphasis has been placed on moving beyond traditional methods to prevent and treat obesity, which has primarily been centered on the individual (Tillotson, 2004; Visscher & Seidell, 2001). New ways of dealing with obesity have utilized multi-level concepts, models, theories, and approaches that reflect the complexity of obesity (Yancey, Kumanyika, Ponce, McCarthy, Fielding, Leslie et al., 2004). One example of these multiple-level approaches is the International Classification of Functioning, Disability and Health (ICF). The World Health Organization (WHO) developed the ICF, a classification and coding system, to measure the spectrum of systems and problems in functions among patients with disabilities.

The ICF was initially intended for addressing disability. However, because obesity has increasingly become a cause of disability and decreased quality of life, the ICF has begun to be applied to other health conditions including obesity in the form of Core Sets (Stucki, Daansen, Fuessl, Cieza, Huber, Atkinson et al., 2004; Stucki et al., 2006). The ICF Core Sets for obesity provide a category listing of the typically encountered problems for obesity that includes an exploration of the interactions between genetic, metabolic, environmental, and personal aspects of an individual's life (Stucki, Daansen, Fuessl, Cieza, Huber, Atkinson et al., 2004; Stucki et al., 2006). The ICF includes a Brief ICF Core Set of the usual problems associated with obesity and the Comprehensive Core Set that provides a comprehensive listing of ICF categories needed for

multi-level assessment of the typical issues identified by obese individuals (Allan, Campbell, Guptill, Stephenson, & Campbell, 2006; Ustun, Chatterji, Bickenbach, Kostanjsek, & Schneider, 2003).

While the interactions of the aforementioned factors have been determined to play a role in the causal pathway for obesity, their degree and variability have not been determined. Additionally, the ICF has primarily been used in clinical settings at the individual level. The purpose of this study was to examine the applicability of the ICF in addressing obesity among women in order to determine the most important aspects for usage in developing prevention and treatment programs at the population level. This was accomplished by identifying how well the ICF Comprehensive Core Set for obesity predicted body mass index (BMI)[5] and assessed the variance of the ICF for BMI, the most common method of measuring obesity. The study includes data on U.S. women from the National Health and Nutrition Examination Survey (NHANES) conducted between 1999 and 2004. It is believed that the environmental component as well as education will be major predictors of BMI and have important roles in the variability of the ICF for BMI in U.S. women. These factors can have a major impact on obesity programs and interventions currently being implemented and those that will be designed to prevent and treat obesity in women.

[5] BMI is a calculation of body weight in kilograms divided by body height in meters squared.

5.3 METHODS

The International Classification of Functioning, Disability and Health (ICF)

The ICF conceptual framework (Figure 1) consists of 2 parts: 1) Functioning and Disability; and 2) Contextual Factors. Functioning and disability is comprised of 2 components: 1) Body Functions and Structures; and 2) Activities and Participation. Body Functions and Structures are the physiological functions of the body systems and the anatomical parts of the body. Activities are individual execution of tasks and participation is involvement in life situations. The Contextual Factors components include environmental and personal factors (ICF, 2001). The Environmental Factors include the physical, social, and attitudinal environment and Personal Factors are age, gender, education, work experience, and disease coping style (Allan et al., 2006; Perenboom & Chorus, 2003).

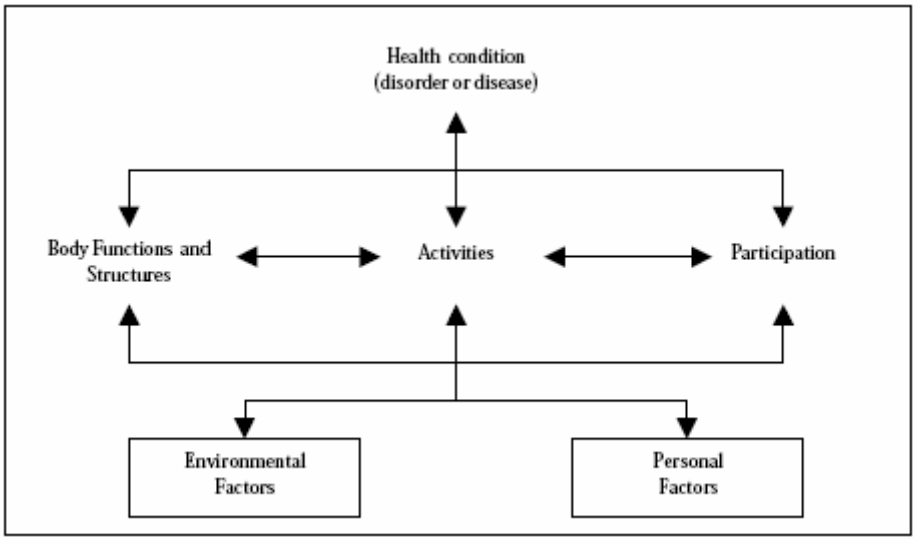

Figure 1. Illustration of interaction of components in the International Classification of Functioning, Disability and Health (ICF). (WHO, 2001)

The components of the ICF are comprised of various domains (Table 1), within which there are categories that are the units of classification. For the purposes of this study, the domains and components for each component were used as a guide to categorize the NHANES questions into 4 groups corresponding to the components according to the Comprehensive Core Sets for Obesity.

Table 1: The ICF Components and Domains

	Part 1: Functioning and Disability		**Part 2: Contextual Factors**	
Components	Body Functions and Structures	Activities and Participation	Environmental Factors	Personal Factors*
Domains	Body functions Body structures	Life areas (tasks, actions)	External influences on functioning and disability	Internal influences on functioning and disability

*Personal Factors are not coded within the ICF; (WHO, 2001)

The National Health and Nutrition Examination Survey (NHANES)

The NHANES is a stratified, national, multistage, probability sample of the civilian, noninstitutionalized U.S. population conducted by the National Center for Health Statistics. The NHANES is used to assess the health and nutritional status of U.S. adults and children. The NHANES is administered annually with interviews conducted at the participant's home and telephone and through physical examinations conducted at the medical examination center (MEC) by trained health professionals (CDC, 2005).

Study Population

Eligible participants consisted of U.S. adult women, aged 18 years and above who completed both the interview and physical examination component of NHANES 1999-2004 (N=8,307). Women who did not complete the MEC exam for the body measures component were excluded. The physical examinations were conducted by health professionals, and thus not self-reported. After excluding cases with missing data of the variables of interest including BMI, age, race, income, education, and smoking status, the final study sample for this study was 6,910 women (Table 2).

Table 2: Sociodemographic Characteristics of the Study Sample

Characteristic	Number (N=6,910)	Percentage
BMI Categories		
Underweight	130	1.9
Normal weight	2,152	31.1
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Born in 50 U.S. States or D.C.	5,402	78.2
Born in Mexico	858	12.4
Born Elsewhere	638	9.2
Missing	12	0.2
Had Pregnancies w/ live births		
Yes	5,162	74.7
No	260	3.8
Missing	1,488	21.5
Smoking 100 cigarettes in lifetime		
Yes	2,680	38.8
No	4,230	61.2
Coexisting health conditions		
Heart Disease		
Congestive Heart Failure	180	2.6
Coronary Heart Disease	200	2.9
Heart Attack	208	3.0
Angina Pectoris	230	3.3
Stroke	597	3.1
Hypertension	2,210	32.0
Cancer	597	8.6
Disability		
Arthritis	1,963	28.4
Asthma	898	13.0
Diabetes/Borderline Diabetes	734	10.6
How do you consider your weight		
Underweight	237	3.4
Right weight	2,416	35.0
Overweight	4,241	61.4

*****No 80-84 year olds are included.
[§]Including Multi-Racial.

Statistical Analyses

Analyses were conducted using Stata SE 9.2 statistical software (StataCorp LP, College Station, Texas). Multiple linear regression analyses were performed separately by each of the ICF components and potential confounders with log of BMI as the dependent variable. Log of BMI was obtained using a data transformation of BMI. The log of BMI, rather than BMI, was used to ensure a straight line adequately described the relationship between the dependent and independent variables. The NHANES measurements for BMI were obtained during the MEC exam. BMI was classified as underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), obese (≥ 30.0), and extremely obese (≥ 40.0).

Independent variables were the NHANES questions (NHANES, 2005; NHANES, 2006; NHANES, 2007) that were grouped with the ICF components using the Comprehensive ICF Core Sets for Obesity. Approximately 200 questions pertaining to Body Functions and Structures were based upon the physiological and psychological functions of the body systems, the anatomical parts of the body, and impairments that inhibits functioning of the body. Approximately 57 questions corresponding to Activities and Participation included the participants' difficulty in executing certain activities and issues being a part of life situations. Sixteen Environmental Factors questions involved the facilitating or hindering aspects of the participants' immediate environment. Personal Factors dealt with personal attributes such as sociodemographic characteristics. Potential confounders included age, race/ethnicity, income, education, parity, smoking status, and self-reported coexisting health conditions (diabetes, arthritis, heart disease, stroke, hypertension, and cancer).

Multiple linear regression was used to determine the extent that the Comprehensive ICF Core Sets for Obesity component variables independently contributed to the prediction of log of BMI. The t statistic obtained in multiple linear regression analysis was also used to determine the significance of the inclusion of the variable in the models. The results of the t statistic were considered significant at p=0.05.

5.4 RESULTS

Characteristics of the study sample are shown in Table 2. BMI was evenly distributed among the participants with the exception of women who were underweight (1.9%). There were equal proportions of younger women and a higher percentage of women ≥ 60 years of age. Half of the sample (50.3%) consisted of non-Hispanic White women with the remaining made up of Mexican American (22.3%) and non-Hispanic Black (19.1%) women. While income varied among the participants, most of the women in the sample had higher than a high school education (45.2%). About three-fourths of the participants were born in the U.S., and had pregnancies with live births. Most women reported not smoking at least 100 cigarettes (61.2%) and about one-third of the women had been diagnosed with hypertension. Other coexisting health conditions among the participants included disability-related diseases and conditions such as arthritis (28.4%), asthma (13.0%), and diabetes/borderline diabetes (10.6%). Sixty-one percent of the women considered themselves to be overweight and one-third (35.0%) perceived themselves to be the right weight.

Effect of Personal Factors

Age, income, and race status were significant in the regression model of log of BMI by Personal Factors variables. Multiple linear regression was performed on each variable as one categorical variable and as multiple variables. R^2 increased with the use of multiple variables for age, income, race, and smoking status. Table 3 displays the final model of log of BMI and the Personal Factors variables. When the sociodemographic variables were divided into multiple indictor variables—18 to 24 year olds, White, income levels of less than $5,000, $45,000 to $54,999, $55,000 to $64,999, $65,000 to $74,999, and ≥$75,000— the t statistics were significant. Because of their increased percentage of R^2, these variables were kept in the model. In addition, education and smoking status were not significant contributors to the model as determined by the t statistic. However, because of the importance of education and smoking as a component of predicting log of BMI, R^2 increasing with their inclusion in the model, and also as a result of them being potential confounders, they were retained in the final model (Table 3). The overall R^2 of the model indicates that 8% of the variance of the log of BMI can be explained by the influence of the Personal Factors, the core model.

Table 3: Log of BMI by Variables in the Personal Factors (Core Model)

Variable	t statistic
Age[§]	
18-24	0.95
25-29	3.64*
30-34	5.03*
35-39	4.89*
40-44	6.69*
45-49	7.56*
50-54	6.97*
55-59	7.51*
60-64	7.62*
65-69	6.38*
70-74	4.76*
75-79	3.27*
≥85	-0.58
Education	
< High School	1.64
High School (incl. GED)	1.46
> High School	1.24
Household Income	
$0 to $4,999	1.83
$5,000 to $9,999	2.60*
$10,000 to $14,999	3.67*
$15,000 to $19,999	2.08*
$20,000 to $24,999	4.29*
$25,000 to $34,999	2.54*
$35,000 to $44,999	3.61*
$45,000 to $54,999	1.13
$55,000 to $64,999	1.40
$65,000 to $74,999	0.91
> $75,000	-1.04
Race/Ethnicity	
Non-Hispanic White	0.91*
Non-Hispanic Black	9.76*
Mexican American	4.15*
Smoking	-1.34
Overall R^2	8.11%

*p<0.05

Effect of Body Functions and Structures with the Personal Factors

The most significant contributors of the Body Functions and Structures component to the Personal Factors are shown in Table 4. The question, "Do you consider your weight to be overweight, underweight, or about the right weight?" accounted for the most variance of the log of BMI. Multiple linear regression was performed on this question as a categorical variable and multiple indicator variables. As one question, how the participants considered their weight explained 40.68% of the variance in the model. As indicator variables for participants who reported considering their weight as underweight, the right weight, and overweight, the variable accounted for 14.82%, 29.20%, and 30.73% of the variance in the model, respectively.

Of the coexisting health conditions, heart and disability diseases and conditions as well as hypertension accounted for similar proportions of the variance in the model of log of BMI and the Personal Factors. Participants diagnosed with diabetes or borderline diabetes (10.04%) and hypertension (11.96%) contributed to the highest amount of variance in the model. Additionally, the participants' physical functioning also accounted for some of the variance in the model. Joint pain, aching, and stiffness as well as low back pain comprised 9.92% and 9.33% of the variance in the model, respectively.

Table 4: Log of BMI by Variables in the Personal Factors and Body Functions and Structures

Variable	R^2 Contribution(%)
How do you consider your weight?	40.68*
Underweight	14.82*
Right weight	29.20*
Overweight	38.73*
Coexisting health conditions	
Angina/Angina Pectoris	8.28*
Arthritis	9.16*
Asthma	8.68*
Diabetes/Borderline	10.04*
Congestive heart failure	8.36*
Coronary heart disease	8.15*
Heart attack	8.19*
Hypertension	11.96*
General condition of hearing	8.31*
Ears ringing, roaring, buzzing in past year	8.21*
Joint pain/aching/stiffness in Past year	9.92*
Low back pain	9.33*

*$p<0.05$

Effect of Activities and Participation with the Personal Factors

Significant contributors of the Activities and Participation component with the Personal Factors and log of BMI included performance of physical activity, diet, access to healthcare, and ability to function physically variables. All variables shown in Table 5 were significant contributors to the model as determined t statistics. Physical activity variables accounted for some of the highest proportions of the variance in the model of Activities and Participation and Personal Factors. Performing muscle strengthening activities, vigorous activity over past 30 days, and the average level of physical activity performed each day influenced 9.75%, 9.14%, and 9.09% of the variance, respectively. Participants performing moderate activity (8.66%), walking or bicycling in the past 30 days (8.65%), and an activity comparison of the previous month to the previous year (8.34%) showed smaller increases in variance.

Access to healthcare variables were also significant contributors to the model and increased the variance in the relationship between log of BMI, the Personal Factors, and Activities and Participation component. Having a routine place to acquire healthcare and the number of times the participant received healthcare over the past year accounted for 8.35% and 8.31% of the variance of the model. In addition, variables regarding ability to participate in their environments were significant in the model of log of BMI, Personal Factors, and Activities and Participation component. These variables included the participants requiring special healthcare equipment and having a dry cough at night, which contributed to the variance in the model by 9.05% and 8.25%. Dietary health behaviors also significantly contributed to the model with the number of times the participant ate restaurant food influencing 8.16% of the variance in the model.

Table 5: Log of BMI by Variables in the Personal Factors and Activity and Participation

Source	R^2 Contribution (%)
Average level of physical activity each day	9.09*
Vigorous activity over past 30 days	9.14*
Moderate activity over past 30 days	8.66*
Muscle strengthening activities	9.75*
Activity comparison last month—last year	8.34*
Walked or bicycled over past 30 days	8.65*
Require special healthcare equipment	9.06*
Had dry cough at night in past year	8.25*
# of times a week eat restaurant food	8.16*
Routine place to go for healthcare	8.35*
# of times received healthcare over past year	8.31*

*$p<0.05$

5.5 DISCUSSION

Research has indicated the complexity of obesity citing numerous factors contributing to its onset and prevalence including behavioral, personal, psychological, sociodemographic, environmental, biological, and childbearing (Adams-Campbell et al., 2000; Addy et al., 2004; Felton et al., 2002; Gordon-Larsen et al., 2006; Winkleby et al., 1998). This study presents results assessing the significance of certain factors in predicting the log of BMI and the amount of variance that can be explained by the influence of certain factors on the log of BMI. In the study, these factors are represented in three of the ICF's four components—Personal Factors, Body Functions and Structures, and Activities and Participation.

The study hypothesized education and the Environmental Factors would be important in the prediction of the log of BMI and the contribution to the variance of the model. However, the amount of variables used in the Personal Factors was restricted by limitations in acquiring social and cultural values. Nevertheless, potential confounders cited in the literature—age, race, education, income, parity, smoking status, and coexisting health conditions—were able to be determined from the NHANES and were used in the models.

Also, there were few environmental variables in the NHANES that met the ICF's guidelines. Those environmental variables that did meet the ICF guidelines did not have enough responses to be analyzed so were not included in the models. However, variables were available in the NHANES corresponding to the Body Functions and Structures and Activities and Participation component. This is primarily due to these two factors fitting more prevalently with the overall objective of the NHANES, which is to describe the overall health and functioning of the U.S. population. As a result, more information was available for these two factors and

accounts for most of the analyses as they relate with the core model containing the log of BMI and the Personal Factors.

The Body Functions and Structures and the Activities and Participation components were major components of the NHANES for the years 1999 to 2004. Body Functions and Structures contained many variables related to psychological issues, coexisting health conditions, and physical functioning. Of the psychological issues, perceptions of body weight were a major contributor. With the addition of body weight perceptions—how the participants viewed their weight—to the core model of the log of BMI and the Personal Factors, R^2 increased from about 8% to approximately 40%. This effect decreased slightly when the categorical variable was divided into 3 indicator variable although R^2 remained significantly higher. This finding corresponds with research that suggests self-perception of body weight may influence obesity among women. Social and cultural influences have been determined to be contributing factors to body weight and image perceptions (Cachelin, Rebeck, Chung, & Pelayo, 2002; Paeratakul, White, Williamson, Ryan, & Bray, 2002). Though they could not be analyzed in this study, an adjustment was made for numerous variables that influence body weight perceptions including race, age, income, and education. This demonstrates the importance of body image perceptions and its relation to the prediction of the log of BMI.

In addition to body weight perceptions, coexisting health conditions were also important in predicting the log of BMI and contributing to the variance in the relationship between the log of BMI and the Personal Factors. Hypertension, diabetes and borderline diabetes, cardiovascular diseases, arthritis, and asthma increased the variance in the core model, albeit slightly. However, this study in addition to other research shows these conditions are significantly associated with BMI and obesity in women (Hootman & Helmick, 2006; Hu, 2003). The relationship was still

significant even after the adjustment of potential confounding variables in the Personal Factors was made; thus suggesting an important relationship with BMI.

Also significant in the Body Functions and Structures component was variables regarding physical functioning. Important physical functioning variables included the condition of the ears, stomach, hip, joints, and lower back. These variables are considered as one of the most important components in managing obesity because of their strong relationship with disability (Pi-Sunyer & Kris-Etherton, 2005; Stucki et al., 2006; Stucki et al., 2004). Problems with physical functioning affect quality of life and the ability to engage in healthy behaviors to prevent and control obesity such as physical activity (Zahran, Kobau, Moriarty, Zack, Holt, & Donehoo, 2005).

Physical functioning variables were also included in the Activities and Participation component, which impact the ability of the women to participate in their lives and environments. Requiring special healthcare equipment was significant in the model and increased the variance of the model. Needing healthcare equipment may interfere with performing physical activity, thus impacting BMI. An additional variable, having a dry cough, focused on the ability of the women to physically function and participate in their environment. Coughing can be symptomatic or an effect of a chronic health condition. Chronic health conditions in U.S. women account for a considerable portion of disability by causing activity limitations (Hootman & Helmick, 2006; Zahran et al., 2005).

Consistent with the literature, engaging in physical activity was important in predicting BMI in women. The combination of physical activity and proper diet is essential to prevention and control of obesity (Kruger, Yore, & Kohl, 2007; Orzano & Scott, 2004). All types of physical activity including moderate, vigorous, walking or riding a bicycle, and muscle

strengthening activities were significant contributors to the model. In addition, the number of times the women ate at a restaurant was a significant contributor to the model. While it was unknown the types of restaurant that were frequented (e.g., fast food) by the women, research has shown a relationship between the availability of and accessibility to fast food restaurants and increased food portion sizes and obesity (Popkin, Duffey, & Gordon-Larsen, 2005). More information in the NHANES regarding restaurant types may provide a better understanding of the relationship between eating at restaurants and obesity in women.

Based upon the results of this study as well as the literature regarding obesity, the question remains as to the applicability of the ICF conceptual framework to addressing obesity in women. However, the study was able to demonstrate the influence of many factors cited in the literature and research as contributing to BMI and obesity at the population level involving U.S. women. As this study utilized data from a commonly used source for assessing obesity and related health conditions, the NHANES, it is a first step in beginning to understand the impact of behavioral, personal, psychological, sociodemographic, environmental, biological, and childbearing factors play in the incidence and prevalence of obesity in women.

In addition, this study has shown the need for more comprehensive surveys that include variables related to environmental and personal factors given the dearth of information and citations of their importance as well as the results which demonstrate their importance. It should be noted that previous years of the NHANES, 1999-2001, collected data on occupation, food security, and social support, which have all been associated with obesity in women. However, this was discontinued in the 2002 and 2003 surveys. As such, these variables could not be used in analyses of the study presented here. Consequently, more research and data are needed to explore the relationship between BMI in women and the multiple influencing factors by going

beyond the more frequently available information of age, gender, race, education, income, and parity.

In conclusion, obesity in women is a complex issue with many underlying factors believed to play a role in its onset and progression in the U.S., and particularly among women. While the World Health Organization has developed the ICF to reflect the complexity of obesity, more population-level studies are needed to test its use beyond the individual level for which it has primarily been utilized. However, the ICF is a good first step in looking at new ways to deal with multi-level problems in the U.S. such as obesity to which research and available data should follow suit.

Given the contribution of the Body Functions and Structures component to the core model, the next chapter will focus specifically on this factor and its relationship to BMI. Analyses will explore the effect of age, income, and race to the relationship between the Body Functions and Structures and Personal Factors and the log of BMI.

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6.0 MANUSCRIPT TWO: USE OF THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF) TO UNDERSTAND OBESITY AMONG U.S. WOMEN

Manuscript in Preparation

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6.1 ABSTRACT

Background: Over the past two decades, obesity among women has significantly increased, with women having the highest prevalence in the U.S. Obesity prevention programs and interventions focusing on women have traditionally included individual-level approaches although obesity is a multi-level problem. The research literature has cited numerous factors in obesity—behavioral, personal, psychological, sociodemographic, environmental, biological, and childbearing. As a result, recent public health efforts have shifted away from individual approaches to those that handle multiple factors.

Methods: Body weight perceptions, coexisting health conditions, and physical functioning have been found to be signification contributors to the prediction of body mass index (BMI) in women. This study seeks to explore the effects of age, income, and race on these factors in relationship to BMI in U.S. women using the International Classification of Functioning, Disability and Health (ICF) Core Sets for Obesity, developed by the World Health Organization and data from the National Health and Nutrition Examination Survey (NHANES). Linear regression was used in the analyses.

Results: The income level ≥$75,000 and Black were significant contributors to the relationship between BMI, body weight perceptions, coexisting health conditions, and physical functioning.

Conclusions: Obesity prevention and treatment programs for U.S. women should focus on the most significant factors identified in these studies to decrease obesity incidence and prevalence.

Public Health Relevance: The information garnered from this study can be used to further identify the most important characteristics needed for future obesity programs with women.

6.2 INTRODUCTION

Obesity is a significant problem among women in the U.S. Although there has not been an increase in obese women in recent years (Odgen, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006), women continue to have the highest prevalence of obesity and extreme obesity. This is especially true for minority women. African American and Mexican American women have higher prevalence of obesity than non-Hispanic white women (Flegal, Carroll, Ogden & Johnson, 2002; Ogden et al., 2006), with African American women having the highest prevalence amongst all U.S. women (Patt, Yanek, Moy, & Becker, 2004).

Obesity in women is a multi-level problem with numerous attributing causes and effects (Stunkard, 1996). Behavioral factors, physical inactivity and poor nutritional practices, are believed to be the root cause of the obesity problem among women in the U.S. and as a result account for the majority of obesity prevention and treatment programs (Alfano, Klesges, Murray, Beech, & McClanahan, 2002; Jakicic, Wing, & Winters-Hart, 2002; Kumanyika, 2001; Visscher & Seidell, 2001). However, studies have documented many other underlying factors of obesity. Causal factors include psychological, personal, sociodemographic, biological, environmental, and childbearing that impact engaging in physical activity and good nutritional practices (Adams-Campbell, Rosenberg, Washburn, Rao, Kim, & Palmer, 2000; Addy, Wilson, Kirtland, Ainsworth, Sharpe, & Kimsey, 2004; Felton, Boyd, Bartoces, & Tavakoli, 2002; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Winkleby, Kraemer, Ahn, & Varady, 1998). In addition, other factors such as coexisting health conditions have been associated with obesity. They include diabetes, metabolic syndrome (insulin resistance, hypertension, and dyslipidemia), cardiovascular risks, certain cancers, and disabilities or decreased quality of life and functioning

(Atkinson et al., 2004; Garber, 2004, Hu, 2003; Polednak, 2003; Stucki, Dansen, Fuessl, Cieza, Huber).

As a result of the multiple-level complexity and the relationship of obesity to disabilities, the World Health Organization has applied the International Classification of Functioning, Disability and Health (ICF) to address obesity. The ICF is a globally agreed upon conceptual framework and classification system to define, assess, and measure the continuum of symptoms and problems in functions of those with disabilities. The ICF explores interactions between the documented underlying factors of obesity using the following components: 1) Personal Factors; 2) Activities and Participation; 3) Body Functions and Structures; and 4) Environmental Factors (Stucki et al., 2004; Stucki, Borchers, Stucki, Cieza, Amann, & Ruof, 2006).

In a previous study, the researcher examined the role the ICF components play in predicting BMI[6], or body mass index, in women was examined by exploring the degree and variability of their relationship to obesity. Results indicated the Body Functions and Structures component in conjunction with the Personal Factors accounted for a significant portion of the variance in obesity among women. Important contributors of the Body Functions and Structures component to the variance consisted of psychological issues including body weight perceptions, coexisting health conditions (e.g., asthma, arthritis, diabetes, heart disease, hypertension), and physical functioning (e.g., joint and lower back pain and condition of the ear). Personal Factors indicators included age, income, education, race, and smoking status.

Psychological and sociodemographical effects including discrimination, lower education and income, depression, and binge eating have all been reported as affecting obesity in women. Although these effects as well as coexisting health conditions and physical functioning are

[6] BMI is a commonly used method of measuring obesity. It is a calculation of body weight in kilograms divided by body height in meters squared.

associated with obesity, the linkage between them and obesity in women is less clear (Drewnowski & Darmon, 2005; Khaodhiar, McCowen, & Blackburn, 1999; Latner, Stunkard, & Wilson, 2005). The purpose of this study was to explore the relationship of the Body Functions and Structures component and the Personal Factors in predicting obesity in women using data from the National Health and Nutrition Examination Survey (NHANES) from years 1999 to 2004. Focus was placed on the contribution of the sociodemographic factors of age, income, and race, which were previously found to be significant contributors to the prediction of obesity in women (Tyler, 2007). It was believed that income would have an important role in the relationship between the Body Functions and Structures component, the Personal Factors and obesity among U.S. women. Understanding the significance of the causal factors of obesity in women is critical first step in developing obesity prevention and treatment programs.

6.3 METHODS

The International Classification of Functioning, Disability and Health (ICF)

The ICF conceptual framework (Figure 1) consists of 2 parts: 1) Functioning and Disability; and 2) Contextual Factors. Functioning and Disability is comprised of 2 components: 1) Body Functions and Structures; and 2) Activities and Participation. Body Functions and Structures are the physiological functions of the body systems and the anatomical parts of the body. Activities are individual execution of tasks and participation is involvement in life situations. The Contextual Factors components include Environmental and Personal Factors (ICF, 2001). The Environmental Factors include the physical, social, and attitudinal environment and personal

factors are age, gender, education, work experience, and disease coping style (Allan et al., 2006; Perenboom & Chorus, 2003).

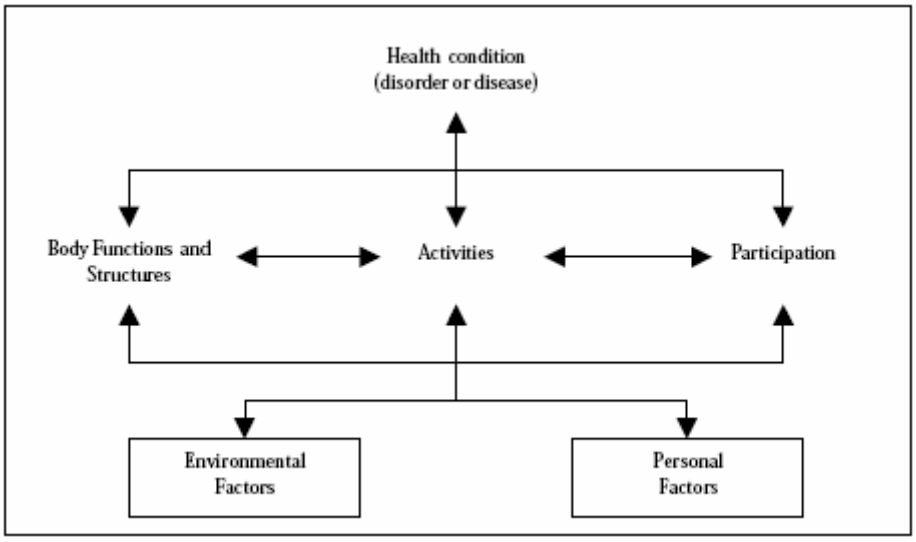

Figure 1. Illustration of the interaction of components in the International Classification of Functioning, Disability and Health (ICF). (WHO, 2001)

The components of the ICF are comprised of various domains, within which there are categories that are the units of classification (Table 1). For the purposes of this study, the domains and components for the body functions and structures component was used as a guide to categorize the NHANES questions into a group corresponding with the component according to the Comprehensive Core Sets for Obesity.

Table 1: The ICF Components and Domains

	Part 1: Functioning and Disability		Part 2: Contextual Factors	
Components	Body Functions and Structures	Activities and Participation	Environmental Factors	Personal Factors*
Domains	Body functions Body structures	Life areas (tasks, actions)	External influences on functioning and disability	Internal influences on functioning and disability

*Personal Factors are not coded within the ICF; (WHO, 2001)

The National Health and Nutrition Examination Survey (NHANES)

The NHANES is a stratified, national, multistage, probability sample of the civilian, noninstitutionalized U.S. population conducted by the National Center for Health Statistics. The NHANES is used to assess the health and nutritional status of U.S. adults and children. The NHANES is administered annually with interviews conducted at the participant's home and telephone and through physical examinations by trained health professionals (CDC, 2005).

Study Population

Eligible participants consisted of U.S. adult women, aged 18 years and above who completed both the interview and physical examination component of NHANES (N=8,307). Women who did not complete the mobile examination center (MEC) exam for the body measures component were excluded. After excluding cases with missing data of the variables of interest including BMI, age, race, income, and education, the final study sample was 6,910 women (Table 2).

Table 2: Sociodemographic Characteristics of the Study Sample

Characteristic	Number (N=6,910)	Percentage
BMI Categories		
Underweight	130	1.9
Normal weight	2,152	31.1
Overweight	2,151	31.1
Obese	2,447	35.8
BMI Classes		
Not obese	4,433	64.2
Class I	1,340	19.4
Class II	664	9.6
Class III	473	6.8
Age, y		
20-29	1,414	18.4
30-39	1,261	16.5
40-49	1,119	16.2
50-59	844	12.2
≥60*	2,269	32.8
Race/Ethnicity		
Non-Hispanic White	3,472	50.3
Non-Hispanic Black	1,319	19.1
Mexican American	1,538	22.3
Other Hispanic	322	4.7
Other Race§	259	3.7
Household Income		
$0 to $4,999	323	4.7
$5,000 to $9,999	584	8.5
$10,000 to $14,999	790	11.4
$15,000 to $19,999	590	8.5
$20,000 to $24,999	650	9.4
$25,000 to $34,999	823	11.9
$35,000 to $44,999	607	8.8
$45,000 to $54,999	513	7.4
$55,000 to $64,999	356	5.2
$65,000 to $74,999	284	4.1
> $75,000	1,010	14.6
Education		
<High School	2,112	30.5
High School including GED	1,662	24.1
>High School	3,125	45.2

Table 2 Continued

Country of Birth		
Born in 50 U.S. States or D.C.	5,402	78.2
Born in Mexico	858	12.4
Born Elsewhere	638	9.2
Missing	12	0.2
Had Pregnancies w/ live births		
Yes	5,162	74.7
No	260	3.8
Missing	1,488	21.5
Smoking 100 cigarettes in lifetime		
Yes	2,680	38.8
No	4,230	61.2
Coexisting health conditions		
Heart Disease		
Congestive Heart Failure	180	2.6
Coronary Heart Disease	200	2.9
Heart Attack	208	3.0
Angina Pectoris	230	3.3
Stroke	597	3.1
Hypertension	2,210	32.0
Cancer	597	8.6
Disability		
Arthritis	1,963	28.4
Asthma	898	13.0
Diabetes/Borderline Diabetes	734	10.6
How do you consider your weight		
Underweight	237	3.4
Right weight	2,416	35.0
Overweight	4,241	61.4

*****No 80-84 year olds are included.
[§]Including Multi-Racial.

Statistical Analyses

Analyses of the data were accomplished using Stata SE 9.2 statistical software (StataCorp LP, College Station, Texas). Multiple linear regression analyses were performed separately by the independent variables and potential confounders with log of BMI as the dependent variable. The log of BMI was obtained using a data transformation of BMI. Log of BMI, rather than BMI, was used to ensure a straight line adequately described the relationship between the dependent and independent variables. The NHANES measurements for BMI were obtained in the MEC exam. BMI was classified as underweight (< 18.5), normal weight (18.5-24.9), overweight (25.0-29.9), obese (≥ 30.0), and extremely obese (≥ 40.0).

Independent variables consisted of the sociodemographic variables—age, income, and race—that have been found to be significant in obesity among women. Age, income, and race were used in the current study's analyses as indicator variables. Additional independent variables were developed from the following NHANES questions: 1) How do you consider your weight; 2) Have you ever been diagnosed with angina, arthritis, asthma, diabetes and borderline diabetes, congestive heart failure, coronary heart disease, heart attack, or hypertension; 3) What is the general condition of your hearing; 4) Have you experienced ears ringing, roaring, or buzzing in the past year; 5) Have you experienced joint pain, aching, or stiffness in the past year; and 6) Have you experienced lower back pain during the last three months.

The NHANES questions (NHANES, 2005, 2006, 2007) were grouped with the ICF components using the Comprehensive ICF Core Sets for Obesity. The 200 questions in the Body Functions and Structures component were based upon the physiological and psychological functions of the body systems, the anatomical parts of the body, and impairments that inhibits

functioning of the body. Questions in the Personal Factors dealt with personal attributes such as sociodemographic aspects. Potential confounders included age, race, ethnicity, income, education, parity, smoking status, and self-reported coexisting health conditions (diabetes, arthritis, heart disease, stroke, hypertension, and cancer).

Multiple linear regression was used to determine how the Body Functions and Structure and Personal component variables independently contributed to the prediction of log of BMI. The t statistic obtained in multiple linear regression analysis was also used to determine the significance of the inclusion of the variable in the models. The results of the t statistic were considered significant at the 0.05 level.

Terms for the interactions between potential confounders and the independent variables were also included in the model to assess whether these relationships affected subgroups of the women differently. The value R^2 was used to determine the amount of variation in log of BMI that was explained by the regression model. A value between 0 and 1, with 1 being a perfect model was used to indicate how well the variables predicted log of BMI.

6.4 RESULTS

Table 2 displays the characteristics of the study sample. BMI was evenly distributed among the participants with the exception of women who were underweight (1.9%). There were equal proportions of younger women and a higher percentage of women ≥ 60 years of age. Approximately, half of the sample (50.3%) consisted of non-Hispanic White women with the remaining made up of non-Hispanic Black (19.1%) and Mexican American (22.3%) women. While income varied among the participants, most of the women in the sample had higher than a

high school education (45.2%). About three-fourths of the participants were born in the U.S., and had pregnancies with live births. Most women reported not smoking at least 100 cigarettes (61.2%) and about one-third had been diagnosed with hypertension. Other coexisting health conditions among the participants included disability-related diseases and conditions such as arthritis (28.4%), asthma (13.0%), and diabetes/borderline diabetes (10.6%). About three-fifths (61.4%) of the women considered themselves to be overweight and one-third (35.0%) perceived themselves to be the right weight.

Effect of the Core Model and Body Weight Perceptions

In the regression analyses, all values of age, income, and race were not significant. Consequently, only those variables that were statistically significant are shown in Table 3. Body weight perceptions accounted for a considerable portion of the variance (40.68%) in the relationship between log of BMI, the Personal Factors, and the Body Functions and Structures component. Body weight perceptions were analyzed as one variable and divided into 3 indicator variables. As one variable, age and Black women made up a significant proportion of the variance in the model. In the model consisting of the body weight perceptions indicators, women who considered themselves underweight (14.82%), having an annual family income of ≥$75,000 and being Black accounted for the highest portion of the variance in the model. Among women who perceived themselves as the right weight (29.20%), there was equal variance the variables of age, income, and race shown in the table. For women who perceived themselves as overweight, those who were members of the younger (18-24) and older (55-59 and 65-69) age groups, lower and higher income levels, and being White or Black consisted of higher proportions of the variance in the model.

Table 3: Log of BMI by the Core Model and Body Weight Perceptions

Variable	R^2 Contribution (%)
How do you consider your weight?	40.68*
Age	
18-24	40.49*
45-49	40.36*
55-59	40.36*
65-69	40.35*
Income	
$5,000-$9,999	39.87*
$10,000-$14,999	39.91*
$20,000-$24,999	39.87*
$35,000-$44,999	39.85*
$45,000-$54,999	39.94*
Race	
White	39.44*
Black	40.48*
Underweight	14.82*
Age	
18-24	13.30*
25-29	12.63*
40-44	12.65*
45-49	12.80*
50-54	12.69*
55-59	12.76*
60-64	12.78*
65-69	12.62*
≥85	12.80*
Income	
$10,000-$14,999	13.95*
$20,000-$24,999	13.98*
$35,000-$44,999	13.93*
≥$75,000	14.37*
Race	
White	13.26*
Black	14.44*

Table 3 Continued

Right weight	29.20*
Age	
18-24	28.66*
45-49	28.44*
55-59	28.47*
60-64	28.46*
65-69	28.46*
≥85	28.47*
Income	
$5,000-$9,999	28.52*
$10,000-$14,999	28.54*
$20,000-$24,999	28.58*
$35,000-$44,999	28.54*
$45,000-$54,999	28.56*
≥$75,000	28.79*
Race	
White	28.03*
Black	28.98*
Overweight	38.73*
Age	
18-24	38.49*
55-59	38.36*
65-69	38.37*
Income	
$5,000-$9,999	37.99*
$10,000-$14,999	38.01*
$20,000-$24,999	38.00*
$35,000-$44,999	37.97*
$45,000-$54,999	38.05*
≥$75,000	38.26*
Race	
White	37.54*
Black	38.54*

*$p<0.05$

Effect of the Core Model and Coexisting Health Conditions

The relationship between the log of BMI, the core model, and coexisting health conditions are shown in Table 4. Income and race were the most significant contributors to the models including angina/angina pectoris (8.28%), arthritis (9.16%), asthma (8.68%), congestive heart failure (8.36%), coronary heart disease (8.15%), diabetes/borderline diabetes (10.04%), heart attack (8.19%), and hypertension (11.96%). In the models, having an annual family income ≥$75,000 and being Black accounted for most of the variance in the model. In the angina/angina pectoris, income level ≥$75,000 and Black accounted for 7.83% and 7.93%, respectively. In the model including arthritis, the income level ≥$75,000 (8.71%) and Black (8.71%) consisted of a major portion of the variance. The income level ≥$75,000 and Black accounted for 8.23% and 8.24% in the model containing asthma. In the congestive heart failure model, the income level ≥$75,000 and Black made up 7.92% and 7.99% of the variance in the model. In the model including coronary heart disease, the income level ≥$75,000 and Black consisted of 7.70% and 7.79% of the variance in the model. The income level ≥$75,000 and Black accounted for 9.67% and 9.73% of the variance in the model containing diabetes/borderline diabetes. In the model with heart attack, the income level ≥$75,000 and Black accounted for 7.75% and 7.83%, respectively. The income level ≥$75,000 and Black accounted for 11.59% and 11.53% of the variance in the model including hypertension.

Table 4: Log of BMI by the Core Model and Coexisting Health Conditions

Coexisting Health Conditions	R^2 Contribution (%)
Angina/Angina Pectoris	8.28*
Age	
18-24	6.21*
25-29	5.52*
40-44	5.56*
45-49	5.68*
50-54	5.58*
55-59	5.67*
60-64	5.71*
65-69	5.51*
≥85	5.86*
Income	
$10,000-$14,999	7.44*
$20,000-$24,999	7.57*
$35,000-$44,999	7.49*
≥$75,000	7.83*
Race	
White	6.80*
Black	7.93*
Arthritis	9.16*
Age	
18-24	6.91*
40-44	6.54*
45-49	6.66*
50-54	6.51*
55-59	6.57*
60-64	6.54*
70-74	6.47*
≥85	6.93*
Income	
$10,000-$14,999	8.37*
$20,000-$24,999	8.50*
$35,000-$44,999	8.43*
≥$75,000	8.71*
Race	
White	7.79*
Black	8.71*

Table 4 Continued

Asthma	8.68*
Age	
18-24	6.70*
25-29	5.96*
40-44	5.96*
45-49	6.11*
50-54	6.00*
55-59	6.11*
60-64	6.12*
65-69	5.96*
≥85	6.25*
Income	
$10,000-$14,999	7.88*
$20,000-$24,999	7.99*
$35,000-$44,999	7.94*
≥$75,000	8.23*
Race	
White	7.25*
Black	8.24*
Congestive heart failure	8.36*
Age	
18-24	6.21*
25-29	5.50*
40-44	5.53*
45-49	5.67*
50-54	5.57*
55-59	5.65*
60-64	5.69*
65-69	5.51*
≥85	5.89*
Income	
$10,000-$14,999	7.53*
$20,000-$24,999	7.64*
$35,000-$44,999	7.56*
≥$75,000	7.92*
Race	
White	6.88*
Black	7.99*

Table 4 Continued

Coronary heart disease	8.15*
Age	
18-24	6.14*
25-29	5.41*
40-44	5.43*
45-49	5.58*
50-54	5.48*
55-59	5.55*
60-64	5.59*
65-69	5.42*
≥85	5.75*
Income	
$10,000-$14,999	7.32*
$20,000-$24,999	7.43*
$35,000-$44,999	7.35*
≥$75,000	7.70*
Race	
White	6.66*
Black	7.79*
Diabetes/Borderline	10.04*
Age	
18-24	8.10*
40-44	7.70*
45-49	7.79*
50-54	7.66*
55-59	7.74*
60-64	7.72*
75-79	7.60*
≥85	7.99*
Income	
$10,000-$14,999	9.31*
$20,000-$24,999	9.43*
$35,000-$44,999	9.38*
≥$75,000	9.67*
Race	
White	8.65*
Black	9.73*

Table 4 Continued

Heart attack	8.19*
Age	
18-24	6.11*
25-29	5.40*
40-44	5.42*
45-49	5.57*
50-54	5.46*
55-59	5.56*
60-64	5.58*
65-69	5.41*
≥85	5.75*
Income	
$10,000-$14,999	7.36*
$35,000-$44,999	7.40*
≥$75,000	7.75*
Race	
White	6.74*
Black	7.83*
Hypertension	11.96*
Age	
18-24	9.38*
40-44	9.28*
45-49	9.36*
50-54	9.18*
55-59	9.23*
60-64	9.18*
75-79	9.21*
≥85	9.71*
Income	
$10,000-$14,999	11.28*
$20,000-$24,999	11.40*
$35,000-$44,999	11.34*
≥$75,000	11.59*
Race	
White	10.98*
Black	11.53*

*p<0.05

Effect of the Core Model and Physical Functioning

The relationship between log of BMI, the Personal Factors, and the physical functioning variables of the Body Functions and Structures component are shown in Table 5. In the models of all the physical functioning variables, the income level of ≥$75,000 and being Black accounted for a significant portion of the variance in the models. In the model including the general condition of the participant's hearing, the income level ≥$75,000 and Black accounted for approximately 7.85% and 7.93% of the variance in the models. For the model including those participants who reported their ears ringing, buzzing, or roaring in the past year, the income level ≥$75,000 and Black consisted of 7.77% and 7.85% of the variance in the model. The income level ≥$75,000 and Black made up 9.49% and 9.47% of the variance in the model including participants who experienced joint pain/aching/stiffness in the past year. In the model containing participants who reported low back pain, the income level ≥$75,000 and Black accounted for 8.92% and 8.97% of the variance in the model.

Table 5: Log of BMI by the Core Model and Physical Functioning

Physical Functioning	R^2 Contribution (%)
General condition of hearing	8.31*
Age	
18-24	6.17*
25-29	5.47*
40-44	5.50*
45-49	5.63*
50-54	5.53*
55-59	5.63*
60-64	5.64*
65-69	5.49*
≥85	5.85*
Income	
$10,000-$14,999	7.48*
$20,000-$24,999	7.58*
$35,000-$44,999	7.52*
≥$75,000	7.85*
Race	
White	6.81*
Black	7.93*
Ears ringing, roaring, buzzing in past year	8.21*
Age	
18-24	6.23*
25-29	5.51*
40-44	5.53*
45-49	5.67*
50-54	5.56*
55-59	5.66*
60-64	5.68*
65-69	5.52*
≥85	5.81*
Income	
$10,000-$14,999	7.39*
$20,000-$24,999	7.50*
$35,000-$44,999	7.44*
≥$75,000	7.77*
Race	
White	6.73*
Black	7.85*

Table 5 Continued

Joint pain/aching/stiffness in past year	9.92*
Age	
18-24	8.10*
40-44	7.73*
45-49	7.83*
50-54	7.70*
55-59	7.75*
60-64	7.77*
65-69	7.68*
≥85	8.10*
Income	
$10,000-$14,999	9.13*
$20,000-$24,999	9.25*
$35,000-$44,999	9.20*
≥$75,000	9.49*
Race	
White	8.52*
Black	9.47*
Low back pain	9.33*
Age	
18-24	7.31*
25-29	6.57*
40-44	6.57*
45-49	6.71*
50-54	6.61*
55-59	6.70*
60-64	6.73*
65-69	6.59*
≥85	6.87*
Income	
$10,000-$14,999	8.57*
$20,000-$24,999	8.69*
$35,000-$44,999	8.63*
≥$75,000	8.92*
Race	
White	7.86*
Black	8.97*

*$p<0.05$

6.5 DISCUSSION

Previous studies conducted with women have demonstrated an association between body image and weight perceptions as well as coexisting health conditions and physical functioning and their link to obesity (Adams-Campbell, Rosenberg, Washburn, Roa, Kim et al., 2000; Winkleby, Kraemer, Ahn, & Varady, 1998). The study reported here aimed to link all three contributing factors to the prediction of the log of BMI in women and to explore the contribution of age, income, and race to obesity using the Comprehensive International Classification of Functioning, Disability and Health (ICF) Core Sets for Obesity and data from the NHANES 1999-2004. Body weight perceptions, coexisting health conditions, and physical functioning were a part of the Body Functions and Structures component of the ICF, which was the most significant component in the relationship to log of BMI (Tyler, 2007).

Psychological factors, including body weight and image perceptions, have been thought to have an impact on obesity among women although whether there are age, race, or class differences has been unclear (Cachelin, Rebeck, Chung & Pelayo, 2002; Caldwell, Brownell, & Wilfley, 1997). In this study, for analyses using body image as a single variable, age and race were the most significant contributors to the relationship with log of BMI. However, when body image was divided into 3 indicator variables of those who considered themselves underweight, the right weight, and overweight, age, income, and race evenly contributed to the variance in the model. This suggests that body image perceptions are important among all women regardless of differences by age, income, and race as has been previously thought. Additionally, although it is believed that body weight perceptions are influenced by social and cultural norms (Charles, Britt, & Knox, 2006) the affect of social and cultural values placed upon the women's perceptions of their weight and body image could not be determined in this study.

Perceptions of the being the right weight and overweight accounted for higher proportions of the variance in the models. Thirty-five percent of the women considered themselves to be the right weight and 61% thought they were overweight. Based solely upon BMI, approximately 31% of the women were classified as normal weight and 67% were either overweight or obese. As the proportions are fairly equal, the women had accurate perceptions of their weight. This is contrary to studies which have shown approximately 30% of people clinically misclassify their weight (Charles, Britt, & Knox, 2006). However, in the NHANES 1999-2004, the participants were asked to provide an overall perception of their weight by considering themselves as being underweight, the right weight, or overweight, rather than provide what they perceived their BMI to be. This demonstrates that although women may not have exact knowledge of their BMI, they do have an understanding of their weight status. That is, whether they perceive themselves as being underweight, normal weight, or overweight.

In this study, how women perceived their weight was directly proportional to their BMI. This is different from some theories of body image which suggests subjective perceptions of body weight have little relationship to the objective realities of an individual's weight (Sarwer, Thompson, & Cash, 2005). Therefore, understanding the effect of body image is essential to determining how to counteract obesity in women. Also, this relationship is important as most obesity prevention and treatment programs for women focus primarily on improving individual behaviors such as physical activity and nutritional practices and less on understanding attitudes and beliefs about weight.

In addition to body image perceptions, the influence of coexisting health conditions and physical functioning on obesity among women has also been discussed in the literature. The most common disabilities associated with women are chronic conditions such as hypertension,

heart disease, arthritis, back disorders, and respiratory problems. Women are often more affected by disabilities than men (CDC, accessed 6/24/07). The relationship between BMI, diabetes, and heart disease is generally stronger for women than men (Hu, 2003). In this study, hypertension (32%), arthritis (28%), asthma (13%), and diabetes/borderline diabetes (11%) made up the highest proportion of coexisting health conditions. Joint (9.92%) and lower back (9.33%) pain accounted for a high proportion of the variance in the model containing physical functioning variables.

Of all coexisting health conditions, hypertension (12%) and diabetes/borderline diabetes (10%) accounted for a significant portion of the variance in the models. In each condition, the income level of ≥$75,000 and being a Black women were significant in influencing the variance in the model. African American women have been reported to experience higher levels of hypertension and diabetes compared to White women (Sullivan, Morrato, Ghushchyan, Wyatt, & Hill, 2005). Additionally, both conditions have been inversely associated with socioeconomic status in women (Kanjilal, Gregg, Cheng, Zhang, Nelson et al., 2006; Robbins, Vaccarino, Zhang, & Kasl, 2001). However, in this study, hypertension and diabetes affected BMI at lower as well as higher income levels. Consistent with the literature, African American women accounted for a higher proportion of the variance in the model than White women. Hypertension is important as it is a risk factor for other coexisting health conditions such as diabetes and heart disease. Although not as significant as the other coexisting health conditions, heart disease accounted for some of the variance in the models. Angina/angina pectoris, congestive heart failure, coronary heart disease, and heart attack followed the trend of the other coexisting health conditions in which having a family income level of ≥$75,000 and being Black were significant contributors to the models.

Arthritis and asthma were also important contributors to the variance in the models and can be directly linked to the ability to physically function. Variables that directly asked about physically functioning included hearing, joint, and back pain. Studies have shown disabilities increase with age (Sturm, Ringel, & Andreyeva, 2004). However, the contribution of age to the variance in the models was evenly distributed in the study. In all the models including the variables associated with physical functioning, the income level ≥$75,000 and Black significantly contributed the most to the variance in the models. According to the results of this study, income and race, and to a lesser degree, age are important in understanding obesity in women.

This study indicates the NHANES 1999-2004 can be helpful in assessing the impact of psychological, coexisting health conditions, and physical functioning status on obesity among U.S. women. Additionally, the sociodemographic variables of age, income, and race demonstrate their importance in the model of obesity and women. It has been suggested that racial and/or ethnic differences in women may explain how women see their bodies, e.g. "perceptual body image", and how they feel about their bodies, e.g. "attitudinal body image" (Fitzgibbon, Blackman, & Avellone, 2000). However, the absence of social and cultural data is an apparent disadvantage of using the NHANES and the ICF to look at obesity in women as the Personal component of the ICF calls for social and cultural information that is not currently available in the NHANES.

It should be noted that during previous years of the NHANES, 1999-2001, data were collected on occupation, food security, and social support, which have all been associated with obesity in women, but was discontinued in the NHANES conducted during 2002 and 2003. Furthermore, the ICF does not provide a classification framework for the Personal Factors citing

large variation among individuals. As such, interpretation of this component may differ in usage by researchers. Hence, the inclusion of a classification scheme for the Personal Factors as well as the addition of social and cultural information would more accurately depict the typical spectrum of obesity and provide a clearer picture of the relationship of body image perceptions, coexisting health conditions, and physical functioning to BMI.

In addition to the inclusion of a classification framework for the Personal Factors of the ICF, the insertion of a structure to categorize the subjective as well as objective dimension of functioning and disability is needed (Ueda & Okawa, 2003). Moreover, the inclusion of more questions in the NHANES that delve into how participants feel about their life, health status, and the impact this has on their environment would provide a more comprehensive view of obesity among women. This is exemplified in the influence of body image perceptions on BMI that would be better understood with more subjective information regarding participants' attitude and beliefs as well their experiences.

This study attempted to assess the applicability of using the ICF to examine obesity in women by focusing on the Body Functions and Structures component of the ICF. While the ICF provides an initial understanding of the true picture of obesity in women, by not having the framework to measure subjective health status, experiences, and relationship to the environment nor the Personal component, as well as the lack of a comprehensive dataset to demonstrate the far-reaching ability of the ICF are major limitations of its use. The results from this study indicate more focus should be placed upon women of all income levels as nutritional practices, lack of physical activity, and life stresses can impact all women. The ability to acquire more data in the NHANES regarding the social and cultural attitudes, values, and beliefs of the women, may help better explain their relationship to BMI. In addition, the more information that

is known about this relationship will help improve current and future obesity prevention and treatment programs for U.S. women.

Building upon the work presented in Chapters 5 and 6, Chapter 7 provides recommendations for usage of the ICF and future obesity research in U.S. women. Specifically, Chapter 7 examines the current trends in obesity prevention and treatment programs and provides further recommendations as to how these programs can be improved based upon the results.

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7.0 RECOMMENDATIONS REGARDING USE OF THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF) TO ADDRESS OBESITY

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7.1 ABSTRACT

Background: Over the past two decades, obesity among women has significantly increased, with women having the highest prevalence in the U.S. Obesity prevention programs and interventions focusing on women have traditionally included individual-level approaches although obesity is a multi-level problem. The research literature has cited numerous factors in obesity—behavioral, personal, psychological, sociodemographic, environmental, biological, and childbearing. As a result, recent public health efforts have shifted away from individual approaches to those that handle multiple factors.

Theoretical Framework: One proposed multiple-level approach is the International Classification of Functioning, Disability and Health (ICF) Core Sets for Obesity, developed by the World Health Organization, to classify the typical symptoms and problems with functioning in obese individuals. Although the ICF has primarily been used clinically, its emphasis on demonstrating the relationship between multiple levels of human functioning aligns with the multilevel aspect of obesity.

Methods: This paper seeks to: 1) discuss current paradigms regarding addressing obesity among women; 2) present the proposal of a framework to address obesity; and 3) offer recommendations based upon results of two previous studies that examined the contribution of the causal factors in predicting body mass index (BMI) in women using the proposed framework and data from the 1999-2004 National Health and Nutrition Examination Survey (NHANES).

Discussion: Recommendations of important factors to include in obesity programs for women were sociodemographic information, body weight perceptions, coexisting health conditions, physical functioning, physical activity, and nutritional practices. Furthermore, obesity programs for women should continue to include engaging in physical activity and proper nutritional practices, although also ensure they are focused on other attributing factors of obesity.

Public Health Relevance: The information garnered from this study can be used to further identify the most important characteristics needed for future obesity programs for women.

7.2 INTRODUCTION

Among U.S. women, obesity has become a serious public health problem. The incidence and prevalence of obesity has increased significantly in women over the past two decades. In fact, women have the highest prevalence of obesity and extreme obesity in the U.S., with minority women having the highest prevalence among all women (Patt, Yanek, Moy, & Becker, 2004). Results from the National Health and Nutrition Examination Survey (NHANES) indicate that approximately 62% of women were overweight, 34% were obese, and 6% were severely obese in 1999 and 2000 [American Obesity Association (AOA), accessed 10/4/2006].

Obesity is a complex health issue because of its multiple causes and effects believed to play a role in its development and progression (Stunkard, 1996). Obesity has been linked to increased morbidity and morality (Wyatt, Winters, & Dubbert, 2006) and associated with shortened life expectancy, disability, and comorbidities (O'Brien & Dixon, 2002; Stucki, Borchers, Stucki, Cieza, Amann & Ruof, 2006). Obesity in women has been attributed to behavioral, personal, psychological, environmental, biological factors, and childbearing factors (Adams-Campbell, Rosenberg, Washburn, Rao, Kim, & Palmer, 2000; Addy, Wilson, Kirtland, Ainsworth, Sharpe, & Kimsey, 2004; Felton, Boyd, Bartoces, & Tavakoli, 2002; Gordon-Larsen, Nelson, Page, & Popkin, 2006; Winkleby, Kraemer, Ahn, & Varady, 1998). Comorbidities of obesity in women include metabolic syndrome (insulin resistance, hypertension, and dyslipidemia), type 2 diabetes mellitus, coronary heart disease, cardiovascular disease (CVD), stroke, gall bladder disease, infertility, hyperuricemia and gout, osteoarthritis, sleep apnea, and certain cancers such as endometrial, breast, colon, and gall bladder (CDC, accessed 10/2/2006; Garber, 2004; O'Brien & Dixon, 2002; Sarwer, Allison, Gibbons, Markowitz, & Nelson, 2006; Visscher & Seidell, 2001).

As a result of the complexity of obesity in women, new approaches to addressing obesity have been sought. Traditional methods of obesity prevention and treatment have focused on individual level approaches. However, recent public health efforts have shifted away from individual level methods toward those methods that focus on multiple factors (Yancey, Kumanyika, Ponce, McCarthy, Fielding, Leslie et al., 2004). Despite this, many obesity programs and interventions still place primary attention on the behavioral component of physical activity and nutritional practices (Banks-Wallace & Conn, 2002; Dunn, Anderson & Jakicic, 1998), which is thought to be the optimal approach to controlling obesity (Alfano, Klesges, Murray, Beech, & McClanahan, 2002; Jakicic, Wing, & Winters-Hart, 2002). This paper 1) explores the current paradigms that address obesity among U.S. women; 2) discusses the proposal of a framework to address obesity; and, 3) offers recommendations based upon results of two previous studies on the proposed framework can be utilized in obesity prevention and treatment programs.

7.3 CURRENT STRATEGIES USED IN OBESITY PROGRAMS

The current trend in developing and implementing obesity programs and interventions involve evidence-based decision-making. There are an increasing number of evidence-based strategies available to prevent and treat obesity. Two national expert panels, the U.S. Preventive Services Task Force (USPSTF) and the Community Task Force (CTF), specifically recommend the usage of evidence-based strategies in clinical and community settings. The recommendations are based upon research and endorsed by the Agency for Healthcare Research and Quality (AHRQ) and the Centers for Disease Control and Prevention (CDC). While the USPSTF focuses on screening,

counseling, and preventive medication as preventive strategies, the CTF looks at the community-level with group education and policy and environmental change strategies. The recommendations of both task forces have been utilized in multiple settings including physician offices, schools, worksites, and entire communities and organizations (AHRQ, 2006; Taskforce on Community Preventive Services, 2005; Ockene et al., 2007).

A number of these the task forces' recommendations have been included in many obesity prevention and treatment programs for women along with many activities that the task forces have not recommended due to "insufficient evidence" such as internet-based weight-loss programs (Gold, Buzzell, Leonard, Pintauro, & Harvey-Berino, 2007). Behavior therapy interventions are one of the most common strategies, which consists of behavioral modification with regards to diet and exercise. Other therapies include pharmacological or drug therapy to suppress appetite and alter metabolism and bariatric or weight reduction surgery (Orzano & Scott, 2004). The inclusion of social support of family and peers in obesity programs have been utilized in many obesity programs to encourage physical activity and proper nutrition (Keller, Allan & Tinkle, 2006). Overcoming environmental barriers to performing healthy behaviors has also been a part of some obesity programs (Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Jilcott, Laraia, Evenson, Lowenstein, & Ammerman, 2007).

Despite the endorsement by the AHRQ and CDC, there are gaps in the recommendations for reducing obesity prevalence based upon gaps in evidence as well as incomplete synthesis of available evidence. As such, recommendations provided by the task forces lists strength of the recommendations and quality of evidence for which some are strong, several are insufficient, and others are in progress (Ockene et al., 2007). This demonstrates the uncertainty regarding how obesity prevention and treatment programs should be conducted.

It should be of note that the current trend of evidence-based public health programs is not endorsed by all researchers and policymakers due to the lack of complete evidence regarding the effectiveness of certain interventions. As such, some researchers believe evidence-based should be replaced with the term "best evidence possible". In addition, it is thought that in order for new evidence to be discovered and be included in prevention and treatment efforts, an appropriate framework is needed to provide the assistance required to assemble evidence and translate it for program implementation (Swinburn, Gill, & Kumanyika, 2005). Furthermore, many researchers indicate the need for a framework to propagate successful interprofessional collaborations by providing a shared language and conceptual framework for clinicians, researchers, and policymakers (Allan, Campbell, Guptill, Stephenson, & Campbell, 2006). One suggested framework is the International Classification of Functioning, Disability and Health (ICF), introduced by the World Health Organization (WHO) in conjunction with the CDC.

7.4 THE PROPOSAL OF THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH (ICF) TO ADDRESS OBESITY

The World Health Organization (WHO) developed the ICF (Figure 1), a classification and coding system, to measure the spectrum of systems and problems in functions of patients with disabilities. The ICF was initially intended for addressing disability. However, because obesity is increasingly becoming a cause of disability and decreased quality of life, the ICF has begun to be applied to obesity and other health conditions in the form of Core Sets (Stucki, Daansen, Fuessl, Cieza, Huber, Atkinson et al., 2004; Stucki et al., 2006).

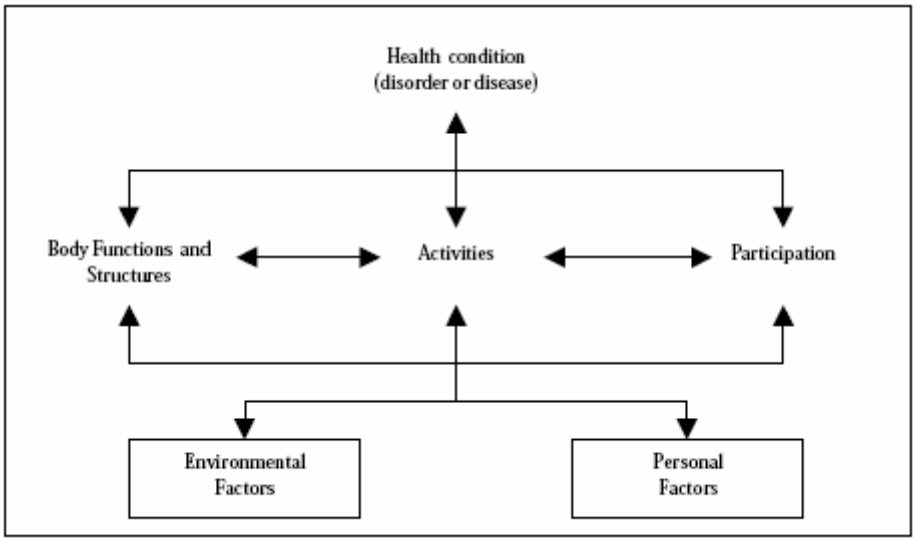

Figure 1. Illustration of the interaction of components in the International Classification of Functioning, Disability and Health (ICF). (WHO, 2001)

The ICF Core Sets for obesity provide a category listing of the typically encountered problems for obesity that includes an exploration of the interactions between genetic, metabolic, environmental, and personal aspects of an individual's life (Stucki et al., 2004; Stucki et al., 2006). The ICF includes a Brief ICF Core Set of the usual problems associated with obesity and the Comprehensive Core Set that provides a comprehensive listing of ICF categories needed for multi-level assessment of the typical issues identified by obese individuals (Allan et al., 2006; Ustun, Chatterji, Bickenbach, Kostanjsek, & Schneider, 2003).

The ICF conceptual framework (Figure 1) consists of 2 parts: 1) Functioning and Disability; and 2) Contextual Factors. Functioning and disability is comprised of 2 components: 1) Body Functions and Structures; and 2) Activities and Participation. Body Functions and Structures are the physiological functions of the body systems and the anatomical parts of the body. Activities are individual execution of tasks and participation is involvement in life situations. The Contextual Factors components include environmental and personal factors (ICF,

2001). The Environmental Factors include the physical, social, and attitudinal environment and Personal Factors are age, gender, education, work experience, and disease coping style (Allan et al., 2006; Perenboom & Chorus, 2003).

7.5 SIGNIFICANT FACTORS AFFECTING OBESITY IN WOMEN

While personal, psychological, sociodemographic, environmental, biological, and childbearing factors have all been determined to play a role in the causal pathway of obesity among women (Adams-Campbell et al., 2000; Addy et al., 2004; Felton et al., 2002; Gordon-Larsen et al., 2006; Winkleby et al., 1998), their degree and variability have not been well-documented in the literature. Two previous studies examined how well the ICF Comprehensive Core Set for obesity predicted body mass index (BMI)[7] and assessed the variance of the ICF for BMI, using data from the 1999-2004 National Health and Nutrition Examination Survey (NHANES).[8] Significant factors predicting BMI in women included the sociodemographic factors of age, income, and race, as well as body weight perceptions, coexisting health conditions, performing physical activity, dietary practices (e.g. the number of times eating at a restaurant), access to healthcare, and physical functioning (e.g., hearing, joint and low back pain, respiratory conditions, and requiring special healthcare equipment) (Tyler, 2007a, 2007b).

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[7] BMI is the most common method for measuring obesity. BMI is a calculation of body weight in kilograms divided by body height in meters squared.

[8] The NHANES is a stratified, national, multistage, probability sample of the civilian, noninstitutionalized U.S. population conducted by the National Center for Health Statistics to assess the health and nutritional status of U.S. adults and children (CDC, 2005).

7.6 RECOMMENDATIONS REGARDING NECESSARY CONTENT FOR OBESITY INTERVENTIONS

The following recommendations emerged from the results of the studies assessing the applicability of ICF to predict obesity in U.S. women. Based upon the results of the most significant factors in predicting BMI, sociodemographic information, body weight perceptions, coexisting health conditions, performing physical activity, dietary practices, and physical functioning (Tyler, 2007a, 2007b) should be included in obesity programs and interventions among women. In addition, changes to the ICF as well as the NHANES are needed to provide a comprehensive viewpoint of obesity in U.S. women. Recommendations are provided for all significant factors as well as for the ICF and the NHANES for usage in addressing obesity in U.S. women.

Sociodemographic Information

In the study examining all components of the ICF (Tyler, 2007a), age, income, and race were significant contributors to the prediction of obesity among U.S. women and education level and smoking status were insignificant. Sociodemographic factors—age, ethnicity, gender, level of education, low-income, and socioeconomic status (SES)—have been associated with obesity (Dekkers, Podolsky, Treiber, Barbeau, Gutin, & Snieder, 2004; Lee, Sobal, Frongillo, Olson, & Wolfe, 2005; Patt et al., 2004; Winkleby et al., 1998; Zhang & Wang, 2004a). They have also been shown to impact energy intake and energy expenditure thereby affecting body fat storage and obesity (Lewis et al., 2000; Keller et al., 2006; Peterson, Sorensen, Pearson, Hebert, Gottlieb, & McCormick, 2002; Wyatt et al., 2006; Zhang & Wang, 2004b). There have been

differing viewpoints among researchers regarding the relationship between SES and obesity (Chang & Christakis, 2005; Chang & Lauderdale, 2005), in which generally, obesity prevalence varies with SES (Dekkers et al., 2004). However, trends in the association between obesity and SES in U.S. adults demonstrated that the disparity in SES has decreased in the past three decades (Zhang & Wang, 2004a) with obesity increasing at all levels of income (Chang & Lauderdale, 2005). This suggests that groups living below the national poverty level may not be the correct group to focus our obesity prevention and intervention efforts on (Chang & Lauderdale, 2005). Consequently, attention should be focused on all income groups of U.S. women.

Perceptions of Body Image

Body image has been associated with obesity in women although whether there are age, race, or class differences has been unclear (Cachelin et al., 2002; Caldwell, Brownell, & Wilfley, 1997; Paeratakul et al., 2002). Age, income, and race evenly contributed to the variance in the model when the perceptions of the women being women underweight, the right weight, and overweight, was analyzed separately (Tyler, 2007b). This suggests that body image perceptions are important among all women regardless of differences by age, income, and race as has been previously thought. In addition, the women in the study conducted by Tyler (2007b) had accurate perceptions of their weight. This is different from some theories of body image which suggests subjective perceptions of body weight have little relationship to the objective realities of an individual's weight (Sarwer, Thompson, & Cash, 2005). Tyler (2007b) further showed how women perceived their body weight was directly proportional to their BMI. There have been some programs focusing on encouraging body acceptance, which have found size acceptance

enabled long-term behavior change (Bacon, Stern, Van Loan, & Keim, 2005). Therefore, understanding the effect of body image is essential to determining how to counteract obesity in women and should be further explored and implemented in obesity prevention and treatment programs.

Coexisting Health Conditions and Physical Functioning

The most common disabilities associated with women are chronic conditions such as hypertension, heart disease, arthritis, back disorders, and respiratory problems. Women are often more affected by disabilities than men (CDC, accessed 6/24/07). In the studies conducted by Tyler (2007a; 2007b), hypertension, arthritis, asthma, and diabetes/borderline diabetes were significant coexisting health conditions while joint and lower back pain were significant physical functioning variables. In the model of the relationship between BMI, sociodemographic factors, and coexisting health conditions and physical functioning, having an income ≥$75,000 and being a Black woman were significant contributors. African American women have been reported to experience higher levels of hypertension and diabetes compared to White women (Sullivan, Morrato, Ghushchyan, Wyatt, & Hill, 2005). Additionally, both conditions have been inversely associated with socioeconomic status in women (Kanjilal, Gregg, Cheng, Zhang, Nelson et al., 2006; Robbins, Vaccarino, Zhang, & Kasl, 2001). Hypertension is important as it a risk factor for other coexisting health conditions such as diabetes and heart disease. These conditions can place an individual at increased risk of suffering other problems and should be considered separately in the development and implementation of obesity treatment programs [National Institutes of Health (NIH), 1998].

Physical Activity and Nutrition Practices

The pairing of engaging in physical activity with proper nutritional practices are the optimal methods for prevention and treatment of obesity (Orzano & Scott, 2004). In the study conducted by Tyler (2007a), both were important contributors to predicting BMI in U.S. women. Important factors included the number of times a week eating at a restaurant, the average level of physical activity performed each day, muscle strengthening activities, and vigorous and moderate activity in the last 30 days. As many obesity programs and interventions include this component and it is a major recommendation of the U.S. Preventive Services Task Force (USPSTF) and the Community Task Force (CTF), this study offers more evidence as to the importance of their further inclusion in public health practice.

The International Classification of Functioning, Disability and Health (ICF)

The purpose of the ICF is to provide a global basis of standardization of data regarding all aspects of human functioning and disability (Ustun et al., 2003) including obesity but this has not been widely tested (Stucki et al., 2004). Although the ICF includes all factors that have been associated with various diseases and conditions, including obesity, there have been some concerns regarding the classification scheme. First, the ICF does not provide a classification framework for the Personal Factors citing large variation among individuals (Jette, 2006; Perenboom & Chorus, 2003). As such, interpretation of this component may differ in usage by researchers and cannot be adequately determined using the ICF. Hence, the inclusion of a classification scheme for the Personal Factors as well as the addition of social and cultural

information would more accurately depict the typical spectrum of obesity and provide a clearer picture of the relationship of body weight perceptions, coexisting health conditions, physical functioning, physical activity, and dietary practices to BMI. In addition, the insertion of a structure to categorize the subjective as well as objective dimensions of functioning and disability are needed (Ueda & Okawa, 2003). Psychological measures such as well-being, depression, self-esteem, and body image have all been linked to obesity in women (Cachelin et al., 2002; Paeratakul et al., 2002) and should be enhanced in the ICF. Demonstrating the effect of each of the aforementioned factors and their interactions on different subgroups of obese women can help in identifying areas of concentration for prevention and treatment efforts.

The National Health and Nutrition Examination Survey (NHANES)

There were several limitations to the 1999-2004 NHANES used in the studies conducted by Tyler (2007a; 2007b). First, the Personal Factors of the ICF consists of information regarding sociodemographics and social and cultural values. However, the NHANES lacked information about social and cultural values and social support. It should be noted that in previous years of the NHANES, 1999-2001, data were collected on occupation, food security, and social support, which have all been associated with obesity in women. These domains were discontinued in the NHANES for the years 2002 and 2003. Social and cultural values and social support have been cited as significant influences on women's attitudes, beliefs, perceptions, and actions about body image, physical activity, and dietary practices (Brownson et al., 2001; Cachelin et al., 2002;

Caldwell et al., 1997; Paeratakul et al., 2002; Keller et al., 2006) and therefore should be included in future cycles of the NHANES.

Secondly, there were few environmental variables in the NHANES that met the ICF's guidelines. Those environmental variables that did meet the ICF guidelines did not have enough responses to be analyzed in Tyler's previous studies (2007a; 2007b) so could not be used. However, variables were available in the NHANES corresponding to the Body Functions and Structures Factor and Activities and Participation Factors. This is primarily due to these two factors fitting more prevalently with the overall objective of the NHANES, which is to describe the overall health and functioning of the U.S. population. As a result, more information was available for these two factors. Although a significant amount of information was obtainable for the Body Functions and Structure and Activities and Participation components, environmental factors play a major role in inhibiting physical activity and healthy nutrition practices (Gordon-Larsen et al., 2006) among women, thereby affecting obesity. Thus, its inclusion is essential to understanding obesity in U.S. women.

Finally, the inclusion of more questions in the NHANES that delve into how participants perceive and feel about their life, health status, and the impact this has on their environment would provide a more comprehensive view of obesity among women. The comparison of subjective, individual perception, with objective measures could possibly enhance what is currently known about obesity in women. Additionally, both subjective and objective data are needed to accurately assess quality of life (Ueda & Okawa, 2003).

7.7 CONCLUSIONS

Given predictions forecasting obesity to become the leading cause of death and most expensive disease in developed countries such as the U.S. in the 21st century surpassing the tobacco-related illnesses and their association with increased healthcare costs (Finkelstein, Ruhm, & Kosa, 2005; Martin, Robinson, & Moore, 2000; Stucki et al., 2004), obesity is an important public health issue. Currently, nutrition, physical activity, and obesity funding ranks 7th among major programs based upon the Fiscal Year 2008 President's Budget and in 2006, the National Center for Chronic Disease Prevention and Health Promotion accounted for only 14% of CDC's Discretionary Resources (CDC, 2007). Consequently, the limited resources by the government ensure funding must be directed in the most effective manner. This includes the factors that have been demonstrated to play a role in obesity among women based upon evidence as well as Tyler's studies (2007a; 2007b) of national data exploring the role of the important factors.

Although not without its limitations, the ICF is a good first step towards developing a framework that can be used and understood by both researchers as well as the medical community providing opportunities for increased collaborations. Not having the framework to measure subjective health status, experiences, and relationship to the environment nor the Personal Factors, as well as the lack the lack of a comprehensive dataset to demonstrate the far-reaching ability of the ICF are major limitations. It is recommended that more focus needs to be placed on obesity programs and intervention that examine body weight perceptions, coexisting health conditions, physical functioning, physical activity, and dietary practices. The ability to acquire more data in future cycles of the NHANES regarding the social and cultural attitudes,

values, and beliefs of U.S. women, may help better explain the relationship to BMI and would thus improve the current and future obesity prevention and treatment programs for U.S. women.

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8.0 CONCLUSIONS

Obesity is a complex problem because of its association with morbidity and mortality. It is predicted it will become the leading cause of death and most expensive disease in the U.S. ultimately surpassing the tobacco-related illnesses (Martin, Robinson, & Moore, 2000). Obesity has increasingly become a serious public health issue affecting women. Minority women disproportionately have the highest prevalence of obesity and extreme obesity (Flegal, Carroll, Ogden, & Johnson, 2002; Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006).

There are numerous attributing causes and effects believed to have a role in its development and progression of obesity (Stunkard, 1996). As a result of these multiple factors, researchers differ regarding the best strategies needed to prevent and treat obesity in women (Kumanyika, 2001). One proposal to address obesity is the International Classification of Functioning, Disability and Health (ICF), a framework introduced by the World Health Organization (WHO) in conjunction with the Centers for Disease Control and Prevention (CDC). The ICF seeks to describe and measure the functioning of those with disabling conditions such as obesity (Stucki, Kaansen, Fuessl, Cieza, Huber, Atkinson et al., 2004; Stucki, Borchers, Stucki, Cieza, Amann, & Ruof, 2006). The purpose of the studies presented here was to assess the applicability of the ICF for use in public health to address obesity among U.S. women and provide recommendations of the most important factors for inclusion in obesity prevention and

treatment programs using data from the 1999-2004 National Health and Nutrition Examination Survey (NHANES).

8.1 SUMMARY OF FINDINGS

In the studies, the Personal Factors, Activities and Participation, and Body Functions and Structure were major contributors to the variance in the relationship with BMI among women. Significant variables in the Personal Factors included age, income, and race. Variables that were significant in Activities and Participation consisted of requiring special healthcare equipment, having a dry cough, engaging in physical activity, and proper dietary practices.

The Body Functions and Structures component was analyzed to explore the effect of age, income, and race. Significant variables in Body Functions and Structures were body weight perceptions, coexisting health conditions, and physical functioning. Body weight perceptions were how the women considered their weight—underweight, the right weight, or overweight. The significant coexisting health conditions were hypertension, arthritis, asthma, diabetes/borderline diabetes, and heart disease. The income level ≥$75,000 and Black women accounted for the highest variance in the models. Additionally, how women perceived their weight was directly proportional to their actual BMI.

Recommendations for the most important factors to include in obesity prevention and treatment programs for women pertained to sociodemographic information, body weight perceptions, coexisting health conditions, physical functioning, physical activity, and nutritional practices. It is recommended that obesity prevention and treatment programs for women focus on all income levels as the disparity in socioeconomic status and obesity has decreased.

"Perceptual body image" as well as "attitudinal body image" of individual body weight should be addressed in obesity programs and used to encourage body acceptance and engagement in healthy behaviors.

The impact of coexisting health conditions on performing physical activity and eating properly should also be the focus of obesity programs. Other aspects related to ability to physically function that should be included in obesity programs consists of special healthcare equipment and ways of addressing chronic coughing, which may directly impact functioning and be symptomatic of the effect of coexisting health conditions. Finally, obesity prevention and treatment programs for women should continue to include engaging in physical activity and proper nutritional practices and ensure they are focused on other attributing factors of obesity.

8.2 LIMITATIONS OF THE STUDIES

Limitations of the studies specifically related to the ICF and the NHANES 1999-2004. As the ICF does not provide a classification framework for the Personal component, interpretation of this component may differ in usage by researchers and cannot be adequately determined using the ICF. In addition, the ICF lacks a classification scheme for a subjective component of human functioning (Ueda & Okawa, 2003). Thus, psychological effects and experiences cannot be ascertained, which is important given the association of these effects to obesity in women (Cachelin, Rebeck, Chung, & Pelayo, 2002; Paeratakul, White, Williamson, Ryan & Bray, 2002).

In addition to the lack of subjective information in the ICF for addressing obesity in women, the inclusion of more questions in the NHANES that delve into how participants

perceive and feel about their life, health state, and the impact this has on their environment would elucidate the relationship between being a woman and obesity. Furthermore, the NHANES does not have information regarding social and cultural values and social support that have been cited as significant influences on women's attitudes, beliefs, and actions about body image, physical activity, and dietary practices (Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Cachelin et al., 2002; Caldwell, Brownell, & Wilfey, 1997; Paeratakul et al., 2002; Keller, Allan, & Tinkle, 2006). Although during previous years of the NHANES, 1999-2001, data were collected on occupation, food security, and social support, these data were eliminated in the NHANES 2002-2003. Also, there were few environmental variables in the NHANES which met the ICF's guidelines that could be analyzed.

8.3 PUBLIC HEALTH IMPLICATIONS

Although not without its limitations, the ICF is a good first step towards finding a framework that can be used and understood by both researchers, the medical community, and policymakers, thus providing opportunities for increased collaborations addressing obesity among U.S. women. The factors of the ICF suggest important components of focus for obesity prevention and treatment programs for U.S. women. Since the ICF has primarily been used clinically, the ability to assess the applicability of the ICF in population-level studies using data from the 1999-2004 NHANES demonstrates the potential the ICF has for future public health research targeting obesity in women.

The information garnered from these studies can be used to further identify the most important characteristics needed for future obesity interventions conducted with African

American, Mexican American, and White women. In addition, the knowledge regarding the relationship between the multiple factors and obesity can assist the medical community in understanding treatment and prevention of obesity among these women. Further, these studies provide additional evidence regarding the inclusion on more subjective information in the ICF and the NHANES. By doing so, a better viewpoint of the complexity of obesity among U.S. women can be determined.

8.4 FUTURE RESEARCH

Obesity reveals a true challenge to public health primarily because it is a sociocultural and economic health issue that requires public health professionals and the medical community to embrace and apply innovative practices to prevent and control the incidence and prevalence of obesity in U.S women. As such, more population-level studies as well as individual-level studies should be utilized in order to ascertain a comprehensive view of obesity in women. Future research should focus on the impact of body weight perceptions, coexisting health conditions, and physical functioning on engaging in healthy behaviors among women at the population level. Also, more studies are needed to examine individual subjective perceptions as well as objective perceptions of health and functioning in order to reveal the complete picture of obesity among U.S. women.

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