

## ABSTRACT

Title of Document: **SOCIAL NETWORK AND DIETARY INTAKE IN COMMUNITY DWELLING ELDERLY WOMEN: A SECONDARY ANALYSIS OF THE THIRD NATIONAL HEALTH AND NUTRITION EXAMINATION SURVEY.**

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Over the last three decades, more emphasis has been placed on describing and explaining the specific nature of social interactions and the effects of these interactions on health. The elderly population, defined in this study as those individuals 60 years of age or older, has been of particular interest because of their increased risk for illness and disability with advancing age. Elderly women are considered particularly vulnerable to the effects of illness and disability. Research from a variety of disciplines suggests that the social network (i.e. the structure of individuals with a specific, designated relationship to the individual in need), and its inherent social support, is an important factor for maintaining physical, mental and social health in all older adults (Cohen, Teresi & Holmes, 1986; Kaufman, 1990; Shumaker & Hill, 1991). Dietary intake is an indicator of overall health; understanding factors that affect dietary intake provides clinicians with the opportunity to promote positive health outcomes and a positive quality of life for the

older adult. Few studies examine the specific relationship between the social network and dietary intake and nutrition in any population. This study examined the relationship between the social network including household size, frequency of non household contact with family/friends and frequency of organizational contact and dietary intake in community-dwelling older women using the third National Health and Nutrition Examination Survey (NHANES III). Dietary intake was measured by total food energy intake, body mass index, total dietary intake of selected vitamins/food components and self reported assessment of food security. Although several significant associations emerged, the study's hypotheses were not supported. For example, frequency of neighbor visits was inversely related to total food energy intake (TFEI) as well as calcium intake. Church attendance was positively associated with TFEI, fiber intake and the odds of having a BMI classified as overweight. This study will heighten the awareness of clinicians, health educators and policy makers to the potential impact of the social network on dietary intake. It emphasizes the need for research that addresses the frequency and quality of the social interactions and more diversity within the sample.

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ELDERLY WOMEN: A SECONDARY ANALYSIS OF THE THIRD NATIONAL  
HEALTH AND NUTRITION EXAMINATION SURVEY.

By

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## CHAPTER 1: INTRODUCTION

Over the last three decades, more emphasis has been placed on describing and explaining the specific nature of people's interactions with one another and the effects of these interactions on health. The elderly population, defined in this study as those individuals 60 years of age or older, has been of particular interest because of their increased risk for illness and disability with advancing age. Research from a variety of disciplines suggests that the social network, and its inherent social support, is an important factor for maintaining physical, mental and social health in all older adults (Cohen, Teresi & Holmes, 1986; Kaufman, 1990; Shumaker & Hill, 1991).

As the proportion of older Americans increases, issues related to physical and mental health, quality of life and mortality in this population have increased importance for health educators and health care providers. In 2000, 12.4% of the U. S. population in was 65 years of age or older (Administration on Aging [AoA], 2004). Most have at least one chronic condition; many have more than one physical or mental health condition (AoA). Despite the high proportion of older adults who report physical and mental health issues, research suggests the social network and social support (i.e. received support) are important determinants of health, well being and successful aging (Barnes, Mendes de Leon, Bienias & Evans, 2004; Krause, 2001; Rowe & Kahn, 1998).

Elderly women, the greatest portion of the older population, are considered one of the most vulnerable, or susceptible, to risk factors that produce negative physical, mental or social health outcomes. The risk factors that increase vulnerability include individual financial circumstances, health, age, personal

characteristics such as race, ethnicity and culture, disability, illness and functional status (National Institutes of Health [NIH], 1998). Through an understanding of the social network, researchers hope to identify specific factors that impact health and target these factors for the prevention of illness and disability in the older population, especially in the largest portion of this population.

#### Problem Statement and Definition of Terms

This study examines the relationship between household social network size, the frequency of non-household family/friend contact, the frequency of organizational contact and the dietary intake of community dwelling older women using the third National Health and Nutrition Examination Survey (NHANES III).

For the purpose of this study, social network will refer to the structure of family, friends and others with whom the care recipient has regular contact. This includes family and friends living in the household as well as family, friends, neighbors or other individuals with whom the individual has regular, ongoing contact. In addition, the social network includes individuals from organizations, such as clubs or the church or similar places of worship, which the individual has regular, ongoing contact. Dietary intake in this study will be determined by the respondent's body mass index (BMI), total food energy intake (TFEI) based on a self-reported food diary, self-reported dietary vitamin/food component intake on specific components, and self-reported food security capabilities from NHANES III data. Other variables of interest include age, exercise/physical activity, race/ethnicity, chronic health problems, income and education. These will be determined through self-reported interview information and will be used to describe characteristics of the sample or

analyze confounding effects. The population of interest in this proposed study is elderly women, i.e. women 60 years of age or older, with no upper age limit. The greatest majority of elderly adults in the United States live outside of a nursing home, in a variety of community based settings (AoA, 2004). These settings include, but are not limited to, assisted living environments, private homes and senior apartments. For the purpose of this study, community dwelling elderly individuals are those living in any setting exclusive of the nursing home.

### Background

Social support is the functional element of the social network, including the actual exchange of resources between the network member and the care recipient (Mendes de Leon, Gold, Glass, Kaplan & George, 2001). Social support is a multidimensional concept with objective or tangible assistance as well as inherently subjective, or intangible, elements (Vaux, 1988). Several schemas exist to describe specific dimensions of support. For example, tangible support, or received support, includes assistance with physical care, meal preparation or household tasks; intangible support includes emotional support, comfort or companionship. George (1996) describes social support as emotional or expressive, instrumental and informational assistance. Emotional or expressive support refers to the social integration or connectedness experienced by the individual within their social network. An individual who derives emotional support from family or friends in the social network may feel a sense of belonging or inclusion with those in the network. Instrumental support is tangible assistance one receives from members of the social network. This type of support includes direct assistance with activities of daily living



(eating, bathing, dressing, toileting, and transferring) assistance with household chores or repairs, and assistance with financial management (Berkman & Glass, 2000). Finally, informational support occurs when social network members provide useful data or education for the individual that addresses some real need or a need perceived by the individual (George; Berkman & Glass). Social support from the social network can be described as formal support or informal support. For example, paid caregivers who assist with activities of daily living or food acquisition represent formal support. If, however, the care recipient receives help from a neighbor or a friend with these same activities without financial compensation, he or she is receiving informal, instrumental support. Both formal and informal support providers can be considered part of the social network. These terms are outlined in Table 1.

Barrera's (1986) description of informal support shows the overlap of terminology in the social support literature. Barrera identified three kinds of informal support: social embeddedness (i.e. addresses frequency of contact with others), received support (i.e. tangible help actually provided by social network members) and perceived support (i.e. subjective evaluation of supportive exchanges such as satisfaction with social support). These definitions are similar to some other descriptions of the social network (i.e. social embeddedness), tangible support (i.e. received support) and perceived support (i.e. intangible support).

While social support is a multidimensional concept, several distinct dimensions of social support can be described. But each dimension rarely exists

Table 1

*Social Support and Social Network Terminology*

<b>Term</b>	<b>Definition/Example</b>
Social network	The web of social relationships surrounding an individual and the characteristics of those ties (Berkman & Glass, 2000). Social ties including intimate and family relationships, and ties with people from the workplace, neighborhood, places of worship or informal associations with whom recipient has a regular and ongoing relationship (Vaux, 1988).
Care recipient	The focus of network resources. In some cases, network resources will self-activate when needed, and provide the necessary assistance to the recipient. If this does not occur, the recipient must activate the network resources and request assistance (Vaux, 1998, p. 68).
Social support	The ongoing exchange of resources between the network members and the care recipient (Mendes de Leon, et al, 2001; Vaux, 1998).
Received support	Tangible help actually provided to the recipient by social network members (Krause, 2001)
Tangible support	Objective network resources, including but not limited to physical care, cutting the lawn, help with meal preparation or food acquisition,
Instrumental support	Tangible assistance from members of the social network. Includes direct assistance with activities of daily living (eating, bathing, dressing, toileting, and transferring) to household chores or repairs, to assistance with financial management (Berkman & Glass, 2000)
Informational support	Useful data or education for the individual that addresses some real need or a need perceived by the individual (George, 1996; Berkman & Glass 2000).
Intangible support	Subjective resources from social network members including but not limited to emotional support, comfort and companionship. Examples include social visits or social telephone calls.
Emotional or expressive support	A sense of belonging or comfort experienced by the care recipient with those in the social network.
Informal social network	Social ties between the care recipient and other social network members who do not have a contractual or paid association with the recipient. Include family, friends, non-friends or neighbors who provide assistance but are not contracted and/or paid for their assistance or support (Logan & Spitze, 1994).
Formal social network	Social ties between the care recipient and other individuals in the social networks that are contracted and/or payment is received. Formal network members include home care providers or individuals who provide intermittent household assistance.

in isolation; instead the dimensions tend to overlap. This is one of the challenges faced by social psychologists in describing and measuring the affects of social support.

George (1996) states that a central tenet of a social perspective of health is the belief that social relationships can protect individuals against stress and illness, and improve disease outcomes. The social network and the social support provided through this network represent an element of the social perspective of health (George). Social networks can be characterized in many ways; most attention has been given to the size of the social network and the frequency of contact (George). The interactions with people within the social network can exert a positive or negative effect on the individual. Positive interactions with those in the social network have a supportive, validating or fulfilling effect for the individual; interactions with a negative effect may be burdensome or psychologically destructive in some way.

#### *Social Network Demographic Characteristics*

Age, gender, marital status, formal or informal relationships, socioeconomic status and culture of social network members are important characteristics affecting social support (Forthofer, Janz, Dodge & Clark, 2001; Krause & Borawski-Clark, 1995; Turner & Marino, 1994; Unger, McAvay, Bruce, Berkman & Seeman, 1999). The older population is expected to continue to grow dramatically: by 2030, the number of older persons is expected to be more than twice the number in 2000 (AoA, 2004). Within the older population, the oldest-old, i.e. those 85 years of age and older, are projected to increase at the greatest rate. With these dramatic increases in the aged population, the social networks in which these individuals interact will potentially be older as well. In the older population, women outnumber men 141 to 100; the ratio of women to men increases as age increases (AoA). Women tend to

outlive men, and potentially constitute the largest portion of the social network among this population. Older women are more likely to be widowed, divorced, separated or single, potentially changing the source of their social network support.

As the total number of older adults increases in the United States, the number of older adults in minority groups is increasing as well. In fact, the number of older adults from minority groups is growing faster than the number of White members of the older population. In the next thirty years, the minority population is expected to represent more than 26% of the older population, a 9% increase from totals in the year 2000 (AoA, 2004). Ethnicity or race has been considered a risk factor for vulnerability in the older population (NIH, 1998).

Other demographic characteristics potentially affect the social network. Older women have the highest rate of poverty as compared to older men (AoA, 2004). Additionally, educational level is increasing in this population. The number of older adults who have completed high school has increased from 28% to 70%; a little more than 15% have a college degree (AoA). Socioeconomic and educational status is linked to ethnic group membership (Johnson & Tripp-Reimer, 2001; Mutran, 1985). Education and socioeconomic status potentially place minority elders at a disadvantage when compared to Caucasian elders. In the United States, 23.8% of elderly African Americans and 21.4% of elderly Hispanics live below the poverty level (AoA). However, the rate of poverty for each of these groups is almost three times the rate of poverty in elderly Caucasians (AoA). Understanding the unique characteristics of social networks in the older population will provide additional opportunities for prevention of negative health outcomes in this group.

### *Social Network, Nutrition and Dietary Intake*

Nutrition is an indicator of overall health; understanding factors affecting nutrition provides clinicians with the opportunity to promote positive health outcomes and a positive quality of life for the older adult. The science of nutrition explores the interaction between the living individual and nutrients in food (Grodner, Anderson & DeYoung, 2000). This includes consideration of bodily processes such as ingestion, digestion, absorption, transportation, metabolism, storage and excretion of nutrients. Nutrients are biochemical substances that provide energy, structure and regulation of body processes (Grodner, et al). Through dietary intake, approximately 45 nutrients must be supplied to the human body and are essential for individual health. These nutrients include carbohydrates, fat, protein, vitamins, minerals, and water (Grodner, et al). Assessing nutritional status is a comparative process. The individual's dietary intake of nutrients is compared with bodily requirements to determine the individual's nutritional status.

Nutritional status and dietary intake can be altered by a variety of physical, social or psychological factors. For example, a multitude of age related physical changes, such as changes to the gastrointestinal system, affect nutrition. With aging, the number of taste buds in the mouth decreases causing food to be less satisfying and causing the individual to change his or her pattern of dietary intake. Decreased secretion of hydrochloric acid and other gastric juices within the stomach reduce digestion, motility and the absorption of nutrients from food. Sensations of hunger and thirst diminish with age, causing older adults to consume inadequate amounts of

food or fluid. This increases the risk that the older adult will become dehydrated and under nourished.

Another physical factor affecting nutrition is the variety of acute and chronic diseases that affect the elderly and increase nutritional risk. Medications used to treat acute or chronic diseases or to manage the effects of age related physical changes are linked to nutritional risk in the older adult as well. Age related physical changes affect absorption, distribution, metabolism and excretion of medications differently in each individual.

Nutrition may also be affected by social factors such as income, educational level, or being alone (Ryan, et al., 1992; Jensen, Kita, Fish, Heydt & Frey, 1997). Income level affects the specific nutrients an individual can afford to purchase and may ultimately contribute to inadequate caloric intake (Bianchetti, Rozzini, Carabellese, Zanetti & Trabucchi, 1990). An individual's knowledge of specific nutrients and the nutrients' potential importance is related to educational level. Individuals often make inappropriate dietary choices because of his or her lack of education. For some individuals, meal times are associated with socialization. Eating alone for more than half of one's meals has been associated with a risk of nutritional deficiency (Sahyoun, Jacques, Dallal & Russel, 1997). Depression, stress, feelings of social isolation and individual living arrangements have been identified as psychological factors affecting nutrition (Ryan, et al.; Jensen, et al.).

Literature focuses on several descriptions of individual nutritional status. Some focus on the nutrient composition of foods ingested, such as specific vitamins, minerals or trace elements like nitrogen, zinc and iron (Bunker & Clayton, 1989;

Kipen, Helme, Wark, & Flicker, 1995; Posner, Jette, Smiegelski, Miller & Mitchell, 1994). Other descriptions of nutritional status are determined by measurements of physical characteristics such as weight, oral health, arm circumference and skin fold thickness (Burr, Milbank & Gibbs, 1982; Davies, King & Davies, 1994). Still other descriptions of nutritional status are in relation to calculations of body mass index, which is a relative expression of the individual's weight in kilograms to his or her height in meters squared (Posner, et al.; Souter & Keller, 2000). Biochemical changes used as indicators of nutritional status include hemoglobin levels, plasma protein and albumin in the blood (Burr, et al.). Others define nutritional status in terms of eating behavior, food patterns or food consumption (Slesinger, McDivitt, & O'Donnell, 1980; Ryan, Craig & Finn, 1992). Regardless of the description used, nutritional status and dietary intake are recognized as fundamental indicators of health for all ages, and are particularly important for older adults.

Malnutrition results from continuing and severe nutritional deficiencies. The American Dietetic Association (ADA) states that malnutrition is a state where an individual does not obtain the proper nutrients because of imbalances, excesses or deficiencies in the diet (1998). When an individual is malnourished, the body's need for protein, calories and other nutrients are severely out of balance. Malnutrition is manifest as over consumption to extreme under consumption (Grodner, et al., 2000). The older population is at particularly high risk for undernutrition leading to malnutrition due to many etiologic, environmental, social, economic and physical changes that occur with aging (Gentleman, 2000; American Academy of Family Physicians, 2001). Etiologic factors include decreased dietary intake of the needed

protein, energy and other nutrients. A variety of factors contribute to increased risk of malnutrition, including age-related physical changes, acute and chronic disease, drugs and alcohol use, and poor dentition. Increased risk for malnutrition has been associated with several socioeconomic factors such as inadequate nutrition, poor knowledge of nutrition and social isolation. Psychological factors associated with increased risk for malnutrition include anxiety, fear, dementia and depression (Gentleman, 2000).

A variety of negative outcomes have been associated with malnutrition including decreased cardiac, pulmonary, liver, and renal function, infections, hospitalization and increased length of hospital stay, increased physician visits, complications from other disease conditions, cognitive and functional limitations, diminished quality of life and increased rates of mortality (Gentleman, 2000; Jensen et al 1997; Keller, Ostbye & Goy, 2004; Sloss, Solomon, Shekelle, Young, Saliba, MacLean, Rubenstein, Schnelle, Kamberg & Wenger, 2000). Identifying an individual's nutritional risk enhances the health educator's and health care clinician's ability to promote positive health behaviors, design effective health education programs, provide cost effective care, speed recovery, reduce complications from illness and improve the quality of life in older adults, including older women.

National surveys such as NHANES I and the Nationwide Food Consumption Survey 1977-78, along with several smaller studies, have assessed food consumption and nutritional status in older Americans living in both urban and rural communities (Davis, et al., 1988; Posner, et al, 1994; Ryan, et al., 1992; Jensen, et al., 1997). Food intake data from these surveys indicates that the elderly generally consume less



food than required to meet nutritional requirements. Inadequate dietary intake for an extended period of time (e.g. weeks or months), can result in undernutrition (Grodner, Anderson & DeYoung, 2000). If under nutrition is extreme, the potential results are diminished muscle mass and vigor, functional impairment and decreased quality of life (Grodner, et al.).

Obesity and its risk to health has been the subject of national attention over the last few months. In the elderly, obesity appears to result from decreased physical activity and changes in metabolic rate (Merck, 2004; Allconet, 2004). In men, the prevalence of obesity is highest in middle age, and declines to 26% by the age of 65-74. In women, the prevalence of obesity is highest between the ages of 65-74, representing approximately 36% of the elderly female population (Merck). Obesity is generally a less important problem in the elderly than in younger individuals; the risk of protein deficiency and malnutrition is greater in the elderly population overall (Merck). Older adults are at greater risk for malnutrition due to under nutrition, especially due to insufficient dietary intake (Keller, Ostbye & Goy, 2004; Munro, 1984; Souter & Keller).

#### *The Third National Health and Nutrition Examination Survey*

The third National Health and Nutrition Examination Survey (NHANES III) is part of a series of nationwide surveys mandated by the National Health Survey Act to provide current statistical data on the health and diet of the people in the United States (National Center for Health Statistics (NCHS, 1994). The NHANES III is actually the seventh survey in the series and was conducted from 1988-1994 using a probability sample of non-institutionalized civilians in the United States.

Approximately 33, 990 people aged two months and over, with no upper age limit, were sampled. The survey used complex, multi-stage, stratified, clustered sampling to collect the data.

The data from NHANES III are gathered through five large data files through a household interview and physical examination (NCHS, 1994). The data files are 1) the Household Adult Data File; 2) the Household Youth Data File; 3) the Examination Data File; 4) the Laboratory Data File; and 5) the Dietary Recall Data File. In most cases, self-reported data is obtained. Physical examinations are accomplished in a mobile examination center (MEC). Along with the physical examination, several additional questionnaires are completed including a 24-hour dietary recall and a food frequency survey. In this study, information for the selected variables was obtained through self report during a personal interview with a trained examiner in the home and as part of the physical examination. The variable titled “body mass index” is obtained through calculations using measurements for weight and standing height obtained during the physical examination. One portion of the NHANES III uses laboratory data in which samples of various bodily fluids (e.g. blood or urine) are obtained. However, in this study, these types of data are not used.

Questionnaires for NHANES III, including the Household Screener Questionnaire, the Family Questionnaire, and the Household Adult/Youth Questionnaire are administered with an interviewer in the respondent’s home. These questionnaires provide data about a multitude of issues including age, gender, ethnicity, social support, exercise and activity, diet and functional impairment.

Additional data about nutritional status including food sufficiency and dietary intake is also obtained through interview and physical examination (NCHS, 1994).

#### Purpose, Research Questions and Hypotheses

The purpose of this study is to examine the relationship between the social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) and dietary intake in community-dwelling, elderly (i.e. 60 years or older) women. The NHANES III data set will be used because it is a large, national, multi-stage, stratified random sample of non-institutionalized individuals. Subjects in NHANES III were two months of age and older. The last grouping within the elderly age range is “90+”.

In this study, the social network is defined as the household social network size, the frequency of non-household family/friend contact and the frequency of organizational contact that the individual has within her personal environment. Social network will be measured using selected items from the NHANES III survey. Data will come from the Screener’s Interview Questionnaire and the Household Adult Data File. The Screener’s Interview Questionnaire contains information about the number of individuals within the household. The Household Adult Data File contains information on all subjects 17 years of age or older. The specific section that will provide additional information about the individual’s social network is labeled “Social support/residence”. Some information included in this section is the number of times per week the individual receives phone calls from family/friends or neighbors, the frequency of attendance at church services, and the frequency of attendance at club meetings outside the home.

In this study, dietary intake will be determined by evaluating the participant's body mass index (BMI), total food energy intake (TFEI) in kilocalories, selected dietary vitamin/food component intake and self-reported issues related to food security. This information is obtained from the 24-hour dietary recall, from height and weight measures collected during the participant's physical examination, and from the household questionnaire. In addition, the confounding effects of several other characteristics will be considered. These include age, ethnicity, education, income, exercise/physical activity and chronic health problems. The research questions and hypotheses are outlined in Table 2.

Table 2

*Research Questions and Hypotheses*

<b>Research Questions</b>	<b>Hypotheses</b>
<p>QUESTION 1. Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal total food energy intake (TFEI) as defined by the Dietary Reference Intakes (DRI) for community dwelling elderly women?</p> <p>Secondary Question 1: What is the relationship between social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) and optimal TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled?</p> <p>Secondary Question 2: Does TFEI differ based on age when the effects of household social network size, frequency of non-household</p>	<p>A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with optimal TFEI in community dwelling elderly women.</p> <p>There is a significant, positive relationship between the social network and optimal TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.</p> <p>There is a significant, positive difference between age and optimal TFEI when the effects of household social network size, frequency of non-household family/friend</p>

<p>family/friend contact and frequency of organizational contact are controlled?</p>	<p>contact and frequency of organizational contact are controlled.</p>
<p>QUESTION 2: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal body mass index (BMI) in community dwelling elderly women?</p> <p>Secondary Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and normal BMI when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?</p> <p>Secondary Question 2: Does optimal BMI differ based on age group when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?</p>	<p>A larger total social network (i.e. household social network size and frequency of non-household social network contact) will have a significant, positive relationship with normal BMI in community dwelling elderly women.</p> <p>There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal BMI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.</p> <p>There is a significant, positive difference between one's age and optimal BMI when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.</p>
<p>QUESTION 3: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components (i.e. dietary calcium, dietary vitamin D, dietary vitamin B12, dietary folate and dietary fiber) in community dwelling elderly women?</p> <p>Secondary Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact,</p>	<p>A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with an optimal intake of specific vitamins/food components in community dwelling elderly women.</p> <p>There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact</p>

<p>frequency of organizational contact and optimal intake of specific vitamins/food components when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?</p>	<p>and optimal intake of specific vitamins/food components when the effects of age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.</p>
<p>QUESTION 4: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security in community dwelling older women?</p> <p>Secondary Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?</p> <p>Secondary Question 2: Does food security differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?</p>	<p>A larger social network (i.e. larger household social network size, frequency of non-household family/friends contact and frequency of organizational contact) will have a significant, positive relationship with food security among community dwelling elderly women.</p> <p>There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.</p> <p>There is a significant, positive difference between age and food security when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.</p>

#### Rationale for this Study

This study is important because it examines the specific relationship between the selected social network characteristics and dietary intake in a sample of older women. The proportion of older women in the elderly population is growing and this growth is expected to continue over the next century. Older women tend to be poor and at risk for chronic illness or disabled. They are most often alone, with a limited social network. The population of older women, considered by many to be vulnerable

to negative health outcomes, has not been examined with the same frequency that other groups have been in the literature. This study provides specific and expanded information about the social network and its relationship to the nutritional status of older women.

Some researchers have examined associations that are similar to those in this study. For example, the effects of social support from physical closeness (proximity) to social network members, such as in marriage, religious salience and ties with neighbors were compared to the effects of simple emotional attachments to relatives, friends, and the community on dietary intake (McIntosh & Shifflet, 1984). The findings suggested that marriage, neighbors and religious salience contributed to higher intakes of specific nutrients (McIntosh & Shifflet). In another study, social support, measured with several indicators of social relationships and the social network, was evaluated in relation to certain stressors and dietary intake (McIntosh, Shifflet & Picou, 1989). These researchers found that friendship networks, as compared with spouse and family networks, contributed to better appetite and more adequate dietary intake (McIntosh, et al.). Others found a strong association between living arrangements and dietary intake (Davis, Murphy & Neuhaus, 1988; Davis, Randall, Forthofer, Lee & Margen, 1985). In these studies, a spouse or significant other, family, friendships, and whether living alone or with others (i.e. living arrangements) are all part of the social network. While these findings are important to our understanding of the social network and health, this study provides more specific and detailed information about the social network and dietary intake in a specific portion of the older population.

Several other features in this study are different from earlier studies. In the completed studies above, as well as others, the study population included both men and women. This study is different than many others because it focuses exclusively on a particularly vulnerable group of elderly, i.e. women. Some research suggests that elderly residents in nursing homes or similar long-term care settings are at great nutritional risk (Compan, diCatri, Plaze & Arnaud-Battandier, 1999; Frisoni, Fanzoni, Rozzini, Ferrucci, Boffelli & Trabucchi, 1994; Morley & Silver, 1995). However, few studies have examined nutritional status or dietary intake in community dwelling elderly, particularly elderly women.

This study also differs from previous studies because a large, randomly selected portion of the national population is used for analysis. Many of the existing studies have used smaller, more homogeneous samples. This study uses the third National Health and Nutrition Examination Survey (NHANES III), which gathered a wide-range of nutritional information from a large sample of individuals selected using a stratified, multistage probability design (CDC, 2001). A sample acquired in this fashion has the potential to control for a variety of threats to internal validity. In addition, a sampling design of this nature increases the representativeness of the study's sample, and with careful analysis can ultimately increase the generalizability of the findings from the research.

This study has the potential to increase our understanding of a significant health issue for growing numbers of elderly women: diminished dietary intake and under nutrition. Despite the information provided by large-scale national surveys that address specific nutrient and food consumption, information is still needed about



dietary intake. The prevalence rates for under nutrition and malnutrition in hospitalized and nursing home patients are well documented (Sloss et al, 2000). However, estimates of under nutrition and malnutrition for community-dwelling elderly are generally lower, and are studied less often (Gentleman, 2000; Jensen, Kita, et al, 1997). Understanding factors that contribute to nutritional deficits in older women will provide opportunities to develop prevention strategies and education programs.

Information learned from this study is valuable to both health educators and health care providers. The study's findings have the potential to supply important information regarding the identification of elderly women in the community who are at nutritional risk due to characteristics of the social network such as limited numbers or less frequent contact. Recognizing those at risk, health educators are able to use this information to develop programs for clients and caregivers identifying strategies enhance social networks that are limited, ultimately enhancing nutritional status. In addition, this information is beneficial to policy makers as they develop and finance local, state and national health promotion programs for community dwelling elderly, especially women. Finally, an understanding of the relationship between the social network and dietary intake in community dwelling older women offers a viable approach to improving overall health and quality of life for a growing portion of the older population.

## CHAPTER 2: LITERATURE REVIEW

### Introduction

Over the last three decades, the important relationship between the social environment and individual health and well-being has been recognized (Cassel, 1976; Cobb, 1976; House, Umberson & Landis 1988; Berkman & Syme, 1979; Dean, Holst, Kreiner, Schoenborn & Wilson, 1993). The concept was first linked to mental health issues in the early 1970's, but shortly thereafter, Cassel and Cobb noted the association between social support and physical health as well. The important association between social relationships and health has been evident in suicide, depression and other psychiatric disorders as well as physical conditions such as cardiovascular disease, tuberculosis and accidents (House, Umberson & Landis). Research examining the specific role of the social network, as the functional unit of social support (i.e. received support), on dietary intake, is limited. Research of this type in community dwelling elderly women is even more limited.

#### Social Support from the Social Network: Differentiating Terms

The belief that social relationships impact an individual's health is a central tenet of the social perspective of health and the basis of social epidemiology (Berkman & Glass, 2000; George, 1996). Social support research is diverse, confusing and assumes a variety of forms and functions. No one framework is consistently presented throughout the literature, a major source of ambiguity in the social support literature. Such inconsistency leads to a "proliferation of terminology and a host of overlapping typologies" (Vaux, 1988, p. 17). For example, the following terms are used in the literature to describe different types of social

support: instrumental vs. affective (Vaux, 1988); tangible, intangible, advice and feedback (Tolsdorf, 1976); emotional support, socializing, practical assistance, financial assistance, advice/guidance (Vaux,); emotional, appraisal, informational, and instrumental (House, 1981); instrumental and expressive (Lin, Dean & Ensel, 1986). Furthermore, within the literature, the following terms are frequently used interchangeably: social network, social support, social ties, social relationships and social integration (Allen, Ciambone, & Welch, 2000; House, Robbins & Metzner, 1982; Lin, Ye & Ensel 1999, Tolsdorf; Vaux).

In the following section, these terms will be described. This information is important because the terms are used interchangeably in the literature included in the review for this project. In addition, some research variables are elements of the social network, such as living arrangements or marital status, but are not the social network by definition.

#### Terms Used in the Literature

##### *Social Ties or Social Relationships*

Social ties link individuals to each other (Garton, Haythornthwaite & Wellman, 1997; Wasserman & Faust, 1994). A single relationship can establish and maintain a social tie or dyad with an individual, and is the most basic level (Wasserman & Faust). An individual may maintain multiple ties with people, such as when they share information together, give financial support to each other or attend educational conferences together (Garton et al.). In this case, there are multiple factors linking the two individuals. Although there may be multiple ties with many individuals, a tie implies the connection between a pair of individuals. Without social

ties, an individual cannot have a social network. Social isolation is the disengagement from social ties, connections or community participation (Seeman, 1996).

### *Social Integration*

Social integration is the extent to which an individual has social ties or social connection; it is the converse of social isolation (Seeman, 1996). Social integration refers to network participation and is generally determined by the diversity and range of the relationships (Brissette, Cohen & Seeman, 2000; Cohen, Gottlieb & Underwood, 2000). Individuals with more extensive social integration had better health outcomes (Berkman & Syme, 1979). Social integration for the elderly implies maintaining normative guidelines, meaningful roles and reference groups in old age that protects the older adult from feeling incompetent and ensures psychological adaptation, diminishes despair, and facilitates health promoting behaviors (Bissette, et al, 2000; Cohen et al, 2000; Heinrich & Ryff, 1993; Rook, 1984). This has important implications for the association of social network with dietary patterns in older individuals.

### *Social Network*

Social network is the finite set of individuals with whom one has a relationship. It refers to the structure of individuals that have a specific, designated relationship with the client, the focal individual or care recipient (Thoits, 1982; Anjrouch, Antonucci & Janevic, 2001). Social network refers to the “web of social relationships that surround an individual and the characteristics of those ties”, including all the individuals with whom the focal recipient has as an ongoing and

regular relationship (Berkman & Glass, 2000, p. 145). For most individuals, the social network includes immediate and extended family and friends or associates with whom the individual works or interacts regularly. In some descriptions, social network may include other members from organizations or church associations.

Table 3

*Social Network Characteristics*

<b>Network Characteristic</b>	<b>Definition</b>	<b>Nature of the characteristic</b>
Size or range	Number of individuals the focal individual has regular and ongoing contact as identified by focal individual.	Whole network
Frequency of contact	Number of face-to-face, phone or mail contacts recipient has with network members	Individual
Density	Extent to which network members are connected and interconnected	Whole network
Boundedness	Degree to which network is defined in terms of traditional group structures such as neighborhoods, work or church groups	Whole network
Multiplexity	Number of different types of transactions of types of support within the network and the content of these exchanges.	Individual
Duration	Length of time network member and focal individual has known each other.	Individual
Reciprocity	Extent to which social network members view exchanges as equitable, rather than one-way	Individual
Intensity	Strength of the social tie, i.e. whether close family or distant or paid assistance	Individual
Homogeneity	Extent to which network members have similar personal qualities	Individual
Emotional or feeling tone	Interaction quality within the social network	Individual

*Social Network Characteristics*

The social network is characterized by range or size, the frequency of contact or interaction, boundedness, homogeneity, duration, reciprocity, multiplexity or the density of the relationships (Berkman & Glass, 2000; George, 1996; Vaux, 1988).

Some characteristics describe the network as a whole, while other characteristics describe the individual network ties. Characteristics such as range or size, intensity and density increase the opportunities for individual assistance while others, such as frequency of contact, may be affected by location and distance (Berkman & Glass; Kaufman, 1990). An interaction's quality descriptors such as emotional or feeling tone help define the degree of instrumental and emotional assistance the individual receives from the social network (Kaufman). The characteristics of the social network are defined in Table 3.

#### *Negative Interactions within the Social Network*

Not all interactions or relationships within the social network are positive or supportive; some are negative, conflicted and otherwise unsatisfying to the recipient (George, 1996; Rook, 1984). In some cases, social network members engage in interactions they believe are positive and supportive to the recipient, but instead are critical, demanding or burdensome to the recipient (Rook). Some studies suggest that negative interactions have a more potent effect than positive or helpful interactions (Krause, 1995; Rook). Negative interactions are positively associated with poor health outcomes related to depression, adjustment to cancer, and recovery from stroke or alcoholism (Dakof & Taylor, 1990; George, 1996; Gordon & Zrull, 1991; Krause & Liange, 1993). Negative interactions in later life may be more detrimental than for younger persons because with advancing age the social network is made up of large proportions of family rather than friends (Antonucci & Akiyama, 1987; Krause, 1995; Rook).

### *Social Network Demographic Characteristics*

Individual social support experiences “arise out of contemporaneous and developmental conditions of life” (Turner & Marino, 1994, p. 194). Gender, age, marital status, formal or informal relationships, socioeconomic status and culture of social network members are some of the conditions that affect social support (Forthofer, Janz, Dodge & Clark, 2001; Krause & Borawski-Clark, 1995; Turner & Marino; Unger, McAvay, Bruce, Berkman & Seeman, 1999). The most powerful level of social support comes from an intimate, confiding relationship within the social network (i.e. from a spouse or significant other), followed by family and friends (Thoits, 1982; Turner & Marino). Ethnicity and religion also affect social network support. Ethnicity affects social network support because it influences opportunities available to individuals in different ethnic groups at different times in the life span, ultimately affecting social relationships (Anjrouch, Antonucci & Janevic, 2001). The social network support from religious groups is particularly well developed, partially due to the central, almost universal philosophy of helping and supporting others of most religious groups (Krause, Ingersoll-Dayton, Liange & Sugisawa, 1999). Thus, the characteristics of the individuals in the social network potentially affect the support provided to the recipient.

### *Social Support*

As described earlier in this document, the social network is the functioning unit of social support. Understanding the relationship between social network and social support is fundamental to understanding the impact of social relationships on

health. Available support may be limited by the size or structure of the social network (Krause & Markides, 1990; Thoits, 1982)

Social support is a complex, dynamic, multidimensional concept that refers to the tangible and intangible satisfaction that one derives from interpersonal relationships with others in social network (George, 1996). Social support, i.e. received support, is influenced by a variety of personal, economic and social forces operating on the recipient and those in this recipient's environment, including the social network structure from which social support comes (Walter-Ginzburg, Blumstein, Chetrit & Modan, 1998).

The social network structure influences health through different dimensions of social support. These dimensions rarely exist in isolation, and frequently overlap. Berkman and Glass (2000) point out that some ties or associations within the social network provide several different dimensions of social support, or may be specialized and provide only one type. In some cases, adding to the inconsistency in this perspective, several different terms are used to describe the same social support dimension. In addition, social support varies in frequency, intensity and extent of the support, characteristics that are similar to the social network (Berkman & Glass).

#### *Subjective or Perceived Social Support*

Received social support potentially has two qualities: the objective qualities of the supportive interactions, or the cognitive aspect, and the recipient's interpretation of the interactions, or the behavioral aspect (Berkman & Glass, 2000). Subjective or perceived support, refers to the recipient's perception that the support received from social network members is adequate, satisfactory and/or available (George, 1996).



Perceived support can be tangible or intangible; that is, the recipient can perceive that the support received is instrumental (tangible), informational (tangible) or emotional (intangible). Vaux (1988) states that in most cases, the perception and the actuality of the support correspond (p.16); however, in some cases the recipient's perception of the support differs from the reports of other observers.

Although instances exist within social relationships where the perception of support and the actual support received are divergent, the recipient's perception that help is available is sufficiently adequate to generate the positive effects of social support. In a similar way, if actual assistance is needed but not provided, potentially detrimental effects may occur not only from lack of actual support but also the cognitive reality that the recipient's perceptions have been incorrect (Vaux, 1998). In many cases, the perception of received support provides more benefit than actual supportive behaviors (Krause, 2001; Walter-Ginzburg, et al, 1999).

#### *Direct Effects vs. Buffering Effects*

Studies of social support and social network have focused on two models of received effects on health and well being: direct or main effects and buffering effects. The effects may act separately or simultaneously. The terms describe the mechanism by which the social network provides social support. Main effects are the direct association between the social network support and either physical or mental well-being or mortality; in this way, social support from network members has a direct affect on positive health outcomes independent of the stressors (Berkman & Syme, 1979; Blazer, 1982; Dean, Kolody & Wood, 1990; Penninx, Tilburg, Deeg, Kriegsman, Boeke & Van Eijk, 1997; Vaux, 1998). In the buffer model, support

moderates the effect of stressors on physical or mental well being (Vaux). With buffering effects, the awareness of support from network members moderates or protects the individual from the negative effects of stress, and the stressors have less impact (Cohen & Willis, 1985; Cohen, Teresi & Holmes, 1986; Lin, Woelfel & Light, 1985; Penninx, et al., Vaux).

#### Conceptual Models: Social Support/Social Network and Health

Over the years, various conceptual models have attempted to describe how the social network impacts overall health and well being. Early research focused on the number of close friends and family, marital status and memberships in religious and voluntary organizations (Berkman, 1986; Cassel 1976; Cobb 1976; House et al., 1988). These variables were conceptualized in a variety of ways, including social network, social ties, social connectedness, and social embeddedness (i.e. frequency of contact or being involved with the social ties (Berkman & Glass, 2000). Subsequent research focused more on the provision of social support from the social network rather than on the structural aspects of the social network (Berkman & Glass). For example, Kahn and Antonucci (1980) describe the individual in a life course perspective. Each individual is surrounded by a variety of social network members at different stages of the individual's life and through different life experiences. The social network and the individual provide support to each other reciprocally over time (Kahn & Antonucci). Thoits (1995) suggests that the protective effect of the social network comes from the provision of emotional support that facilitates coping with stressful life events. Others suggest the social network provides enhanced feelings of

self-esteem and control that protect the individual's health and well being (Krause & Borawski-Clark, 1994).

Berkman and Glass (2000) describe a comprehensive framework to demonstrate the relationship between the social network, social support and health.

The framework outlines multiple mechanisms by which the social network influences

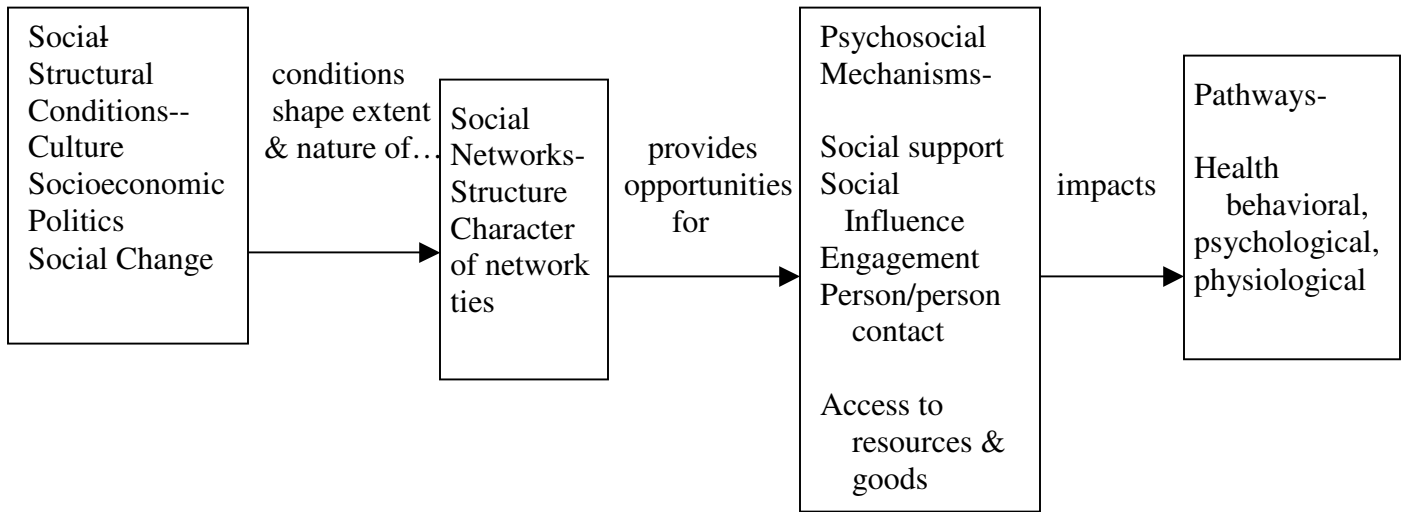


Figure 1. Diagram of the relationship between the social network and health outcomes. (Adapted from Berkman & Glass, 2000)

health outcomes. Berkman and Glass suggest a dynamic continuum of factors affect the nature of the social network and provide opportunities for the social network to affect and individual's health. Figure 1 represents the relationship between the social network and health outcomes described by Berkman and Glass.

Berkman and Glass (2000) suggest that social networks are 'embedded' in larger social and cultural contexts (p. 142). Social and cultural contexts are important because they contribute to the overall perspective in which the social network is formed. The social and cultural perspective includes cultural conditions, socioeconomic factors, political conditions and social changes experiences. For

example, cultural conditions include norms, values, sexism, racism, and competition or cooperation. Socioeconomic factors include conflict, poverty, inequality, and discrimination. Political conditions in this model are created by laws, public policy, and the political culture. Social change includes urbanization, war/civil unrest and economic depression (Berkman & Glass). These conditions shape the extent and nature of the social network.

The next element in this model is the social network itself. Two large domains are considered: the structure of the social network and characteristics of the ties. Structure refers to the size, range, density, boundedness, proximity, homogeneity and “reachability” of the social network (Berkman & Glass, 2000, p. 143). The characteristics of the social network ties identified are frequency of face-to-face contact, frequency of non-visual contact, frequency of organizational participation, reciprocity of ties, multiplexity, duration and intimacy. It is important to note that in the proposed project, the social network is defined in terms of the size and frequency of contact with family, friends or organizational associations.

In this model, the social network provides opportunities for psychosocial mechanisms to occur. Psychosocial mechanisms represent ways in which the social network might influence health (Berkman & Glass, 2000). In this framework, many types of support affect health status; not all of these are supportive. Furthermore, there are several different types, frequencies, intensities and extent to support. The first mechanism, social support, includes instrumental, financial, informational, appraisal and emotional support. (These terms are defined in Table 1 in this document.) Another psychosocial mechanism, social influence, includes forces that

constrain or enable health behaviors, norms toward help-seeking adherence, peer pressure and the social comparison process (Berkman & Glass). Social engagement, another psychosocial mechanism, includes physical/cognitive exercise, reinforcement of meaningful social roles, and bonding/interpersonal attachment (Berkman & Glass). Person-to-person contact such as close person or intimate contact may also influence health. Finally, access to resources and material goods, such as economic opportunity, access to health care, housing and human capital are mechanisms that impact health outcomes.

In the last portion of this model, Berkman and Glass (2000) identified three pathways through which the psychosocial mechanisms affect overall health. First, the human behavioral pathway which includes smoking, alcohol consumption, diet, exercise, compliance with medical regimens and help seeking behavior. Another mechanism, the psychological pathway, includes self-efficacy, self-esteem, coping effectiveness, depression and a sense of well being. The final mechanism is the physiologic pathway, which includes immune system function, cardiovascular reactivity and fitness and transmission of infectious disease.

This model most closely represents the suggested relationship of the variables in this study. The social network provides opportunities for social support (Berkman & Glass, 2000). The analysis will consider the effects of several social structural conditions in relation to the social network, including ethnicity, income and education. Psychosocial processes in the proposed project include frequency of contact with family and friends, both in face-to-face, and in non-visual ways. Social support from the social network impacts on health outcomes; in the proposed project,

the health outcome is dietary intake, specifically BMI, TFEI, selected vitamins/food components and food security issues.

### Social Network and Nutrition

Little research exists specifically examining the relationship between social network and dietary patterns in older women. Social support in general has been shown to have an effect on dietary intake in both younger age groups and older adults (Kristal, Patterson, Glanz, Heimendinger, Hebert, Feng, & Probart, 1995; McIntosh & Shifflett, 1984; Toner & Morris, 1992). A variety of factors related to the social network have been evaluated in relation to nutrition or dietary variables including living arrangements, marital status, program participation and interpersonal relationships (McIntosh, Shifflet & Picou, 1989; Smith, Mullins, Mushel, Roorda, Colquitt, 1994; Toner & Morris). Like other social epidemiological research, research specifically examining social network and dietary intake is limited by ambiguous or overlapping definitions and inconsistent use of terms. Terms used for nutrition or dietary variables in the literature include: anthropometric indices (Burns, Nichols, Calkins, Blackwell & Pragay, 1986; Tully & Snowdon, 1995), dietary adequacy (Walker & Beauchene, 1991), dietary intake (Toner & Morris; McIntosh & Shifflet; McIntosh, et al; Schoenberg, 1998), dietary practices (Popkin, Haines & Patterson, 1992), food patterns (Slesinger, McDivitt & O'Donnell, 1980), dietary quality (Ryan, Craig & Finn, 1992), dietary patterns (Ryan, Craig & Finn, 1992), eating behavior (Hays, Bathalon, Roubenoff, Lipman & Roberts, 2002), nutritional status (Burr, Milbank & Gibbs, 1982; Ritchie, Burgio, Locher, Cornwell, Thomas, Hardin & Redden, 1997), nutrient intake (Ryan, Craig &

Table 4

*Dietary and Nutrition Terminology*

<b>Term</b>	<b>Definition</b>	<b>Measurement strategies</b>
Anthropometric indices or parameters	Objective body measures indicative of nutrition	BMI, usual body weight, mid-area muscle area, triceps skin fold, ideal body weight percentiles measures
Dietary Intake	Food choices as part of the daily diet	24-hour dietary recall (i.e. asking respondent to recall all foods and amount eaten in the preceding 24 hours), direct observation, or menus as compared to RDA
Dietary Patterns	Food consumption practices, including frequency and cycle of use	Food diary, 24-hour dietary recall
Dietary Practices	Food consumption practices	Food diary, 24-hour dietary recall, behavior survey
Dietary Quality	Energy and nutrient intake, food or meal frequency, food group intake, skipped meals	Biochemical analysis and food diary and survey information
Eating Patterns	Frequency of eating, skipping meals, meals eaten alone, foods consumed before rising, etc.	Food diary, 24-hour dietary recall
Eating Behaviors	Attitude toward and relationships with eating and food.	Food diary, 24-hour dietary recall, survey information
Food patterns	Includes food intake and eating patterns	Food diary. Does not routinely include precise amounts of food quantities
Nutrient intake	Analysis of specific nutrients consumed as part of the diet	Analysis of nutrient from information obtained from food diary and 24-hour dietary recall
Nutritional risk	Assessment of health factors, nutritional status and dietary patterns as a predisposition to or indication of malnutrition	Health assessment, 24-hour dietary recall, biochemical analysis, nutritional status indicators (e.g. BMI, weight)
Nutritional status	Biochemical measures (i.e. nutrients), clinical signs or anthropometric values with dietary patterns	BMI, serum levels for specific biochemical indicators, such as folate, calcium, cholesterol, albumin, 24-hour dietary recall

Finn), and nutritional risk (Jensen., Kita, Fish, Heydt, & Frey, 1997; Posner, Jette, Smigelski, Miller, & Mitchell, 1994; Souter & Keller, 2000). Some research focuses on nutrition program participation as an indicator of eating or dietary behavior by

evaluating nutrition site attendance Burkhard, Lago & Blattenberger, 1983) or nutrition program participation (Peterson & Maiden, 1991). Definitions for some dietary or nutrition terms in the literature are listed in Table 4.

While some literature suggests that the social network has a positive effect on various measures of nutritional status, no consistent mechanism has been proposed for this specific relationship. McIntosh and Shifflett (1984) suggest that dietary intake is a preventative health behavior. Supportive social relationships have a direct effect on good health. They hypothesize that different types of social network support (i.e. marriage, neighbors or religious salience) affect dietary intake. Social support that is positive affects dietary intake, a health outcome, in a positive way. McIntosh, Shifflett and Picou (1989) hypothesize that the risk of poor nutritional health, indicated by a reduced dietary intake, is minimized in older adults with high levels of social support. Stressors such as financial problems contribute to poor appetite and reduced dietary intake (McIntosh et al.). In this case, social support from network members acts as a buffer against the negative effects of poor appetite on dietary intake (McIntosh, et al.). As with the earlier work of McIntosh and Shifflett, McIntosh et al. confirm that the type of social network (e.g. friendship vs. marital status vs. companionship) affects social support. Toner and Morris (1992) explored the relationships between dietary intake and nutrition support in relation to self actualization. Through their investigation, Toner and Morris proposed that food fulfills a variety of intra- and interpersonal needs that are part of overall well being. This relationship can be explained through a preventive health orientation model



(Toner & Morris). In this model, self actualization and social support have a positive and direct effect on dietary quality.

Torres, McIntosh & Kubena (1992) did not identify a specific mechanism to explain the effects of social network on eating. They did, however, identify characteristics of the individual as well as the social network that determine when an individual will eat alone no matter what living arrangements might exist. First, Torres et al. suggested that people compensate for fewer living companions by using their social network members for companionship. Torres et al. contend that as functional impairment increases and the ability for self-care decreases; the likelihood of living alone decreases as well. In this way, individuals who need help with cooking or eating may eat with others for the inherent assistance (i.e. tangible support). At the same time, disabilities that cause inconvenience or embarrassment may increase the individual's desire to eat without network members.

#### *Foundational Research*

The works of McIntosh and Shifflet (1984) and McIntosh et al. (1989) closely parallel the proposed project. McIntosh and Shifflet examined the association between social support and dietary intake in elderly individuals in both rural and urban settings. Social support was measured by the frequency of contact with relatives, friends, neighbors, religious salience (i.e. the degree to which religious beliefs were perceived to affect the respondent's everyday life), localism (i.e. attachment to the local community versus the outside world), marital status, and living arrangements (McIntosh & Shifflet). Social support characteristics such as frequency of contact, marital status and living arrangements have been identified in

this proposed study as social network characteristics. Dietary intake in the study by McIntosh and Shifflet was defined as the specific nutrients consumed by the participants from a self-reported 24-hour dietary recall.

Social support from spouses or neighbors resulted in significantly higher intake in specific nutrients, calories and better overall food quantities in this study (McIntosh & Shifflet, 1984). McIntosh & Shifflett confirm some relationships in the social network support have a negative effect on dietary intake, with lower intake in some nutrients. In this case, strong attachments to relatives, friends and the community had the same affect on nutrient intake as living alone. This underscores the need to better understand both positive and negative social network factors that impact on dietary intake.

Subsequently, McIntosh et al. (1989) evaluated the effect of friendship and companionship on dietary intake. In this study, McIntosh et al included marital status, the number of close friends, friendship density (whether these friends were friends among themselves), the extent of advice from friends, frequency of disagreements, mealtime assistance and companionships as descriptors of social network support. Using a sample who was mostly White (90%), mostly female (82%), mostly low income and living in rural communities, this study found that friendship and companionship were associated with improved dietary intake (McIntosh et al.).

The work of McIntosh and Shifflet (1984) and McIntosh et al (1989) provide more specific information about social network and dietary intake patterns than previous studies. Both studies are an important foundation for the proposed study.

However, the small sample sizes (N=201 and N=170 respectively) as compared with the proposed sample and the samples' homogeneity limit the studies' generalizability. This study builds directly on knowledge obtained from these two studies and incorporates a larger probability sample focused on women and increased diversity.

#### *Other Social Network and Nutrition Research*

Some studies evaluated the supportive role exercised by specific network members (Marcoux, Trenkner & Rosenstock, 1990; Toner & Morris, 1992).

Consistent with McIntosh et al (1989), Marcoux et al. found that neighbors and friends were the greatest source of both general support and support specific to weight control; spouses and family members were highest rated for general instrumental support (i.e. grocery shopping, transportation, child care). These findings are consistent with Toner and Morris, who found the informal sources (i.e. family and friends) were associated with improved dietary intake.

Both studies had limitations. Marcoux et al. (1990) used a small, self-selected sample (N=26) that was mostly female (92%), married (54%), employed (81%) and ranged in age from 24-61 years. Toner and Morris (1992) sampled 100 community-based elderly, a sample that closely parallels the proposed study except in size. This study was designed to extend the knowledge acquired from these studies by using a large, probability sample with increased cultural and ethnic diversity.

Other studies examine specific elements of the social network, such as living arrangements. Living alone increases nutritional risk. (Davis, Randall, Forthofer, Lee & Margen, 1985; Davis, Murphy & Neuhouse, 1988; Slesinger, et al, 1980; Torres, McIntosh & Kubena, 1992; Davis, Murphy, Neuhouse, Gee & Quiroga, 2000). Data

from the first NHANES noted increased nutritional risk for older adults living alone, especially men (Davis et al., 1985). A subsequent study, using data from the 1977-78 Nationwide Food Consumption Survey, examined the effects of living arrangements on selected eating behaviors (i.e. eating alone, eating away from home, calories consumed at various times of day, meal skipping, snacking, and use of ready-to-eat cereals) in a sample aged 55-98 years (Davis et al.,1988). In this study, more women were living alone. People who lived alone were more likely to eat alone and skip meals; the percentage of meals eaten alone increased with age in this group (Davis et al., 1988). Davis et al. (1988) found that women over the age of 75 living with others (not a spouse) demonstrated eating behaviors similar to those living alone. The researchers suggest that it is not merely living alone that influences eating behaviors but that the presence of a spouse has added significance (Davis et al., 1988). This finding agrees with previous research indicating marital status is more closely associated with dietary quality and intake than the number of individuals in the household (Davis, et al., 1985; McIntosh & Shifflett, 1984). Davis et al. (2000) further evaluated the affects of ethnicity on the association of living arrangements and dietary quality. They found no significant effects from ethnicity, but suggested that more research is needed. This study examines older women and ethnicity, increasing existing knowledge in these areas.

Social interaction and exchange at mealtimes has a beneficial effect on diet and health (Goodwin, 1989; Marcoux et al, 1990; Smith, et al., 1994; Walker & Beauchene, 1991). Social interaction implies the presence of a social network. Fostering social interaction was a fundamental purpose of congregate meal programs

studied by Smith et al. Loneliness and social isolation are associated with poor nutrient intake in the elderly (Walker & Beauchene). Loneliness was measured by limited or absent social network contact, such as daily telephone calls made or received, the respondent's participation in group activities, visits from or to friends, neighbors, relatives' or significant others during an identified period. Torres et al. (1992) included network density and network size as a measure of social contact. The number of social contacts is inversely related to loneliness: as contacts decrease, loneliness increases. These studies confirmed that being alone increased nutritional risk.

Several demographic characteristics, such as gender, age and income, that impact social network members have been evaluated in association with dietary intake, with mixed results. Slight differences in nutrient intake have been found related to gender (McIntosh et al. 1989; Walter & Beauchene, 1991; Torres et al. 1992). Elderly women are more likely to live alone or have limited financial resources, implying an enhanced nutritional risk. However, the number of men in Walter and Beauchene's sample was too small to fully evaluate gender differences. Slesinger et al. (1980) evaluated food intake in relationship to age (18 and older) and other socioeconomic factors, finding that most socioeconomic variables (age, education and gender) had no effect on food intake and eating patterns. Income did have a significant detrimental effect on dietary intake (Slesinger et al). However, this study provides little information about the social network as a whole and older adults were not adequately sampled.

Other studies show the effect of demographic characteristics on social network support and dietary intake as well. Pierce, Sheehan and Ferris (2001) evaluated the perception of social support in a group of older women in relation to health related diet changes (i.e. physician prescribed or self prescribed diet modifications). Less than half of the women sampled received social network support for health related diet changes (Pierce, et al.). Single women with low incomes were at risk for malnutrition and benefited from social network support (Pierce, et al.).

Widowhood in elderly women also has a profound effect on nutritional status (Quandt, McDonald, Arcury, Bell & Vitolins, 2000). Quandt et al. identified two recurring themes in this group. First, the husband's death is only one event in a life course transition; in most cases, the women had been care giving for their husbands and managing the husband's terminal illnesses, most of which involved altered eating behaviors and food practices. Secondly, "widowhood lifted the food-related obligations" of a wife (Quandt et al., p.90). Many women reported changes in food intake and meal structure such as skipping meals, less food prepared at home and less overall dietary intake (Quandt et al.).

Few studies evaluate ethnicity specifically in relation to the support network and diet. Some evaluate different ethnic or cultural groups in relation to social factors associated with health in general or dietary intake specifically. For example, Walker & Beauchene (1991) studied the relationship between loneliness, social isolation as compared to physical health and dietary adequacy. Several demographic characteristics, including age, gender and ethnicity were considered in relation to

loneliness. Walker & Beauchene found ethnicity did not affect nutrient intake in women. African American participants in this study reported a higher degree of loneliness than Whites, but no significant differences in nutrient intake were found between African American and White women (Walker& Beauchene). Their study is similar to the proposed study since both evaluate the effects of social network (i.e. social contacts) in relation to nutrient intake and consider the effects of ethnicity. The samples in both studies are closely matched, although this study's sample size is a considerably larger probability sample.

#### *Implications of this Study*

Several findings from these studies are important to this study. Advancing age increases nutritional risk; furthermore, network size decreases with increasing age and the social network size affects nutrition (McIntosh et al., 1989; Smith et al., 1994). The smaller the social network, the greater the detrimental affect on nutrition. Some researchers have shown that women, especially single women or widows, are particularly vulnerable to poor nutrition (Pierce et al. 2001; Quandt et al. 2000). Women living alone are more vulnerable to poor nutrition as well (Davis et al., 1985.)

Specific social network members have been shown to have more positive effects on dietary intake in comparison to other groups. The presence of a spouse, friends and even neighbors has been shown to be more beneficial than other network members (McIntosh et al, 1989; Davis et al., 1985; Davis et al., 2000).

This study will expand the existing knowledge of the relationship between dietary intake and social network support in several ways. This study uses a large, probability sample of older women rather than the non-probability samples used by

several previous studies (Smith et al., 1994; Toner & Morris, 1992; Walker & Beauchene, 1991). In addition, a specific definition of the social network is used to determine fundamental information about the size and frequency of contact within the social network.

#### Social Support, Social Network, Overall Physical Health and Mortality

During the last 35 years, literature has accumulated linking social support to physical health and mortality (Berkman & Syme, 1979; Broadmead, et al., 1983; Cassel, 1976; House, Landis & Umberson, 1988). The research in this section describes social support derived from the social network although the term “social network” is not specifically used. However, since social support comes from some social network members, this link between social support and the social network is a natural one. A similar link is evident between physical health and dietary intake. Morbidity and mortality may result from poor dietary intake and may be prevented by improving dietary intake quality.

The literature in this section is important to this research since studies specifically examining social network support and dietary intake or nutrition are limited in number. However, findings from studies of the association of social network or social support to physical health or mortality suggest that social network may be important to dietary intake, the health outcome in this study.

#### *Foundational Population Studies*

Individuals with social network support live longer than those without social support (Berkman & Syme, 1979; Blazer, 1982; Seeman, 1996). The Health and Ways of Living Study, commonly referred to as the Alameda County study, is a



survey of more than 6900 adults in this California County that explored the association between social and community ties and mortality. Data were gathered from individuals 30-69 years of age with a nine-year follow up period (Berkman & Syme). Social network included marital status, contact with close friends and relatives, church membership and group associations. Individuals with social ties had lower mortality rates; friends and family had the greatest effect on mortality when compared to church or community group membership (Berkman & Syme). Mortality risk increased with decreased social interactions, decreased perceived support and decreased roles, all functions of the social network (Blazer).

Findings similar to those from Alameda County were obtained in other large community based, prospective studies, including the Tecumseh Community Health Study in Michigan and the Evans County Cardiovascular Epidemiological Study in Georgia (House, Robbins & Metzner, 1982; Schoebach, Kaplan, Fredman & Kleinbaum, 1986). The Tecumseh, Michigan project, an ongoing (30 year) longitudinal, prospective study, included health and physical examination data from approximately 15,000 individuals. Some subsequent research replicated portions of the earlier Alameda County, California study or conducted a secondary analysis of the study data, with findings consistent with the original study (House et al.; Inter-University Consortium for Political and Social Research, 1992; Schoebach et al.; Seeman, Kaplan, Knudsen, Cohen & Gurlanik, 1987). House et al. used a middle aged sample (age 35-69 years) from Tecumseh County, Michigan and included biomedical measures absent in the Alameda County, California study. Their findings

extend those of Berkman and Syme (1979), suggesting that social relationships and activities lower mortality risk (House et al.).

Schoenbach et al. (1986) used a slightly older sample (age 40 and older) than House et al. (1982), who were originally recruited from the Evans County (Georgia) Cardiovascular Epidemiologic Study. The researchers revised Berkman's Social Network Index to provide more consistent social network measurement (Schoenbach et al.). The revised scale considered marital status, group and church memberships, and contacts with family, friends and intimate others (Schoenbach et al.). Social network ties, especially with close friends or relatives, assume greater importance to good overall health and reduced mortality risk for people aged 60 and older (Schoenbach et al., Seeman et al. 1987). Isolation from family and friends in the social network was shown to be a significant predictor of mortality in the older groups, even after controlling for other factors (Schoenbach et al.).

Seeman, Kaplan, Knudsen, Cohen & Guralnik (1987) also found that marital status was not as significant in protecting against mortality as friends or relatives in those over age 70, an unexpected shift from earlier findings that marital status was a significant factor on both positive mental and physical health (House et al. 1982). Seeman et al. suggested this was related to "misclassification from age-related shifts in the social network structure" during the 17 years of the study (p. 721). Marital status for some participants may have changed during the time of the study. Women over 70 years, for example, were more likely to be widowed during the time of the 17 year follow-up. Thus the marital status reported by the participant at the initiation of

the study potentially became less important as part of social support or even inaccurate over the span of this longitudinal study.

As with social network and nutrition studies described previously, no definitive and clearly accepted definition of the term “social network” exists in the literature concerning social network and physical health or morbidity. Some studies of morbidity and mortality consider church membership as part of the social network; however, few isolate church membership or religiousness as a predictor of mortality in the elderly (Berkman & Syme, 1979; Blazer, 1982; Seeman et al, 1987). As with most findings about social network and health, when church membership is included as part of the social network, overall health improves or mortality is reduced. When religiousness (i.e. religious beliefs or attitudes) is isolated or considered as a separate variable, overall health also generally improves, especially among elderly in poor health (Zuckerman, Kasl & Ostfeld, 1984).

#### *Limitations of these Foundational Studies*

Despite the consistent finding that social network support reduces morbidity and mortality, these studies of social network, physical health and morbidity/mortality have several limitations. No consistent design was used. Social network definitions generally vary within each study. Sample size, respondent characteristics, and the length of time for follow up also vary between the studies (Berkman & Syme, 1979; Blazer, 1982; House et al., 1982; Seeman, et al., 1987).

Other inconsistencies in these findings can be attributed to measurement. Of the studies reported here, different indices for social network and social support were used in most cases (Berkman & Syme, 1979; House et al, 1982; Schoenbach et al,

1986). While Schoenbach et al.'s findings support those of Berkman and Syme, Schoenbach et al. measured social network differently. For example, the former used the number of friends the respondent felt close to while the latter used frequency of contact with families living nearby (Berkman & Syme; Schoenbach et al.). The number of relative families, the frequency of visits with relatives and the number of close friends were not related to mortality risk (House et al.; Schoenbach et al.). Schoenbach et al. conceded that the specific social ties studied may differ based on the regions of the country used in each study. Shumaker and Hill (1991) suggested that rural settings promote denser social networks, with overlapping friendships and more kinship as compared to the more diverse, urbanized networks. All of these factors make it difficult to generalize findings from the studies.

#### *Comparisons to Earlier Social Network Support Research*

Two recurring social network characteristics, network size and structure (i.e. frequency of contact), are evident in research of physical and mental health outcomes and in association with a variety of chronic illness outcomes as well (Kaplan & Hartwell, 1987; Colantonio, Kasl, Ostfeld & Berkman, 1993; Ford, Ahluwalia & Galuska, 2000). In most cases, larger social networks and their corresponding structures have a beneficial effect on physical and mental health. However, the findings from some research of specific chronic illness outcomes are inconsistent with these findings.

One study that exemplifies this inconsistency, completed by Kaplan and Hartwell (1987), examined social support satisfaction and social network size in relation to control of diabetes. The 68 people in this sample were advised of the

complex diet and exercise regime necessary for control of non-insulin dependent diabetes mellitus (NIDDM). Social network satisfaction and size was evaluated at the outset of the study. Kaplan and Hartwell found the larger the social network for women, the less likely they were to attend diabetes support meetings, complete their activities within this program and the women had a lower probability of attending clinic sessions, a negative effect of the social network. Network size did not have this same detrimental effect with men in the sample.

Network size was also associated with an increase in the number of symptoms reported by women; individuals with larger networks reported more symptoms (Kaplan & Hartwell, 1987). However, the opposite trend occurred in men; number of symptoms reported decreased when network size increased. The negative effects of social support on the outcomes were not clearly understood in this study, and further research is needed.

Colantonio et al (1993) findings were inconsistent with those of Kaplan and Hartwell. They found that social network size improved stroke outcomes in non-institutionalized elderly clients, findings more consistent with earlier research (Colantonio et al.). Clients with larger social networks had fewer physical limitations post-stroke and a decreased risk of institutionalization (Colantonio et al).

Colantonio et al.'s (1993) study is important because of its similarities to the proposed research. Colantonio et al. and the proposed study use probability samples, although the sample size in the proposed study will be larger than Colantonio et al.'s. The participants in both studies are non-institutionalized elderly individuals. The study in described in this document focused on network size and frequency of contact

in association with one characteristic important for overall health, i.e. nutritional status; Colantonio et al's study focused on a specific disability. The study described here incorporates only women, however, while Colantonio et al. used both men and women.

Ford, Ahluwalia and Galuska (2000) examined the effects of social relationships on chronic illness, specifically cardiovascular risk factors. This is another study that closely parallels the study described here in several ways. Ford et al. used data from NHANES III, including the specific items about social network (i.e. frequency of organizational relationships and individual relationships) identified for use in the proposed study. Risk factors evaluated by Ford et al. included cigarette smoking, lack of blood pressure checks during the previous year, lack of cholesterol check during the last year, lack of physical exercise and limited amounts of daily fruit and vegetable intake. This study examined the “structural components of one's social networks as reflected by the frequency of interactions between and individual and his or her family or friends ...” (Ford et al., p. 89). This is the foundation of the social network examined in this study as well. Social relationships in Ford et al's study had a significant effect on risk factors for cardiovascular disease such as diet; individuals with more elements of social network support (i.e. being married, contact with friends or family, organizational participation) were more likely to engage in physical activity, have a healthy diet, have their blood pressure and cholesterol checked and participate in smoking cessation activities, findings consistent with earlier studies (Berkman & Syme, 1979; House, et al, 1982; Ford, et al.).

*Studies of Social Network, Physical Health, Morbidity/mortality from other Cultures*

Findings from other cultures (i.e. Australia, Finland, Japan and Sweden) are generally consistent with findings from American studies: the social network, and the social support it generates, improves physical health and prevents mortality (Hanson, Isacson, Janzon & Lindell, 1989; Sugisawa, Liang & Liu, 1994). Like American studies, research designs and descriptions of the social network variable differ in each study. The Australian and Finnish studies examine selected elements of the social network: marital status and living arrangements or social connections respectively (Gliksman, Lazarus & Leeder; 1995; Kaplan, et al.; 1988). Social connections and marital status were significant risk factors for cardiovascular disease and/or mortality. Hanson et al., in a Swedish sample of elderly men, defined social network as a sum of several parts: social anchorage (i.e. the degree to which the individual belongs to and is anchored in formal and informal groups and describes a feeling of membership), frequency of contact and social participation (i.e. how actively the individual takes part in the activities of the formal and informal groups). Social support was generated from the interactions of the individual within the social network. Sugisawa et al., in the Japanese sample, described aspects of the social network in a similar way, measuring frequency of contact and social participation like Hanson et al., and adding marital status. However, in the Japanese study, effect of the perceived or real absence of the social network (i.e. loneliness) was assessed. These studies found that social network reduces mortality; Hanson et al. found an independent association between specific aspects of the social network and all cause mortality (p. 106). Individuals with low participation or who lived alone had a greater mortality risk than individuals who were more active or lived with others. Sugisawa et al., on the other

hand, differentiated between the direct effects of the social network support on mortality and the indirect or buffering effects. In this case, social participation demonstrated stronger effects on mortality rather than frequency of contact; social participation, one aspect of social network, decreased mortality.

*Parallels of Social Network and Morbidity/mortality Studies to this Study*

There are several parallels between this study and these studies of social network and physical health and mortality. Berkman and Syme (1979) and Hanson et al. (1989) considered aspects of the social network to life-style measures such as smoking cessation, blood pressure measures and dietary intake including BMI, one of the dietary intake measures suggested for the proposed study. Social network characteristics examined by Berkman and Syme are similar to those suggested for this study as well. In fact, some questions used by Berkman and Syme in the Alameda County study, such as identifying the number of friends and family, are similar to items in NHANES III, the data set for this study.

The Alameda County study was not representative of the older population since the sample's upper age limit was 69 years (Berkman & Syme, 1979). Blazer's (1982) sample of community based elderly 65 years or older is more consistent with the proposed sample. The longitudinal design used in both these studies has some limitations (Berkman & Syme; Blazer). Respondents may have entered the study in excellent health, but became ill during the follow up period, subsequently changing their social network support needs. Thus, the effects of social support on physical health may be inaccurately credited or discredited. This study's cross-sectional design



and stratified sampling technique helps to alleviate this effect since data are gathered at one time. In addition, the sample size is larger in this study.

#### *Social Network and Specific Physical Impairments or Disabilities*

Social network is considered important to individuals with physical impairments or chronic illnesses because the social network may provide both instrumental and emotional support (Broadmead, et al., 1983; Unger et al., 1999). In addition to the research related to overall physical health and mortality cited earlier, a variety of specific chronic conditions have been evaluated in relation to social network, including cardiac conditions, diabetes and strokes (Kaplan & Hartwell, 1987; Norris, Stephens, & Kinney, 1990; Colantonio, Kasl, Ostfeld & Berkman, 1993). As with the research associating social network support to physical health and mortality, some research identified in this section does not examine social network specifically. However, social support comes from some social network member or a portion of the social network. The connection between social support and the social network is natural.

The relationship between social network support and these chronic illnesses differs depending on several factors, including the characteristics of the social network, the type of chronic condition, the course, prognosis or degree of disability associated with the condition. In some cases, the chronic conditions evaluated are dependent on dietary compliance (e.g. cardiac conditions and diabetes), and the findings of these earlier studies have direct impact on this study.

## Social Network and Quality of Life Indicators

An individual's quality of life is affected by many factors including physical health, dietary intake, nutritional status and the ability to live independently. Research suggests a relationship between the social network and quality of life indicators in the elderly, such as institutionalization. Findings from studies examining the association between the social network and quality of life indicators are applicable to the proposed research because dietary intake ultimately affects nutritional status, another indicator of quality of life.

Steinbach (1992) used a sample from the Longitudinal Study of Aging (LSOA) to evaluate the effect of social networks on institutionalization and mortality in the elderly. The LSOA interviewed more than 7000 individuals, age 77 and older, concerning living arrangements, family structure and support, institutionalization and a variety of other life style and health issues (National Center for Health Statistics, LSOA, 2003). Decreased social activities, decreased visits/talks with friends or relatives and living alone were associated with institutionalization and/or mortality in the presence of increasing age in this study (Steinbach). This research was one of the first to identify social network characteristics, other than living arrangement, as factors in prevention of institutionalization. The presence of a supportive social network, not marital status, may delay institutionalization in older adults.

Social Network, Socioeconomic Status, Gender and Ethnicity Associated with  
Morbidity/mortality

The strongest predictors of mortality risk and poor health in the older age group were being male, increasing age, poor objective health status and low network size (Berkman & Syme, 1979; Shye, Mullooly, Freeborn & Pope; 1995; Schoenbach, et al., 1986; Unger et al., 1999). Social network structure differs dependent on gender (Shye, et al.). In general across the life span, and specifically in older age groups, men tend to have larger but less intensive networks (Shumaker & Hill, 1991). Both men and women were more likely to rely on women as their primary support sources, but in times of need women were more likely than men to mobilize the social network (Shumaker & Hill).

Social network size, a variable in this study, provides direct protection against the risk of mortality for both men and women (Shye et al., 1995). However, Yasuda et al. (1997) identified slight variations from earlier studies in this finding when comparing young-old (65 -74 years) and old-old (75 and over) women (Berkman & Syme, 1979; Pugliesi, 1998; Schoenbach et al., 1986; Seeman et al., 1987). Yasuda et al. examined age-related differences between discrete social network characteristics (i.e. availability of network resources, contact with resources and neighborhood integration) and 5-year mortality for approximately 800 aged White women living in the community. In previous studies, living alone increased mortality risk, but in the study by Yasuda et al, mortality risk did not increase for women living alone. Mortality risk for women living alone was approximately half that of women living with a spouse; in the young-old women (65-74 years), the mortality risk for those living alone was lower than those in any other living arrangement. In the oldest age

group (75 years and older), there was no association between living arrangements and mortality (Yasuda et al.).

Yasuda et al (1997) suggested that the women in these groups (64-74 years and 75 years and older) compensated for living alone by selecting other network resources to ensure social engagement and ultimately created a protective effect against mortality. Although these women lived alone, they had contact with neighborhood resources and integrated into the neighborhood, suggesting a protective effect in this age group from neighborhood contacts and integration (Yasuda et al). These variations in findings also suggest that more “gender-sensitive” approaches in this type of research are needed (Shye et al., p.945). The study described in this document is consistent with this recommendation since the sample focuses exclusively on women. Yasuda et al. also noted the importance of additional research in the multiple, discrete elements of the social network. The study described in this document may enhance information on some specific characteristics within the social network (frequency of contact and number of members in the social network) for women living in the community.

The effects of the social network on health differ between men and women depending on whether the individual lives in a rural or urban setting (Berkman, 1986; Shumaker & Hill, 1991). These findings are supported by the large scale studies of Tecumseh County, Michigan, Evans County, Georgia and Alameda County, California (House et al., 1982; Seeman et al., 1987; Schoenbach et al., 1986). Shumaker and Hill stated that rural settings promoted denser social networks. Network density refers to the extent to which the network members are directly

connected and interconnected with each other (Brissette, Cohen & Seeman, 2000). Dense networks have multiple ties between members. This can be beneficial to the network member since this creates the potential for multiple helping relationships. Social networks in urban areas usually have less interconnectedness among its members. The effects of the social network are potentially less pronounced in the rural community because an individual may be included in many smaller networks or relationships. For example, an individual without children may have other family (nieces or nephews) or friends in the same community. Thus, the social network effects are potentially less dramatic for women living in the rural community. This study will help clarify this finding since the sampling strategy allows the inclusion of individuals from both urban and rural settings.

#### Social Network Support and Mental Health and Well-Being

The presence of a social network can have positive or negative effect on mental health and personal well-being (Berkman & Syme, 1979; Berkman & Glass, 2000; Dean, Kolody & Wood, 1990; Gordon & Zrull, 1990). The association between social network support was first made to mental health in the 1970's and shortly thereafter researchers noticed its importance to physical health as well (Berkman & Syme, 1979; Cassell, 1976; Cobb et al, 1988). While early research in this area questioned whether social relationships contributed to overall psychological well-being, subsequent research has focused on the different types of social exchanges (i.e. positive or negative) generated by the social network or segments of the social network, and the effect (e.g. encouraging or discouraging) that these interactions have on psychological well-being or specific conditions effecting well-

being such as alcoholism or depression (Cobb, 1976; Dean & Lin, 1977; Gordon & Zrull, 1990; Matt & Dean, 1993; Rook, 1987). As in other areas of social support and social network research, inconsistent definitions and terminology challenge the applicability of the research results.

*Similarities with Research of Physical Outcomes and Social Network Support*

When examining the association between social network support and physical health (i.e. physical health, specific chronic conditions or mortality) or mental health outcomes, some similarities in the findings are evident. Social network size has consistently been found to impact mental health and well-being (Cohen, Teresi & Holmes, 1986; Gordon & Zrull, 1991; Grant, Patterson & Yager, 1988; Levitt, Clark, Roton & Finley, 1987). As in physical health outcomes, larger networks are associated with more positive mental health outcomes since larger social networks increase the opportunities for the recipient to receive support.

Another similarity is that both physical and mental health research examines specific, discrete segments or members of the social network such as the spouse (i.e. marital status), other family members or friends rather than the entire network (Dean, et al., 1990; Matt & Dean, 1993). Findings suggest that the spouse represents the social network member with the most direct impact on mental health, a finding consistent with other health outcomes as well (Dean et al.). Dean et al. found that support from the spouse, followed by friends in the social network, followed by children, had a strong and positive effect on mental health, specifically depressive symptoms. Other relatives had no effect at all. Researchers examining other chronic conditions have found similar results (Gordon & Zrull, 1991). Grant et al. (1988)

found that the elderly respondents in their sample reported a higher quality of support from kinship networks rather than friendship networks.

Matt and Dean (1993) used a sample of non institutionalized adults over the age of 50 in their research of the friend network. They found that age made a difference in the processes operating among the old-old (70 years and older) individuals as compared with the young-old (50-70 years) (Matt & Dean). The old-old were most vulnerable to psychological distress from the loss of supportive friends, with old-old men being most vulnerable of all (Matt & Dean). This study provides useful information about the effects of a portion of the social network on psychological distress. The age group for the proposed study, 60 years and older, is not compatible with the age groups in the work of Matt and Dean. Many individuals 50-60 years of age still maintain work-oriented friendships since they have not reached more traditional retirement aged.

Like research on physical health and disability, some research concerning mental health and the social network examines specific conditions or chronic illnesses such as depression or alcoholism (Dean et al, 1990; Gordon & Zrull, 1991). Gordon and Zrull evaluated network size and composition, characteristics similar to the proposed study. A small percentage of their sample was over age 55 (11%), only 1/3 was married, and most were White. Family, friends and non drinking co-workers had a positive effect on mental health, specifically treatment for alcoholism (Gordon & Zrull).

An interesting characteristic of the social network in Gordon and Zrull's study is that part of the social network potentially promoted negative behaviors, i.e. the

increased use of alcohol (1991). For example, the participant from this small sample might have identified friends in the social network who also motivated or encouraged the participant to continue drinking. In fact, Gordon and Zrull noted two social network effects with different outcomes. In one network effect, the recipient generated and received support from people with whom he or she did not drink, and the health outcome was positive. In another portion of the network, which included people who engaged in and promoted the use of alcohol, more negative social network effects were experienced by the individual. In this case, the recipient perceived support but did not benefit from active support with positive health outcomes.

Other research suggests that not only does social network structure impact mental health, but the functional components, such as participation and involvement will have an impact as well (Lin, Ye & Ensel, 1999). Lin et al. found that embeddedness, i.e. social integration within the social network, promotes better support and decreases depressive symptoms. They suggested that interaction with the social network, the presence of intimate ties (spouse or significant other) and participation in the community enhanced social support (Lin et al.). The structural component in this study, the social network, was measured by the frequency of contact and number of members identified by the participant in the social network, a description that closely matches the proposed study.

A unique characteristic of the mental health research is that support (i.e. social interaction aimed at problem alleviation) and companionship (i.e. social interaction aimed at providing mutual enjoyment) are differentiated in some studies (Dean &



Lin, 1977; Rook, 1987). Rook found that social support and companionship made different contributions to psychological well-being in a study using a large sample of community-dwelling adults. The results indicated that social support, i.e. “access to others who can provide advice, assistance, and emotional reassurance is most important for people who are confronted by multiple major life stresses” (Rook, p.1137). Companionship, on the other hand, made a different contribution to the individual’s psychological well-being when facing a variety of persistent, everyday life stressors and situations.

#### *Implications for this Study*

These studies of the association of the social network and mental health generally show that social support is beneficial to health with only a few exceptions. Gordon and Zrull (1991) found that receiving support from individuals who enhanced negative health behaviors (excessive alcohol consumption) had a negative effect. This shows the power of the social network on health: health behavior, in some cases negative health behavior, is enhanced by social network support. In Gordon and Zrull’s study, the health behavior (alcohol use) was a negative health behavior. Findings of this nature show the important role that the social network has in relationship to overall health as well as in association with specific conditions. This, coupled with the positive association that social network support generally has on physical health and mortality represent important justification to continue this investigation in relation to dietary intake and nutrition.

## Nutrition in the Older Woman

This study is important because it will contribute to the available body of knowledge about factors impacting on dietary intake in older women. Nutrition and dietary intake play an important role in the health, productivity, self-sufficiency and quality of life in all older adults (American Dietetic Association [ADA], 2000). Morley (2001) states that there is a physiological decline in dietary intake associated with aging. Many older adults, including women, are undernourished (Clarke, Wahlqvist, & Strauss, 1998; Richie, Burgio, Locher, Cronwell, Thomas, Hardin & Redden, 1997). Close to half (40%) of older Americans face health risks because of insufficient nutrients in their diet (Abbasi & Rudman, 1994). Estimates suggest that 5-12% of the community-dwelling elderly are malnourished (Thomas, 1999). These numbers suggest that older adults, including older women, are vulnerable to decreased dietary intake and malnutrition. Information acquired from the proposed project has the potential to assist clinicians and health educators in developing strategies to address the overall nutrition and quality of life of a large portion of the elderly population.

A multitude of factors have a potentially detrimental effect on nutrition and dietary intake. These can be classified as physical, psychological or social in nature, and result normal age related changes or changes from acute or chronic disease (Clarke, Wahlqvist & Strauss; Morley).

### *Physical Factors*

Physical age related changes or physical changes due to illness affect nutrition and dietary intake. Body composition changes associated with aging, such as decreased lean muscle mass, decreased bone density and redistribution of body fat, affect energy needs, or total calories required by the older adult (Clarke, Wahlqvist & Strauss, 1998; Mathys & Finnin, 2002; McEvoy & James, 1982). Physical activity and basal metabolic rate generally decrease with advancing age and contribute to decreased caloric needs and decreased intake as well (Mathys & Finnin; Morley, 2001; Thomas, 1999; Wurtman, Lieberman, Tsay, Nader & Chew, 1988).

Some physical changes to specific body systems have a significant impact on nutrition and dietary intake. Gastrointestinal (GI) system changes, including changes to the mouth, esophagus, stomach and intestine, are particularly important to overall nutrition because the major GI system function is digestion, absorption, distribution and provision of nutrients to the body, including amino acids, energy, essential fat components, vitamins, minerals and fluids (Mirie, 2001). A change to any portion of the GI system ultimately affects physiological functioning in the entire system. Several GI system changes are anticipated as part of the aging process. These include decreases in salivation, dentition and oral health, taste sensation, movement of food through the GI system and decreased overall digestion.

Poor oral health (i.e. mouth) has been associated with poor nutrition (Franzoni, Frisoni, Boffelli, Rozzini, & Trabucchi, 1996; Mojon, Budtz-Jorgensen & Rapin, 1999; Ritchie, Joshipura, Silliman, Miller & Douglas, 2000; Sahyoun, Lin & Krall, 2003; Thomas, 1999). Changes in dentition and gum integrity affect overall

oral health and mastication, and ultimately limit food choices, varieties and quantities. These changes further increase the risk of decreased dietary intake and nutritional deficiencies, evident by a lower BMI and decreased protein intake (Mirie, 2001; Mohon, et al; Ritchie, et al.; Thomas).

Other age related changes to the GI system include decreased esophageal motility and decreased amounts of digestive enzymes. This results in reduced appetite, incomplete digestion of food, elimination irregularities, and decreased nutrient intake (Mirie, 2001). Hunger and thirst sensations diminish with age, causing older adults to consume inadequate amounts of food and fluids, increasing the risk of dehydration and under nutrition (Gentleman, 2000; Mirie).

Age-related physical changes to other body systems impact dietary intake and overall nutrition as well. For example, musculoskeletal changes include the loss of muscle mass and decreased muscle strength. These changes limit mobility and affect the ability to acquire, prepare or eat food (Evans, 1995, Souter & Keller, 2000). Sensory system changes associated with age affect vision, hearing and taste sensation. Sensory changes may be limited to the individual system (i.e. limited to vision or limited to auditory) or be a combination of sensory changes (Clarke, Wahlqvist & Strauss, 1998). Vision changes may affect the ability to buy, store or prepare food. Changes to vision may also affect the appeal of or desire for food. Auditory changes affect balance, hearing, limit safe movement and socialization. Changes to taste limit sweet and sour sensations and satisfaction with food. The older adult may compensate for these changes by applying excessive amounts of sugar or salt to

maximize food taste or by repeatedly preparing the same foods because of ease or familiarity regardless of nutritional content or variety.

### *Acute and Chronic Diseases Affecting Nutrition*

A variety of acute and chronic diseases can be related to nutritional risk in older adults and can be managed or prevented by healthy nutritional practices. Data from the United States Senate Committee on Education and Labor indicates that 85% of older Americans have chronic diseases that could be helped by nutritional interventions (American Academy of Family Physicians, 2001). The risk for cardiovascular disease could be reduced or treated through dietary measures and other lifestyle changes. Low serum folate levels have been associated with an increased risk of fatal coronary heart disease, the primary cause of death in women. Several other nutrients, including antioxidants, beta-carotene, vitamin E, vitamin C and selenium, potentially prevent heart disease in women and men, but have been reported below RDA levels in at least 20% of the elderly population (Ryan et al., 1992). Dietary fiber intake, which protects against cardiovascular disease, diabetes and obesity, is frequently inadequate in the elderly as well (Ripsin, Keenan, Jacobs, Elmer, Welch, Van Horn, Liu, Turnbull, Thye & Kestin, 1992). Adequate fiber also plays an important role in normal bowel function. Inadequate fiber may lead to constipation, necessitating harsh laxative use or abuse.

Medications used to compensate for age related changes or to treat acute or chronic disease are linked to altered dietary intake and affect overall nutrition. Age related physical changes affect absorption, distribution, metabolism and excretion of medications differently in each individual. One unintended side effect of medication

use in some cases is a chemical suppression of appetite, leading to altered eating patterns. Some drugs interact with vitamins or minerals and alter absorption. Medications also cause nausea, vomiting, diarrhea, increased dehydration risk, or leave an unpleasant taste that diminishes the desire to eat.

Alcohol use further complicates nutritional status in the elderly because it robs the body of required nutrients. The use of alcohol by the elderly is generally considered detrimental to their health. For some, alcohol replaces a scheduled meal or is used to diminish the effects of physical or psychological symptoms of aging, disease or pain. Excess alcohol consumption leads to gastrointestinal, cardiovascular and cerebrovascular disease and potential cognitive impairment, all potential contributors to nutritional impairment. However, there is little agreement on the size of the problem in this population. The National Institute on Alcohol Abuse and Alcoholism (NIAAA) considers one drink a day (i.e. 12 ounces of beer, 5.5 ounces of wine or 1.5 ounces of hard liquor) to be the acceptable limit for people over 60 years old (2000). Surveys conducted in a variety of health care settings indicate an increasing prevalence of alcohol problems among this population. In fact, 6-11% of the elderly admitted to hospitals exhibit symptoms of alcoholism (NIAAA).

#### *Psychological Factors Affecting Nutrition*

Many psychological factors contribute to dietary intake and nutritional status changes in older adults. These factors may act alone or in concert with other psychological, physiological or social factors. Some psychological factors are reversible, such as depression or reversible confusions; others are irreversible, such as dementia.

Altered cognitive function is one psychological factor that increases the risk of decreased nutritional status. Impaired cognition can be reversible when caused by some illnesses, dehydration, electrolyte imbalances or medication, or irreversible when caused by dementia or Alzheimer's disease. Cognitively impaired adults may not recognize hunger sensations, may forget or refuse to eat, or forget that they have eaten and consume a meal they think they have missed. Wandering associated with dementia or Alzheimer's disease may increase the individual's caloric needs because of excessive activity (Reynish, Andrieu, Nourhashemi & Bellas, 2001). At the same time, wandering may prevent the client from sitting for meals, and less than adequate dietary intake results.

Depression also contributes to altered nutritional status. Individuals with depression experience appetite changes, decreased interest in food, weight loss, or overeating. Untreated, depression may lead to malnutrition. The client may experience depression alone or in combination with other changes to cognition, such as dementia.

#### *Social Factors Affecting Nutrition*

A multitude of social factors including loss, isolation and feelings of loneliness potentially affect nutrition in the older adult (Lehmann, 1989). Older adults experience many losses that may be significant to the individual. For example, the loss of a spouse or significant other is often viewed as important or significant to them personally. Almost half of the population of older women is widowed (AoA, 2004). Other losses that contribute to changes in dietary intake and nutritional status are relocation of the client or relocation of valued friends or family. The loss of a

loved one or friend, whether from death or other factors such as relocation and institutionalization, contributes to depression and nutritional deficiency (Lehmann).

Other social factors potentially affecting nutrition include knowledge deficits, financial constraints and lack of social contacts (Lehmann, 1989; Locher, Burgio, Yoels & Ritchie, 1997; Richard, Gosselin, Trickey, Robitaille, Payette, 2000; Slesinger, et al, 1980). Lack of individual nutrition knowledge is a potential risk factor for altered nutrition. Most people do not have formal education in healthy nutrition practices, and may use information that is inaccurate or incomplete to plan their diet. Some older adults inappropriately restrict dietary intake for weight control or restrict fluids to control urinary incontinence and other physical discomforts. Limited financial resources affect nutrition by restricting food choices or the ability to purchase necessary foods and nutrient supplements (ADA, 2000). Those with adequate income may fear the potential loss of financial resources and preserve revenue by purchasing minimal amounts of food or food that is of poor quality (Lehmann; Slesinger, et al.). Slesinger, et al. found that a portion of the diminished food intake reported by the elderly in their sample, particularly in fruits and vegetables, was associated with lower income, less education and living alone.

Locher, Burgio, Yoels and Ritchie (1997) noted the importance of the social qualities of eating. The social interaction that occurs with meals has an important impact on dietary intake. As a result of their work with clients receiving food through the Meals on Wheels program, Locher et al. recommended that volunteers delivering food “alternate sitting and eating meals with different clients” to increase food



consumption (p. 30). Living or eating with others and social support plays a role in food consumption (Richard, Gosselin, Trickey, Robitaille, Payette, 2000).

In some cases, age alone or life style changes associated with age have been found to contribute to alterations in food intake. Wurtman, Lieberman, Tsay, Nader and Chew (1988) compared the caloric and nutrient intake in elderly, community dwelling adults with younger subjects under similar living conditions. Significant age-related deficits in cognition and mood were excluded, often considered psychological factors affecting nutrition. Study participants took medications, had self-imposed food restrictions or special diets to manage chronic conditions. Wurtman et al. found that age made a significant difference in the intake of selected nutrients and calories. Elderly subjects consumed fewer calories from both meals and snacks than younger participants in the study (Wurtman et al.). Protein intake during meals for male subjects was higher than female subjects independent of the participant's age. Older participants consumed less snacks. Wurtman et al. suggested that the age-related decrease in physical activity and the decrease in basal metabolic rate could, in part, be responsible for decreased intake. They conceded, however, that these changes could not account totally for a caloric change in older adults since the older adults had a slightly higher level of spontaneous physical activity than younger adults (Wurtman, et al.).

Procuring and preparing food depends on cognition, mobility, dexterity and an intact sensory system in order to reach the store, manipulate the cart, reach for items on the shelves, read the small print on packaging and cope with glaring lights and slippery floors. Adverse weather conditions potentially limits mobility outside the

home. Some elderly (8-16% or 2.5-4.9 million) have reported that they did not have access to a diet that was nutritionally adequate and culturally compatible (ADA, 1998). In one sample of 1156 community dwelling elderly who participated in interviews and in-home physical assessments, close to 1/3 consumed inadequate amounts of protein, calcium and vitamins A, C, and B1 (Posner, Jette, Smigelski, Miller & Mitchell, 1994). Slesinger, McDivitt and O'Donnell (1980), using data from 24-hour dietary recall and interviews about eating patterns, found that the elderly (N=102) reported eating fewer times per day than younger age groups, and did not eat appropriate food amounts when compared with the RDA. Some researchers have suggested that dietary intake has a cyclic or predictable pattern; older adults often consume foods that are easy to prepare and eat (Medaugh-Abernathy & Fanelli-Kuczmariski, 1994).

#### *Differences in Dietary Intake/Nutrition Related to Gender, Culture or Ethnicity*

Some age related changes are experienced exclusively by women and have the potential to increase the risk of diminished nutritional status in this population. Hormonal changes associated with menopause alter the nutritional requirements of women. Decreased estrogen production increases bone reabsorption and leads to rapid decline of bone mass (Howard & Malone, 1998). This accelerated bone loss necessitates increased calcium intake to minimize calcium deficiency (Howard & Malone). Decreases in Vitamin D, normally associated with sunlight, contribute to reduced calcium absorption. Calcium is frequently consumed at levels below those recommended for older adult women (Sahyoun, 1992). Increased intake in vitamins

and minerals is particularly important for older women to counteract the effects of decreased hormone levels.

Obesity affects more women than men. More than one-third of older adults are overweight (Heiat, Vaccarino & Krumholz, 2001). Factors contributing to obesity include genetics, altered nutrient intake, musculoskeletal limitations and changes in metabolic rate. Obesity increases the risk of cardiovascular disease, degenerative arthritis, functional impairment, gall bladder disease, sleep apnea, varicose veins and low self-esteem, all of which affect health and overall quality of life (American Obesity Association, 2002; McGinnis & Ballard-Bush, 1991).

Minority elderly, both men and women, are at greater risk of nutritional deficits (Peterson & Maiden, 1991; Administration on Aging, 2000; ADA, 2000). Members of this group have a higher incidence of chronic disease which potentially affects dietary needs and intake (AoA, 2000). In addition, minority elderly may have limited social resources, such as lower educational levels, lower income and limited access to transportation (AoA, 2000; AoA, 2004). These factors also contribute to increased risk of nutritional deficits in this population.

Minority women are at greater risk for obesity than Caucasian women. African American women (78%) represent the highest proportion of overweight people in the United States followed by Mexican-American women (71.8%) (American Obesity Association, 2002). Elderly African Americans, both men and women, are more likely to be obese than their White counterparts. Elderly Hispanics are at high risk for diabetes, hypertension and high cholesterol, all conditions affected by obesity (AARP, 2001). Mobility limitations and age-related changes reduce the

likelihood of exercise and weight loss in minority elderly women and contribute to diabetes, hypertension and heart disease.

Diabetes, especially Type II Diabetes (NIDDM), is more prevalent in older adults, especially in minority populations (American Diabetes Association, 2002). Diabetes is considered to exist in epidemic proportions in the United States (American Diabetes Association). This is due to the increased numbers of older adults and the prevalence of obesity and sedentary lifestyles especially in the older population (American Diabetes Association). Diabetes in older women may be complicated by menopausal hormone changes and decreased metabolic rate. Without proper dietary compensation, women with type II diabetes notice a significant weight gain and a corresponding increase in blood glucose level.

Research shows that dietary intake differs based on gender. Women consume less milk and milk products, less fiber and more prepared lunch meats and high sodium snacks (Popkin, Haines & Patterson, 1992). Women have less mean energy intake (Ryan, Craig & Finn, 1992). Ryan et al. also found women consumed two-thirds less vitamin E, calcium and zinc than suggested by RDA.

#### Specific Nutrients/Food Components

Changes in dietary intake may ultimately affect specific nutrients supplied to the body. Grodner, Anderson and DeYoung (2000) identify six broad categories of nutrients: carbohydrates, minerals, vitamins, fats, protein and water. In this study, selected vitamins and food components are considered as indicators of dietary intake. These are dietary calcium, dietary vitamin D, dietary vitamin B12, dietary folate and

dietary fiber. Each of these vitamins/food components was selected because of their important role in the nutrition and overall health of older women.

Nutrition plays an important role in the prevention of cardiovascular disease, a major cause of death in women 70 years of age and older (ADA, 1999). Dietary fiber is an important food component for women because it reduces blood lipids, reducing the risk of cardiovascular disease. A fiber-rich diet has also been shown to lower the risk of colon cancer (ADA, July, 2002). The ADA states “Dietary fiber intake continues to be at less than recommended levels in the United States...” (ADA, July 2002, p. 994). In NHANES III, mean dietary fiber intake in elderly men and women was at least 4-5 g/day lower than recommended (Russell, Rasmussen & Lichtenstein, 1999).

Approximately 10-30% of older adults experience a decrease in their ability to adequately absorb vitamin B12 from food due to changes in gastric acidity and atrophic gastritis (Dairy Council, 1998; Office of Dietary Supplements NIH, 2004). Deficiencies of vitamin B12 and folate are also of particular concern in older adults, including women. Vitamin B12 deficiencies have a suspected role in dementia (Office of Dietary Supplements, 2004). Folate intake in many older adults is also low; deficiencies of folate and vitamin B12 are suspected of contributing to elevated homocysteine levels in the blood (Dairy Council). Homocysteine is an amino acid that potentially contributes to atherosclerosis.

Calcium is another mineral important for preventative health in women. A sub optimal level of calcium has been reported in approximately 87% of older women (ADA, 2004). Calcium is linked to bone health, particularly osteoporosis.

Osteoporosis, characterized by reduced bone mass, leads to an increased susceptibility to fractures (ADA, 2004). Data from the NHANES III indicated that more than 40 million individuals, mostly women, were affected by osteoporosis (ADA, 2004; United States Department of Agriculture, 2003.). Currently, actual calcium intake among women in the United States is considerably lower than the current DRI (ADA, 2004). Calcium intake in older adults of 600 mg/day is common, and is sufficiently lower than the 1500 mg/day recommended for women over 65 years of age (NIH, 1994). Osteoporosis is largely preventable utilizing several factors including a diet rich in calcium and vitamin D. Low calcium levels have also been associated with hypertension and colon cancer as well (ADA, 2004; NIH, 1994).

Vitamin D also plays an important role in the prevention of osteoporosis. Vitamin D is important in the intestinal absorption of calcium and is necessary for normal bone metabolism (ADA, 2004; NIH, 1994). Lower than recommended levels are common in the elderly population, especially those considered homebound. Poor vitamin D status leads to diminished calcium absorption, accelerated bone loss and increased fracture risk (ADA, 2004). Vitamin D deficiency is a particular risk in the elderly because of insufficient vitamin D intake from their diet, impaired renal synthesis of the vitamin, and inadequate exposure to sunlight (Kinyamu, Gallagher, Rafferty, Balhorn, 1997; NIH, 1994).

#### Significance of this Study

Older adults are at disproportionately high risk of under nutrition. Many factors contribute to this increased risk, such as age-related physical changes, acute and chronic disease and medication use. Depression and altered cognition contribute

to an increase risk of nutritional deficit as well. Social factors such as loneliness, living or eating alone, financial constraints, and cultural factors play a potential role. Women, including minority women, have been identified as particularly vulnerable to the risks of altered nutritional status. Evidence suggests that effective social networks can provide protection from stress and can help maintain physical, social and psychological well-being (Broadmead, et al., 1983; Cohen, Teresi & Holmes, 1986; Grant, Patterson & Yager, 1988). Supportive interactions within the social network are related to a variety of health promoting behaviors including increased exercise, decreased fat consumption, medical regimen compliance, weight control and smoking cessation. Little research exists specifically examining the relationship between dietary intake and the social network, especially in women.

Understanding the relationship of the social network to dietary intake is important for several reasons. First, the demographics of the population are shifting. The number of older adults in the population has increased dramatically in the last several decades and this growth is expected to continue into this century. Presently, approximately 12.3% of the total population is over the age of 65 years, with an increase to 20% of the population expected by the year 2030 (AoA, 2004). The elderly population itself is aging (AoA). The young-old, those 65-74 years of age, have increased by eight times the number 100 years ago. The old, those 75-84 years, has increased 16 times the number during this same time period. The population of oldest-old, those 85 years and older, is 38 times larger than at the beginning of the 21<sup>st</sup> century and is the fastest growing segment of the elderly population (AoA).

The majority of the older population is women; women outnumber men 116 to 230 (AoA, 2004). In the oldest segments of the elderly, the ratio of women to men is even higher. Women over 65 years of age are more vulnerable to poor health than their younger counterparts. One reason older women are vulnerable because they are less likely to be married. Close to half of the women in the older population are widows. A small segment of the older population is divorced; they are more likely to be women. Taken together, this constitutes approximately 2/3 (60%) of older women in the community who are living alone, a proportion that increases with advancing age (AoA). Living alone increases potential vulnerability to negative health outcomes, decreases life expectancy and decreases the potential number of individuals in one's social network.

Poverty, another characteristic that increases an individual's risk of poor health, is a particular concern in the elderly population. Approximately 3.6 million elderly were below the poverty level in 2002 (AoA, 2004). Another 2.2 million elderly are considered "near poor" with income between the poverty level and 125% of that level (AoA). For many older adults, the challenge of a fixed income following retirement along with increasing health care needs severely limits financial reserves. This income burden leads to poverty. Others have lived in poverty throughout their entire life; many of these individuals are women and other minorities (AoA). Older women are almost twice as likely to live in poverty as older men (AoA).

Ethnicity is a risk factor for generally poor health, malnutrition and poverty (AoA, 2004). The racial and ethnic composition of the older population is changing with advancing age because the number of individuals in minority groups is growing



faster than their White counterparts. Members of minority groups are expected to represent 26.4% of the older population by 2030, an almost 16% increase from totals in 2000 (AoA). Members of minorities are vulnerable to poor health outcomes, including nutritional deficits, because they are more likely to live in poverty and be less educated than their White counterparts (Miller, et al., 1996). Women minority group members are even more vulnerable to poor health including poor nutrition. The highest poverty rates were experienced by older Hispanic women living alone or with non-relatives (AoA).

This project is important because older adults, particularly women, are at increased risk of under nutrition, disability and death. The elderly have a greater risk of under nutrition than other members of the general population (Vailas, Nitzke, Becker & Gast, 1998). The rate of chronic illness and disability in older women increases proportionately with age. Older adults, both men and women, have at least one chronic condition and more than half report at least one disability (AoA, 2004). Women spend twice as many years disabled prior to death as men (LaCrois, Newton, Leveiller & Wallace, 1997).

Ryan, Craig and Finn (1992) point out that despite the information provided by large-scale national surveys that address specific nutrient and food consumption, information is still needed about general nutritional status. Under nutrition potentially leads to malnutrition, disability and even death (Fishman, 1996). Malnutrition among vulnerable older adults was listed by a panel of clinical geriatric experts as one of the 21 target conditions that account for almost half of the hospitalizations and approximately 1/3 of the physician visits in this population (Sloss

et al., 2000). Recognizing the older adult's vulnerability to poor health, researchers have tried to identify those conditions that are most likely to require health care. Prevalence rates for malnutrition in the elderly are available for hospitalized patients as well as nursing home and other long term care patients. Estimates of malnutrition for community-dwelling elderly are generally lower, and are studied less often (Gentleman, 2000; Jensen, Kita et al., 1997). Understanding factors that contribute to under nutrition and malnutrition in older women will provide opportunities for development of prevention strategies and education programs.

Changes in nutritional status and general health have a potential effect on the overall quality of life for older women. This study is significant because it provides an opportunity to evaluate an important health measure among older adult women with a potential to impact overall quality of life. The American Dietetic Association (2000) states that health, productivity, self-sufficiency and the quality of life are all impacted by nutritional status. A variety of programs have been developed to provide the necessary help or care in order to maintain a satisfying quality of life in the community (Payette, Coulombe, Boutier, Gray-Donald, 2000). Identifying and understanding factors affecting dietary intake, as an indicator of health, has the potential to improve overall health and overall quality of life.

This study is important because it may increase our understanding of the impact of social network on health. The social perspective of health suggests that social relationships impact health and well being (Broadmead, et al., 1983). A variety of studies have examined the role of social support derived from the social network on physical or psychological health (Broadmead, et al; Cohen, Teresi & Holmes,

1986; Goodwin, 1989; Franks, Campbell & Shields, 1992). However, little research has specifically addressed the association between the social network and one indicator of physical health: dietary intake. This proposed study would help provide an understanding of the effect of social network on dietary intake in older women.

### Summary

This study examines the relationship between the household size, frequency of non-household family/friend contact, frequency of organizational contact and dietary intake in community-dwelling older women using the NHANES III. This study builds on the existing body of knowledge concerning the relationship of social network to dietary patterns in this population. As the aging population increases in number, it is imperative that health educators and care providers better understand strategies that will limit disability and disease and improve the overall quality of life. Health educators may find the information useful from this study to educate clients and caregivers about strategies to increase dietary intake to optimum levels and prevent altered nutritional status. Furthermore, this study focuses on older women, the greatest portion of the older population and a group with unique nutritional needs because of a variety of physical and social factors. Information about ethnic differences in the social network may be obtained through this project. Finally, through careful analysis of the data obtained from the large, randomized sample in NHANES III, the study allows for decreased bias and potentially increased ability to generalize the study's findings.

## CHAPTER 3: METHODOLOGY

### Introduction

Health promoting behaviors, such as changing dietary intake, can improve overall physical health, increase life expectancy, and improve quality of life in older adults (Chernoff, 2001; Drewnowski & Evans, 2001). The purpose of this study was to evaluate the relationship between social network and dietary intake in community based elderly women. A secondary analysis of data obtained from NHANES III was used. This chapter will review the research questions analyzed in this study. A description of the sample and the procedures used in the analysis will be described.

### Research Questions

This study addressed the following research questions. Each question, secondary questions and the appropriate research hypotheses are outlined below.

#### *Research Question 1*

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal total food energy intake (TFEI) as defined by the Dietary Reference Intakes (DRI) for community dwelling elderly women?

The purpose of this research question was to determine if TFEI was predicted by the frequency of contact with non-household family, friends, organizations or household size. The research hypothesis for this question states: A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with optimal TFEI in community dwelling elderly women.

There are two secondary questions related to this research question. The questions and the respective research hypotheses are identified below.

Secondary Question 1:       What is the relationship between social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) and the TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled?

Hypothesis:   There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.

Secondary Question 2:       Does TFEI differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?

Hypothesis:   There is a significant, positive difference between age and optimal TFEI when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

### *Research Question 2*

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal body mass index (BMI) in community-dwelling elderly women?

The purpose of this research question is to determine if optimal BMI is predicted by the frequency of contact with the social network. The research hypothesis states: A larger social network (i.e. household size, frequency of non-household social network contact and frequency of organizational contact) will have a significant, positive relationship with normal BMI in community dwelling elderly women.

Secondary Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and normal BMI when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?

Hypothesis: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal BMI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.

Secondary Question 2: Does optimal BMI differ based on age group when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?

Hypothesis: There is a significant, positive relationship between one's age and optimal BMI when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

### *Research Question 3*

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components (i.e. dietary calcium, dietary vitamin D, dietary vitamin B12, dietary vitamin folate and total dietary fiber) in community dwelling elderly women?

The purpose of this question is to determine if the frequency of contact with the social network and household size are predictive of optimal BMI in this population. The research hypothesis states: A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with an optimal intake of specific vitamins/food components in community dwelling elderly women.

Secondary Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?

Hypothesis: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components when the effects of age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.

#### *Research Question 4*

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security in community dwelling older women?

The purpose for this question is to determine a relationship, if any, between social network elements and self reported food adequacy in this population. The research hypothesis states: A larger social network (i.e. larger household social network size, frequency of non-household family/friends contact and frequency of organizational contact) will have a significant, positive relationship with food security among community dwelling elderly women.

Secondary Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?

Hypothesis: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.

Secondary Question 2: Does food security differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?



Hypothesis: There is a significant, positive difference between age and food security when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

### Population and Design of NHANES III

This project was a secondary analysis of data from the third National Health and Nutrition Examination Survey (NHANES III). NHANES III is part of a series of nationwide surveys mandated by the National Health Survey Act to provide current statistical data on the health and diet of the people in the United States (NCHS, 2003). The NHANES III is the seventh survey in the series and was conducted from 1988-1994 using a probability sample of non-institutionalized civilians in the United States.

#### *Sampling for NHANES III*

Approximately 33, 990 people aged two months and over, with no upper age limit, were sampled and interviewed. This represents 86% of the total number of sampled persons (NCHS, PHS 2002-1695, p. 2, 7/02). NHANES III used a complex, multi-stage, stratified clustered sampling strategy to recruit participants. (The sampling technique for NHANES III is specifically described in the following paragraphs.) This sampling strategy was used because it was considered a time and cost efficient method of identifying a probability sample for a large-scale study. The total civilian non institutionalized population, within the age parameters identified, is represented in the NHANES III sample.

The initial stage of the multi-stage sampling strategy for NHANES III was obtained using U.S. Census data. In this stage, primary sampling units (PSUs)

throughout the U.S were identified. Most PSUs were individual counties, but in some cases two or three adjacent counties were grouped to form one PSU in order to obtain an identified minimum size (Korn & Graubard, 1999). From the original 2812 PSUs, 81 PSUs were sampled. The PSUs were stratified proportional to size. For operational efficiency, 13 certainty PSUs were designated and divided into 21 survey locations. Certainty PSUs, with a probability of selection of one, were usually large counties, selected for administrative reasons (NCHS, 1994; 2003). The 13 largest counties were usually in California or Texas, reflecting substantial over sampling of Mexican-Americans (Ezzati, Massey, Waksberg, Chu & Maurer, 1992). The remaining PSUs were grouped into 34 strata and 2 PSUs were selected per stratum, creating an additional 68 survey locations. The final NHANES III sample contained 81 PSUs or 89 actual locations (NCHS, 2003).

Next, the 89 locations were randomly divided into two sets of 44 and 45 sites respectively. One set was designated to receive the first 3-year survey (1988-91) and the second set received the second 3-year survey (1991-94) (NCHS, 1994; 2003). In the next sampling stage, household and certain types of group quarters (dormitories, apartments, etc.) were identified as sampling segments. This process allowed for a national, approximately equal, probability sample of households in most of the United States, with a higher rate from the geographic strata with more Mexican-American and African-American populations. This strategy allowed for over sampling of specific ethnic groups (i.e. African Americans and Mexican Americans). This process was done to obtain useful information on the characteristics and health of minorities (NCHS, 1994, p.4). In the final sampling stage, specific household

members were identified/selected; all household members were listed and a sub sample of household members was selected based on sex, age, race and ethnicity.

The particular groups chosen for over sampling were selected because they represent the largest portions of the U. S. minority populations. The content of NHANES III questions is not targeted to these groups, however. The questions target the health of the United States, with planned over sampling of these groups providing for more complete data. Each of these groups represents separately approximately 1/3 of the total sample (NCHS, 2003). This standardization is important because systematic error is decreased. NHANES III was the first survey in the series to have no upper age limit for the sample. Previously, participants were limited to those under the age of 75 years. In order to obtain more reliable population estimates, individuals 60 years and older, along with children age 1-5 years, were sampled at a higher rate in NHANES III (NCHS, 2003). Because NHANES III placed increased emphasis on older adults and over sampled specific minority populations, extensive data is available concerning Black women, Mexican-American women and older women; however, men and women were sampled equally. This information is pertinent since the focus of the study is women who live in the community.

#### *Response Rates for NHANES III*

As indicated earlier, 86% (33, 994) of the total number of sample individuals were interviewed by the screener; 78% of all sample individuals completed the health and nutrition examinations (NCHS, PHS 2002-1695, p. 2, 7/02). More than 30,000 respondents or their proxies completed the 24 hour dietary recall. Not all of these completed questionnaires were useable, however. More than 300 were excluded

because of refusals, communication problems or problems completing the survey. The analytic sample was 29,105 respondents who had completed, reliable 24 hour dietary recalls; this represents 94% of the examined sample and 73% of the total (original) sampled individuals (NCHS, PHS 2002-1695, p. 2, 7/02).

### *Instrumentation for NHANES III*

The data from NHANES III were gathered in five large data files through the household interview and physical examination. The data files are 1) the Household Adult Data File; 2) the Household Youth Data File; 3) the Examination Data File; 4) the Laboratory Data File; and 5) the Dietary Recall Data File. Initial screening for possible participants was completed in two steps (NCHS, 1994). First, a set of questions was administered to identify household members and determine if anyone in the residence was eligible to participate in the sample based on age, gender, ethnicity or race. If the initial screening of demographic characteristics allowed any household member to be included, the second screening module was completed. The purpose of this second questionnaire was to establish the relationship of household members to each other. These questionnaires are important sources of demographic information for the proposed study.

Depending on the participant's age, the Household Adult Questionnaire (HAQ), for those individuals age 17 years and older, or the Household Youth Questionnaire (HYQ), for those individuals aged 2 months to 16 years, was administered. In the proposed study, data from the HAQ will be used. The last questionnaire was the Family Questionnaire (FQ) which was used to collect more information about the household members, education levels, health insurance,

characteristics of the residence, occupational information, and ethnicity (NCHS, 1994).

Physical examinations were conducted in mobile examination centers (MEC). NHANES III offered a home examination option for very young children or the elderly, an option not offered in previous surveys. The Laboratory Data File was used to collect biochemical or similar laboratory data during the medical examination. Some of these data, such as urinalysis, were not available from a physical examination conducted in the home. In this study however, the individuals selected for the sample had physical examinations conducted in the MEC.

During the physical examination, additional questionnaires about diet and food intake were completed. In the MEC, all NHANES III participants were asked to complete a 24-hour dietary recall. Recognizing the major aims of the NHANES III nutrition component, the 24-hour dietary recall was identified as the principle methodology for detailed quantitative food and nutrient intake data. The 24-hour recall method was used to estimate detailed nutrient intake for populations and subgroups and to study these estimates in relation to health (DHHS publication No, (PHS) 2002-1695, p. 2). In 1988, the NHANES III Dietary Data Collection (DDC) System was developed. It is an automated, interactive dietary interview and coding system (DHHS (PHS) 2002-1695). The system includes a standardized interview format with automated probes that facilitate detailed information about food usage, preparation, and ingredients (DHHS, PHS, 1695). The data obtained from this method were used to formulate total kilocalories, an outcome measure used in this

study. Reliability and validity issues with this method of data collection will be discussed later.

Dietary and nutritional assessment for the NHANES III was developed in consultation with the Nutrition Methodology Working Group. This group included National Center for Health Statistics (NCHS) planning staff members and other Federal staff with special expertise in this area, or who were primary data users for nutrition policy development (NCHS, 1994). Experts in dietary survey methodology, epidemiology, nutrition, public health and biostatistics presented information about the unique dietary assessment, methodological and analysis issues in this type of study. NHANES III included information on food security, water intake, vitamin and mineral supplementation, nutrition biochemistries and anthropometrics (NCHS).

#### *Sample in this Study*

The study sample consists of women 60 years of age or older from households who participated in the NHANES III. This age was chosen (i.e. 60 years and above) because it most closely matches the age categories identified in the NHANES III data. Age is defined as age in years at the time of the household interview (NCHS, PHS 2002-1695, p. 4, 7/02). This information was obtained on the Household Adult Questionnaire (HAQ). Inclusion criteria for the sample were females, age 60 and older who received the medical examination as part of the NHANES III interview. This inclusion criterion is important since BMI was calculated only on individuals who had a medical examination. Another inclusion criterion is a recorded number of total kilocalories on the 24-hour dietary recall. This criterion necessitates a medical examination at the MEC, rather than at home, and completion of the 24-hour dietary

recall information. In the NHANES III data, a specific item identified the location of the physical examination, and whether the information reported by the participant was complete and reliable. These two survey items along with age and gender were used to identify members of the sample.

Of the 3,479 women 60 years of age interviewed for NHANES III, only 2,715 women had a medical examination in the MEC. However, not all of these women recorded the total number of kilocalories. Therefore, the total number of women eligible for inclusion in this sample was 2,588 (Flegal, Carroll, Ogden, & Johnson, 2002; NCHSED, 2003, June 27).

Table 5

*Age Group Size in Sample*

<b>Age Group</b>	<b>N</b>
60-69 years	1,097
70-79 years	895
80 years and above	596
Total	2,588

In the original sample, the oldest individuals were 90 years of age, accounting for 196 individuals. Therefore, the upper age group in this study was 80 years and above to accommodate this small number at the highest age group. Table 5 shows the specific number of women included in each age group.

*Items from NHANES III Instrumentation in this Study*

Selected items from several NHANES III instruments were used in the study. Specific items and their location in NHANES III are shown in Table 6 on the following page. Survey items from the Household Screener’s Questionnaire (HSQ) and the Family Questionnaire (FQ) were used for demographic information, to

identify the individual criteria for sample selection, and to address each research question. Items were also included from the examination file. These items related specifically to BMI, total food energy intake, and dietary intake of specific nutrients/food components.

Table 6

*Items and Location in NHANES III*

<b>Item</b>	<b>NHANES III Instrumentation Location</b>
A3 Age	Family Questionnaire (FQ)
A4 Sex	FQ
A10 Ethnicity and Race A11	FQ and Household Screener's Questionnaire (HSQ)
A12 Marital status	FQ
K1 Number household members	HSQ
Total food energy intake	24-hour dietary recall, Total Food Energy Intake (TFEI)
Body Mass Index (BMI)	Physical examination using height & weight measured in MEC.
V1, V2, V3 Family/friends contacts	Household (adult) questionnaire (HAQ)
V4, V6 Church/organizational contacts	HAQ
D1, E2, E7, F9, F10, F23, F27, G11, G16 Chronic Health Problems	HAQ
T1-T18 Exercise/Physical Activity	HAQ
F4 Food Security	HAQ
F20 Income Last Month	FQ
A7 Education Level	FQ
Specific Vitamin/Food Component Intake	24-hour dietary recall, physical examination

Special Analysis Considerations

Some characteristics of the NHANES III design necessitate special analysis considerations. The multi-stage sampling used in this survey creates an unequal probability of selection of subjects and contributes to clustering of observations



(Brogan, 1997). Surveys of this type use stratification, which breaks the larger population into groups or strata. For example, the sampling design in NHANES III randomly selected counties, then blocks, households, then individuals to obtain the sample (Barrett, Dunkin & Shelton, 2001). In some cases, strata were created for administrative or geographic reasons. (Levy & Lemeshow, 1999; NCHS, 1994). Creating strata in this manner ultimately affects the probability of an individual being included. Another analysis consideration was that NHANES III over sampled certain ethnic groups and age groups (NCHS, 1994). While this strategy increases the information available about these particular groups, it potentially affects an individual's probability of being included in the sample. As described earlier, the analytic sample was 29,105 respondents who had completed reliable 24-hour dietary recalls; this represents 94% of the examined sample and 73% of the total (original) sampled individuals (Bialostosky et al, 2002). Use of this design and these inclusion criteria made traditional methods of analysis, based on simple random sampling, not applicable. Therefore, analysis using appropriate sample weights and special considerations because of the complex design were incorporated into the study.

Exploratory analysis and data management were initially done on unweighted data. However, the final analysis was completed using appropriate sample weights. Weighting the data produces statistical estimates as if the entire sampling frame (i.e. the United States) had been used (NCHS, 1994). Sample weights incorporate the probability differences that occur because of the sampling strategy and include statistical adjustments for non response and non coverage within the sample (NCHS, 1994). Sample weights are measures of the number of persons the particular sample

observation represents (NCHS, 1994). In addition, two design variables were included in the data analysis. These are important for accurate variance estimates (personal communication, L. Trofimovich, 5/19/05).

The appropriate design variables and sampling weight were chosen based on guidelines from NCHS (1994). Design variables are selected based on the stratum and PSU of the sample members. Choosing the correct sampling weight depends on the variables chosen. The sampling weight selected in this study was chosen because variables from both the MEC examination and from the household interview were included in the items of interest (NCHS, 1994).

Two computer programs were used for the analysis in this study. The computer program used for data management was SPSS 12.0, originally titled “Statistical Package for the Social Sciences”. However, the NHANES III design described earlier necessitates the use of a specialized computer software package for analysis. In this study, SUDAAN Release 9.0.0: Software for the Statistical Analysis of Correlated Data (SUDAAN) was used for analysis of the hypotheses. This software package was designed to analyze data obtained by multi-stage, stratified, unequally weighted and/or clustered procedures like that used in NHANES III. (Research Triangle Institute, 2004b). In this type of design, observations are not independent and identically distributed (Research Triangle Institute). The analysis of data from research similar to this study has been successfully accomplished with SUDAAN (Ford, et al., 2000). In addition, SUDAAN is one of the programs identified specifically by NHANES III as useful for data analysis.

## Data Acquisition and Preparation

The NHANES III items used in this study were obtained from several sources. First, all data files with the exception of the Dietary Recall Data File, were obtained from the NCHS CD-ROM. The CD-ROM, purchased from the NCHS, contained data files, supplemental documentation and the Statistical Export and Tabulation System (SETS) retrieval software (NCHS, 1997). The SETS program facilitated review of documentation and files, creation of data subsets and export of the data to other analysis systems, such as SPSS.

Two data files were uploaded for this study using SETS. These two files were the household adult data file and the examination data file. The household adult data file contained information from the household interview; the examination file contained the information from the medical examination and dietary recall information. Weighting variables for analysis were also available from these data files. One variable, dietary vitamin D, calculated from the dietary recall data, was obtained from the Nutrient Intake Data, available on the NHANES III web site. This item and the selected items from the other data files were merged using SPSS into a single data subset for this study.

### *Recoding*

Several items from the original NHANES III data were recoded in SPSS for use in this study. These items included marital status, income, education, race/ethnicity, chronic health problems, and exercise/physical activity. The recoding was completed prior to using the SUDAAN program. For all variables, missing data

and blanks were coded both coded as missing values. Specific details of this process are described in the remainder of this section.

Table 7

*Marital Status Response Options*

<b>Original Marital Status Response Options</b>	<b>Consolidated Response Options with Code</b>
Married-spouse in household	Married-spouse in household/living as married (1)
Living as married	
Married-spouse not in household	Married-spouse not in household/separated (2)
Separated	
Widowed	Widow/divorced (3)
Divorced	
Never married	Never married (0)
Don't know	Missing values
Blank	Missing values

Marital status was used for demographic information. In NHANES III, this is self-reported information. The respondent could choose one of eight marital status options. The original options and the response options used in this study are listed in Table 7. This was done to consolidate the data with a focus on the availability of a potentially supportive person in the household social network.

The survey item 'family income during the last month' was used for demographic information and as a covariate in the analysis. This item in NHANES III was a self reported value that included all sources of family income for the preceding month. The respondent selected the appropriate amount from a card presented to him or her during the interview. Possible responses from the original survey were 'no income', 'less than \$100', and then increments increasing by approximately \$500 up to \$4000 or more per month. In the proposal for this study, income for the preceding month was categorized in increments of approximately \$500. However, the proposed scheme was not compatible with the manner in which

income for the preceding month was reported in NHANES III. In addition, only two respondents reported earning ‘no income’ the previous month. The category of no income was combined with ‘less than \$100’. Therefore, the coding format was

Table 8

*Family Income Preceding Month-NHANES III and Final Coding*

Family Income Preceding Month— NHANES III	Family Income Preceding Month- Final Recoding
88=Blank but applicable	Missing Values
99=Don't know	
00=No income	1-less than \$100
01=Less than \$100	
02 = \$100-199	2 = \$100-499
03 = \$200-299	
04 = \$300-399	
05 = \$400-499	
06 = \$500-599	03 = \$500-999
07 = \$600-699	
08 = \$700-799	
09 = \$800-899	
10 = \$900-999	4 = \$1000-1499
11 = \$1000-1099	
12 = \$1100-1199	
13 = \$1200-1299	
14 = \$1300-1399	
15 = \$1400-1499	5 = \$1500-2199
16 = \$1500-1599	
17 = \$1800-2199	6 = \$2200-2299
18 = \$2200-2999	
19 = \$3000-3999	7 = \$3000-3999
20 = \$4000 and over	8 = \$4000 and over

revised prior to any additional analysis. The presentation of data from NHANES III and the revised definitions used in subsequent analysis are shown in Table 8.

Education was determined by an NHANES III item from the household interview in which the individual was asked to indicate the highest grade or year of school

completed. In the original data, 18 possible education options existed. These included ‘never attended school or kindergarten only’ to various annual designations for education beyond four years of college. Two additional codes, ‘blank but applicable’ (88) and ‘don’t know’ (99) were coded as missing data in NHANES III and this study. The education options were recoded in this study to match the common designations of grades used in school today (Table 9).

Table 9

*Original Education Responses and Recoded Options*

<b>Original Education Response</b>	<b>Recoded Education Responses with Numerical Code</b>
Never attended/ kindergarten only	Never attended/kindergarten only (0)
Grade 1	Grades 1-5 (Elementary School) (1)
Grade 2	
Grade 3	
Grade 4	
Grade 5	
Grade 6	Grades 6-8 (Middle School) (2)
Grade 7	
Grade 8	
Grade 9	Grades 9-12 (High school) (3)
Grade 10	
Grade 11	
Grade 12	
College -1 year	College (1-4 years) (4)
College -2 years	
College-3 years	
College-4 years	
College-5 years +	College (5 or more years) (5)
Don't know/blank but applicable	Missing values

For this study, education level was reported in groups as grades 1-5, grades 6-8 (i.e. middle school), grades 9-12 (i.e. high school), and the specific number of years of college (1-5+). Individuals who never attended school or kindergarten only were recorded as the same response in NHANES III and in this study.

Another characteristic considered in this study is the respondent's chronic health problems. Table 10 outlines the specific NHANES III items used for this variable. Each item about chronic health conditions was answered by the participant as a 'yes' or 'no' response. A positive response was coded as 1; a negative response

Table 10

*Location of NHANES III Items for Chronic Health Conditions*

<b>Section and Item</b>	<b>Specific Question</b>	<b>Response / Code</b>	<b>Health Problem Indicated by Item</b>
Diabetes; Item D1	Have you ever been told by a doctor that you have diabetes or sugar diabetes?	Yes (1) or No (0)	Diabetes
High Blood Pressure/ Cholesterol; Item E2	Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?	Yes (1) or No (0)	Hypertension
High Blood Pressure/ Cholesterol; Item E7	Have you ever been told by a doctor or other health professional that your blood cholesterol level was high?	Yes (1) or No (0)	High cholesterol
Cardiovascular Disease: Item F9	Have you ever had severe pain across the front of your chest lasting for half an hour or more?	Yes (1) or No (0)	Ischemia and/or heart attack
Cardiovascular Disease: Item F10	Has a doctor ever told you that you had a heart attack?	Yes (1) or No (0)	Heart attack
Cardiovascular Disease: Item F23	Have you ever had weakness or paralysis in one side of your face, an arm or leg lasting more than 5 minutes?	Yes (1) or No (0)	Stroke
Cardiovascular Disease: Item F27	Have you ever had a spell during which you experienced a problem with your ability to speak, or to understand what someone was saying to you?	Yes (1) or No (0)	Stroke
Musculoskeletal Conditions: Item G11	Has a doctor ever told you that you had osteoporosis, sometimes called thin or brittle bones?	Yes (1) or No (0)	Osteoporosis
Musculoskeletal Conditions: Item G16	Have you ever had pain in your hands on most days for at least 6 weeks? This includes aching and stiffness.	Yes (1) or No (0)	Arthritis

was coded as 0. In two cases, the specific questions would potentially indicate the same or similar condition. One set of items are F9 and F10, both of which are potentially indicative of a heart attack. The second set of similar items is F23 and

F27, both potentially indicative of a stroke. For these items, if the participant answered “yes” to the first item of the set (F9 or F23), the second item (F10 or F27) was skipped. The sum of all positive responses was calculated to determine a chronic health condition score and was used as a descriptive variable as well as a confounding variable in analysis. The maximum score was 7; the lowest score was 0.

Table 11

*Items from NHANES III Related to Exercise/Activity*

<b>Item</b>	<b>Interview Question</b>
T1	In the past month, how often did you walk a mile or more at a time without stopping? (Never, number per day, week or month)
T2	In the past month, did you jog or run? (yes or no)
T4	In the past month did you ride a bicycle or an exercise bicycle? (yes or no)
T6	In the past month did you swim? (yes or no)
T8	In the past month do aerobics or aerobic dancing? (yes or no)
T10	In the past month did you do other dancing? (yes or no)
T12	In the past month did you do calisthenics or exercises? (yes or no)
T14	In the past month did you garden or do yard work? (yes or no)
T16	In the past month did you lift weights? (yes or no)
T18	In the past month did you do any other exercise, sports? (yes or no)

Exercise and physical activity was considered as a descriptive variable and as a confounding variable in analysis. The original data included thirty items concerning exercise or physical activity; ten items were used in this study (Table 11 next page). A negative response (i.e. never or no) was coded as 0. For example, in



item T1 if the respondent indicated that he/she ‘never’ walked a mile or more, the item was coded as a 0. If, for these same items (T1, T2, T4, etc.) the respondent indicated he or she has engaged in the identified activity, then the item was coded as a positive response or a ‘1’. There were no missing values.

In this study, ethnicity is operationally defined as the self-reported ancestry or national origin of the respondent. The terms “ancestry” and “national origin” were used in the original NHANES III interview to refer to ethnicity. Ethnicity or race was identified in the screener interview and the family questionnaire; it was used for demographic information and hypothesis testing. Ethnicity or race was determined on NHANES III by handing the participant one of two cards in succession with specific groups identified. The respondent was asked to state if their national origin or race was included in any of the groups identified on the cards. Two questions were included on the FQ to determine the participant’s specific race or ethnicity (Table 12).

Table 12

*NHANES III Items to Determine Race/Ethnicity*

<b>Item</b>	<b>Interview Question</b>
A10	Which of those groups best describes national origin or ancestry? (Mexican/American, other Latin/American or Spanish country or specify)
A11	What is the number of the group that best represents race? (1 Aleut, Eskimo or American Indian; 2 Asian or Pacific Islander; 3. Black; 4.White; 5. Another group not listed (specify).

The designations of national origin (A10) were grouped as either “Mexican/Mexican/American” or “Other Latino” group. Designations of race (A11) were grouped as Black, White or other. These ethnic or racial groups were selected

for this study because they represented the largest minority groups in the U.S. (AARP, 2001; McKinnon, 2003; Ramirez & de la Cruz, 2003). These designations were coded as indicated in Table 13.

Table 13

*Minority Group Designation Codes*

<b>Minority Group</b>	<b>Assigned Code</b>
White	1
Black	2
Other Racial Group	3
Mexican-American/Mexican unknown race	4

Social network was operationally defined as the size of the immediate household and the self-reported frequency of contact the respondent had with family, friends and neighbors and organizations or church members. While there are a variety of definitions for social network as discussed in chapters 1 and 2, this definition most closely matches the literature and the data available in NHANES III.

Household size information was found in the Screener Interview Questionnaire. Information about the frequency of contact within the social network was found in the Household (Adult) Questionnaire (HAQ) labeled “Social Support” (Table 14). Three items (V1-V3) are specifically related to frequency of contact with family, friends and neighbors. The last two items (V4 and V6) are related to interactions the respondent has outside of the household or neighborhood.

All social network items, with the exception of household size and number of telephone calls from family/friends/neighbors, were converted to weekly values. Household size was not applicable to a weekly number. Frequency of telephone calls was recorded by NHANES III as weekly so no conversion was necessary. In the case

of the other four items, visits with neighbors, attending church, attending club meetings and visits with family/friends were recorded by NHANES III as a yearly frequency. Each of these items was converted to weekly value.

Table 14

*NHANES III Items for Social Network Contact*

<b>Item</b>	<b>Interview Question</b>
V1	In a typical week, how many times do you talk on the telephone with family, friends, neighbors?
V2	How often do you get together with friends or relatives; (e.g. going out together or visiting in each other's homes)
V3	About how often do you visit with any of your other neighbors, either in their homes or in your own?
V4	How often do you attend church or religious services?
V6	Altogether, how often do you attend meetings of the clubs or organizations you belong to?

*Factor Analysis*

It was originally hypothesized that two social network factors would emerge from the NHANES III items. Factor analysis is used to uncover latent dimensions within a set of variables (Garson, 2004). Principle components analysis (PCA) is generally used for data reduction, as in this case. Table 15 shows the assumptions of factor analysis and how these assumptions were resolved.

Prior to initiating the factor analysis, intercorrelations were performed on the five social network items (excluding household size) using SPSS. The correlations between the items ranged from 0.006 to 0.220, all indicating a low correlation between the items. Since factor analysis is looking for some 'overlap' in the dimensions of the items, there seemed to be little chance that any of these items would reveal any common dimensions after performing a factor analysis.

Correlations that are too low defeat the purpose of data reduction (Garson, 2004).

The assumptions of factor analysis were not satisfied at this point.

Table 15

*Assumptions for Factor Analysis*

Assumption	Comments
Interval level or near-interval data	The data for each of these variables are continuous variables and are measured at the ratio level.
No outliers	Outliers potentially affect the interpretation from the analysis. NHANES III indicate that every attempt was made to remove outliers from the data prior to publication (NCHS, 1994).
Proper specification of model	The variables were relevant; extraneous variables were excluded.
Linear relationship	This was verified by scatter plot. This is not a strong assumption in this case because a large sample size is being used in the proposed study.
Normality	Normal distribution is assumed because the sample size is large (N=2588) and the sample was selected using randomization techniques.
Common response format	Each of the variables is based on self-reported frequency data.
Moderate to moderate-high intercorrelations	Garson (2004) says this is not mathematically required. Factor analysis evaluates the correlation of items to each other. Correlations that are too low defeat the data reduction purposes. Intercorrelations that are too high may indicate a multicollinearity problem.

As a result of the low correlations between the social network variables, each of the five social network items was included in the analyses as an individual item with household size, resulting in a total of six social network items for use in subsequent analyses. The items included as social network variables are household social network size, frequency of telephone calls-non household family/friends/neighbors, frequency of visits-non household family/friends, frequency of visits neighbors, frequency of church attendance, and frequency of organizational meeting attendance.

*Diagnostic Procedures to Address Assumptions of Multiple Regression*

A form of multiple regression was proposed for several of the analyses in this study. In order to determine if the assumptions of multiple regression were met,

Table 16

*Assumptions for Multiple Regression*

Assumption	Comments
Data are continuous, measured at the interval or ratio level.	The independent variables (i.e. household size, plus V1-V3, V4 and V6) and dependent variables (i.e. TFEI, BMI, vitamins/food components) satisfy this assumption
The proper model has been specified.	It is assumed that the proper model has been specified. If relevant variables are omitted from the model, the shared variance may be attributed to variables included but not attributed to other variables that should be considered.
The dependent variable is normally distributed.	This was assumed to be true because the random sample in this study is large, making the sample robust to non-normality. This was tested by plotting the data, looking for a normal distribution or bell-shaped curve.
Variables are measured without error.	This data is self reported information from survey participants. As with any self-reported data, some threat to reliability exists. In this case, the responses, generally frequency information, will be scanned initially to identify any extreme scores or outliers. Checking for outliers as well as normality can be verified by a scatter diagram to visualize relationships (Munro, 2001).
High or perfect multicollinearity is absent.	Multicollinearity is the interrelatedness of the independent variables (Munro, 2001). This is determined by calculating correlations between each of the independent variables to see that these variables are not highly correlated. A high multiple correlation means that the variable is closely related to the other independent variables.
Homoscedasticity assumption	Assures that the variance of residual error remains constant for all values of the independent variable. This is tested by plotting values and looking for a funnel shaped pattern (Garson, 2004).

diagnostic procedures were completed in SPSS. The assumptions of multiple regression are identified in Table 16. It should be noted that the use of SUDAAN eliminates the need to perform these analyses, since the SUDAAN procedures make

the data robust to these assumptions (personal communication, L. Trofimovich, March, 2005). However, these diagnostic procedures are described.

In order to test the assumption that the dependent variables used in multiple regression models were normally distributed, a plot of each dependent variable was produced in SPSS. Visually, none of the variables was normally distributed. Normality was also tested using the skewness and kurtosis of the distribution. Skewness is a measure of the lack of symmetry. A normal distribution is symmetrical; a distribution that is skewed will be asymmetrical (Munro, 2001). In a perfectly symmetrical distribution, the skewness coefficient will be 0 (Munro; personal communication, W. Dardick, 3/05). Kurtosis measures whether the distribution of the data is peaked or flat. The kurtosis of a normal distribution should be a value of approximately 3 (Personal communication, W. Dardick, 3/05). None of the distributions met these characteristics and therefore were not considered normally distributed. It should be noted, however, that multiple regression is robust to this assumption.

In addition, no outliers were identified. Analysis information provided by NHANES III indicates that attempts were made to confirm or remove values considered outliers as part of the data preparation procedures (NCHS, 1994). Values were plotted looking for a funnel shaped curve to test the assumption of homoscedasticity. This assumption was satisfied. Correlations were performed between each of the independent variables to test for multicollinearity. Garson (2004) indicated that correlation coefficients in these relationships should be less than

0.80. In all cases, the correlations coefficients for this test of interrelationships ranged from -0.002 to 0.275.

## Hypothesis Testing

### *Initial Preparation and Procedures*

Following data preparation, data for each research question was analyzed using SUDAAN. During the data preparation procedures, the specific design and weighting variables were identified. The design variables are the stratification and PSU variables and are important for variance estimates (personal communication, L. Trofimovich, 5/19/05; RTI, vol. 2, 2004) The weighting variables were selected based on specific guidelines outlined by NHANES III, and are important for approximating the findings to the larger population.

Another important step in using SUDAAN was identifying the design option from the program that was appropriate for this study. The design option determines how some standard error estimates are made (RTI, 2004b). Design options are based on either the Taylor linearization methods, which are equivalent to Generalized Estimating Equations in regression procedures, or replication methods (RTI, 2004b). Generalized Estimating Equations (GEE) are a type of regression modeling that is used to accommodate correlated data (Horton & Lipsitz, 1999). There are two specific types of Taylor linearization strategies: with replacement of sampled elements (WR) or without replacement. The WR design is appropriate for complex sample surveys using multi-stage sampling strategies like NHANES III (RTI, 2004b). In addition, the first stage sampling of NHANES III is approximated as unequal

probability sampling of PSU's with replacement (RTI, 2004b). This is also the default design in SUDAAN.

Descriptive procedures, such as means, totals and percentages are produced using the DESCRIPT statement. The DESCRIPT procedure performs descriptive statistics for continuous and categorical analysis variables, and was completed on appropriate variables (RTI, 2004b).

As a result of the earlier data management procedures, each of the six social network variables was included in the analyses. This strategy differs from the study proposal. In the proposed study, a combination of NHANES III items created variables known as frequency of family/friend contact or frequency of organization contact. The following section identifies the specific research questions and the statistical procedures used in analysis. In this study, the accepted level of significance is  $p \leq 0.05$ .

#### *Operational Definitions of Variables and Covariates*

For this study, the operational definitions of relevant variables and covariates are identified in Tables 17-20. In each of the proposed research questions, selected  
Table 17

#### *Operational Definitions of Social Network Variables*

Social Network Variables	Operational Definition
Household social network size	Self reported household size on NHANES III
Frequency of telephone calls-non household family, friends, neighbors(V1)	Self reported frequency that respondent talks on telephone to family, friends, neighbors weekly
Frequency of visits-non household family/friends (V2)	Self reported frequency of visits with non household family or friends weekly
Frequency of visits-neighbors (V3)	Self reported frequency of respondent visits with neighbors weekly
Frequency of church attendance (V4)	Self reported frequency of church attendance weekly
Frequency of organizational meeting attendance (V6)	Self reported frequency of club or organizational attendance weekly



social network variables were hypothesized to be group together. Although each social network item was included in the analysis individually, the grouped variable titles originally proposed remain in the study’s research questions (Table 18).

Table 18

*Social Network Variables as Defined in Research Questions*

<b>Specific Social Network Variable</b>	<b>Reference Group in Research Questions/Hypotheses</b>
Household social network size	Household social network size
Frequency of telephone calls-non household family, friends, neighbors (V1)	Frequency of non household family/friend contact
Frequency of visits-non household family/friends (V2)	
Frequency of visits-neighbors (V3)	
Frequency of church attendance (V4)	Frequency of organizational contact
Frequency of organizational meeting attendance (V6)	

Table 19

*Operational Definitions of Outcome Variables*

<b>Outcome Variable</b>	<b>Operational Definition</b>
Total Food Energy Intake (TFEI)	The total kilocalories calculated from the self reported 24-hour dietary recall data submitted during the physical examination.
Body Mass Index (BMI)	The calculation obtained by NHANES III from the following formula: BMI = (Weight in Kilograms) / (Height in Meters Squared), using values for weight and height obtained during the physical examination.
Total Dietary Calcium	The total dietary calcium derived from food and beverages consumed and reported as part of the 24-hour dietary recall
Total Dietary Fiber	The total dietary fiber derived from food and beverages consumed and reported as part of the 24-hour dietary recall.
Total Dietary Folate	The total dietary folate derived from food and beverages consumed and reported as part of the 24-hour dietary recall.
Total Dietary Vitamin B12	The total dietary vitamin B12 derived from food and beverages consumed and reported as part of the 24-hour dietary recall.
Total Dietary Vitamin D	The total dietary vitamin D derived from food and beverages consumed and reported as part of the 24-hour dietary recall.
Food Security	The self reported assessment by the participant regarding whether there is sufficient amounts of food, expressed as ‘enough’, ‘sometimes not enough’ or ‘often not enough’.

Table 20

*Operational Definition of Covariates*

<b>Variable</b>	<b>Operational Definition</b>
Age	Self-reported age in years from NHANES III
Ethnicity	Respondent's self-reported race, ancestry or national origin
Education	Self-reported highest grade or year in school attained by respondent
Income	Self-reported value of family income for the last month
Exercise/Physical Activity	Sum of all self-reported responses to NHANES III items related to the frequency of specific exercises/physical activities per week.
Chronic Health Problems	Sum of all self-reported positive responses to specific NHANES III items related to chronic health problems

Research Question 1-Hypothesis Testing

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal total food energy intake (TFEI) as defined by the Dietary Reference Intakes (DRI) for community dwelling elderly women?

Hypothesis: A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with optimal TFEI in community dwelling elderly women.

Independent variables: Social network variables-household social network size, frequency of telephone calls-non household family/friends/neighbors, frequency of visits-non household family/friends, frequency of visits-neighbors, frequency of church attendance, and frequency of organizational meeting attendance.

Dependent variable: Total food energy intake (TFEI)

Originally, it was proposed that hierarchical regression would be used for this analysis. Hierarchical regression is a specialized form of regression that allows covariates to be entered into the regression model in stages or steps. As proposed, groups of covariates would be entered into the regression model in three steps. The first group to be entered was all the social network variables (household size, frequency of non-household family/friend contact and frequency of organizational contact). Next, age, education, ethnicity and income the preceding month were to be added to the model. Finally, the two variables ‘exercise/physical activity’ and ‘chronic health problems’ would be added to the model. Hierarchical regression can not be performed by SUDAAN.

Since hierarchical regression is simply a specialized form of regression, the regression procedure from SUDAAN, called REGRESS, was used. This procedure fits linear regression models and performs hypothesis testing related to the parameters of the model. Generalized Estimating Equations (GEE) are used to estimate regression parameters (RTI, 2005). Regression analysis is a statistical tool used to test the strength and significance of relationships between variables (Campbell, 2004; Garson, 2004). The model helps explain the variation in the dependent variable when given specific values for the independent variables (Campbell). The hierarchical regression model enters the variables in stages and reveals the degree to which the groups of variables in each stage explain the variance on the dependent variable. Ultimately, a final model is created that includes all variables of interest. With the REGRESS procedure in SUDAAN, the models representing each stage or subset of

variables are not created. The model created by SUDAAN includes all variables, similar to the model in the final stage of hierarchical regression.

For this question, a regression model was created using the dependent variable, TFEI, in relation to the independent variables (i.e. six social network variables). The REGRESS procedure permits a single dependent variable with multiple independent variables. The dependent variable should be a continuous variable, as was the case with TFEI. The independent variables may be continuous or categorical (RTI, 2004b).

The purpose of this regression was to explore the relationship between the predictor variables, i.e. the specific social network variables (i.e. household social network size, frequency of visits-family/friends, frequency of visits-neighbors, frequency of phone calls, frequency of church attendance and frequency of organizational attendance) and the dependent variable, TFEI. The output that results revealed several things. First, the value of multiple R-square is defined as the percent of variance in the dependent variable that is explained by the independent variables (Adams, 2003; Garson, 2004). The output also tells how well the individual independent variables (i.e. the social network variables) allowed prediction of the dependent variable, TFEI. The predictive value of the individual social network variables was indicated when the p value for each independent variable was significant. Level of significance for this study was  $p \leq 0.05$ ; an independent variable was significant if the p value was 0.05 or less. The strength of the relationship was determined by the beta coefficient. The direction of the relationship was determined by a positive or negative sign preceding the beta coefficient. Finally, the predictive

value of the overall model was determined by the level of significance of the model. The same level of significance was used for this value as well.

It is important to note that for each regression, the number of observations in the analysis sometimes varied from one model to the next. The change in the number of observations was due to the manner in which SUDAAN handles missing values. With SUDAAN, if any variable in the model was missing a value for the observation, that observation was not included in the analysis (RIT, 2001, p. 457).

A secondary research question asks: What is the relationship between social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) and the TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled?

Hypothesis: There is a significant, positive relationship between the social network and optimal TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.

Independent variables: Social network variables as identified earlier

Dependent variable: TFEI

Covariates: age, education, ethnicity, income, exercise/physical activity, chronic health problems

In the original proposal, the hierarchical regression generated in the first question was to be used for analysis of this question as well. In SUDAAN, this analysis was accomplished using the REGRESS procedure. In this case, and EFFECTS statement was added to provide for testing of potential covariates. In this

analysis, all of the social network variables were included in the regression model along with age, ethnicity, income, education, exercise/physical activity and chronic health problems.

The output from this analysis was similar in appearance and purpose to the regression model described earlier. Multiple R-square represented the percent of variance in the dependent variable that was explained by the independent variables either jointly (Adams, 2003; Garson, 2004). The predictive value of the individual social network variables when the covariates are controlled was indicated by the beta coefficients. The strength of the relationship was determined by the beta coefficient. The direction of the relationship was determined by a positive or negative sign preceding the beta coefficient. Level of significance for this study was  $p \leq 0.05$ . An independent variable was considered significant if the p value was 0.05 or less.

An additional question related to TFEI asks: Does TFEI differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?

Hypothesis: There is a significant, positive difference between age and optimal TFEI when the effects of household social network size, frequency of non-household family/friends contact and frequency of organizational contact are held constant.

Independent variable: Age

Dependent variable: TFEI

Covariates: Social network variables as identified earlier

In the proposed study, analysis of covariance (ANCOVA) was suggested for analysis. The ANCOVA is used to test the main and interaction effects of categorical

variables on a continuous dependent variable, controlling for the effects of selected other continuous variables which may affect the dependent variable (Garson, 2004). However, in SUDAAN, there is no ANCOVA procedure. The variable structure for ANCOVA is similar to multiple regression. Therefore, the REGRESS procedure was used to perform this analysis.

This analysis was completed in two ways. First, age was interpreted as a continuous variable in the analysis. Next, age was interpreted as a categorical variable, with age groups defined as 60-69 years, 70-79 years and  $\geq 80$  years. The REGRESS procedure was used for both models since it is an appropriate procedure for both continuous and categorical data of this type. In this case, the regression model tests the specific relationship between TFEI and age with the social network variables controlled. From this model, the multiple R-square was determined for this relationship. The strength and direction of the association with age, the p value for the relationship and the overall significance of the model was generated.

#### Research Question 2-Hypothesis Testing

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal body mass index (BMI) in community-dwelling elderly women?

Hypothesis: A larger total social network (i.e. household social network size and frequency of non-household social network contact) will have a significant, positive relationship with normal BMI in community dwelling elderly women.

Independent variables: Social network variables-household social network size, frequency of telephone calls-family/friends/neighbors, frequency of visits-non

household family/friends, frequency of visits-neighbors, frequency of church attendance and frequency of organizational meeting attendance.

Dependent variable: Body Mass Index (BMI)

Originally it was proposed that the findings for this question would be analyzed using multinomial logistic regression. Logistic regression in general is used to estimate the likelihood of events when the dependent variable is dichotomous, based on the independent variables (Garson, 2004; Pampel, 2000). In multinomial logistic regression, a specialized form of logistic regression, the independent variables may be different levels of measurement; the dependent variable is a categorical variable with two or more levels. In this case, possible options for BMI are low ( $< 18.5$ ), normal ( $18.5-24.9$ ) or high ( $\geq 25$ ). The independent variables are both continuous and categorical. Multinomial logistic regression simultaneously considers the independent variables as predictors of the dependent variable. For this study, one function of multinomial logistic regression is to predict the probability of having a particular characteristic (i.e. BMI) due to a one-unit change of the independent variable (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) (Pampel, 2000).

In SUDAAN, the MULTLOG procedure was used for the analysis of question one concerning BMI. This procedure provides modeling capabilities for dependent variables that have two more categories (RTI, 2004b). The specific SUDAAN procedure used with the dependent variable BMI was called the Generalized Logit Model for nominal responses (RTI, 2004b). This procedure is used when the response variable has more than two categories, as in the case of BMI. This



command in SUDAAN uses estimating procedures to determine the odds of being in one category or another on the dependent variable. This model handles both continuous and categorical variables like those in the independent variables.

The logit is a natural logarithm of odds ratios (Garson, 2004; Pampel, 2000). The logit transforms probabilities into odds (Pampel). The probabilities are the likelihood of an event, vary between 0 and 1, and are expressed as a proportion of occurrences and nonoccurrences (Pampel). Odds represent the likelihood of an occurrence in relation to the likelihood of a nonoccurrence (Pampel). In this case, odds are calculated for the probability of being underweight vs. the probability of being optimum/normal BMI. In addition, odds are calculated for the probability of being overweight vs. the probability of being optimum/normal BMI. As probability gets closer to one, the numerator becomes larger in relation to the denominator, and the odds become an increasingly larger number. Larger increases in odds will result from smaller changes in probability (Pampel, 2000). Odds ratios are comparisons of two different odds.

The analysis produced odds ratios, i.e. measures of the association or effect size between the two variables. Garson (2004) says the syntax refers to the odds ratio of the first value to the second value, where the first value is the value on the independent variable one is coming from and value two is the independent variable one is going toward. Odds ratios below one indicate a decrease i.e. a unit change in the independent variable is association with a decrease in the odds of the dependent variable being the highest value (Garson). Confidence intervals are provided around

odds ratios as well. If the 95% confidence interval on the odds ratio includes the value of 1.0, the variable is not considered a useful predictor variable.

Logit coefficients represent the rate of change in the log odds (i.e. underweight BMI vs. normal BMI) as the independent variables (i.e. social network variables) change (Whitehead, 2005). Presented as beta coefficients in the output, these coefficients are the effect of the independent variable on the odds ratio. Effects of one mean that the probability of one event occurring is the same as the other. In this case, an effect of one means the probability of underweight BMI is the same as the probability of having a normal BMI. Negative effect coefficients lead to odds ratios less than one; Whitehead says that these are harder to interpret than odds ratios greater than one, i.e. positive coefficients (2005).

Tests of significance were included in this analysis as well. Test of significance for logistic regressions are similar to those in ordinary regression (Pampel, 2000). The level of significance for this analysis is  $p \leq 0.05$

One secondary question asks “Is there a relationship between one’s household social network size, frequency of non-household family/friend contact, frequency of organizational contact and normal BMI when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?”

Hypothesis: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal BMI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.

Independent variables: Social network variables as identified earlier

Dependent variables: BMI

Covariates: age, education, ethnicity, income, exercise/physical activity, chronic health problems.

In the original proposal, multinomial logistic regression was suggested as the statistical procedure for analysis of this question. In SUDAAN, the MULTLOG procedure was used and was described earlier. As with the earlier question concerning BMI, odds ratios with confidence intervals and logit coefficients are produced. The output indicates which independent variables, if any, have a significant effect on the log odds for underweight to normal BMI or overweight to normal BMI. The description of the output provided earlier is pertinent here.

Another secondary research question asks “Does optimal BMI differ based on age group when the effects of household social network size, frequency of non-household family/friends contact and frequency of organizational contact are controlled?”

Hypothesis: There is a significant, positive difference between age group and optimal BMI when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

Independent variable: Age group

Dependent variable: BMI

Covariates: Social network variables as identified earlier

In the original proposal, it was suggested that ANCOVA be used for the analysis. As stated earlier, SUDAAN does not support the use of ANCOVA. Instead, the MULTLOG procedure, described above, was used for the analysis of findings for this question. Output similar to that described for question one and two concerning BMI was produced for this question as well.

### Research Question 3-Hypothesis Testing

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components (i.e. total dietary calcium, total dietary fiber, total dietary vitamin B12, total dietary vitamin D and total dietary folate) in community dwelling elderly women?

Hypothesis: A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with an optimal intake of specific vitamins/food components in community dwelling elderly women.

Independent variables: Social network variables-household social network size, frequency of telephone calls-family/friends, frequency of visits-family/friends, frequency of visits-neighbors, frequency of church attendance and frequency of organizational meeting attendance.

Dependent variables: Optimal intake of specific vitamins/food components-total dietary calcium, total dietary fiber, total dietary folate, total dietary vitamin D and total dietary vitamin B12. Table 21 shows the specific vitamins/food components for analysis and the accepted range for each.

Table 21

*Accepted Ranges of Selected Vitamins/Food Components for Women  $\geq$  60 years*

<b>Specific Vitamin/Food Component</b>	<b>Accepted Range</b>
<b>Vitamin D</b>	51-70 years – 10mcg/d $\geq$ 70 years- 15 mcg/d
<b>Calcium</b>	51-70 years 1200 mg/d $\geq$ 70 years – 1200 mg/d
<b>Total dietary fiber</b>	50-70 years—21 gm. $\geq$ 70 years – 21 gm.
<b>Vitamin B12</b>	51-70 years 2.4 mcg/d $\geq$ 70 years- 2.4 mcg/d
<b>Folate</b>	51-70 years 400 mcg/d $\geq$ 70 years- 400 mcg/d

The purpose of this analysis is to determine the nature of the relationship between the social network variables and an optimal level of each specific vitamin or food component. Each of these nutrients is measured at the ratio level. Originally, the findings for this question were to be analyzed using hierarchical regression. Since hierarchical regression was not specifically available in SUDAAN, the REGRESS procedure was used. This procedure was used with each of the identified vitamins or food components as independent variables. Each dependent variable was analyzed in the model individually. A regression model was created using each vitamin or food component as the dependent variable (i.e. dietary calcium, dietary fiber, dietary folate, dietary vitamin D and dietary vitamin B12.) in relation to the independent variables (i.e. six social network variables). Using SUDAAN makes these analyses robust to the assumptions of multiple regression. The regression model will predict the strength and direction of the relationship of each independent variable (i.e. each social network variable) to the individual vitamin/food component.

Level of significance for this study was  $p \leq 0.05$ . The level of significance helps identify the predictive value of the overall model and p values for each independent variable determine their predictive value within the model. The strength of the relationship between the independent variables and the dependent (i.e. each vitamin/food component) was determined by the beta coefficient and the direction of the relationship was determined by a positive or negative sign preceding the beta coefficient.

For the purposes of discussion, the DRI for each vitamin/food component was compared to reported intake later in this document.

One secondary question states “Is there a relationship between one’s household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled? ”

Hypothesis: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components when age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.

Independent variables: Social network variables as identified earlier

Dependent variables: total dietary calcium, total dietary fiber, total dietary folate, total dietary vitamin D, total dietary vitamin B12.

Covariates: age, education, ethnicity, income, exercise/physical activity, chronic health problems

The proposed analysis for these findings was hierarchical regression. For this study, the REGRESS procedure in SUDAAN was used. Regression models for each dependent variable relative to the social network variables were produced. The data output from these associations indicated the strength and direction of the relationship between each dependent variable to the social network variables. In addition, the significance of the relationship was determined by a p value of 0.05 or less.

#### Research Question 4-Hypothesis Testing

Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security in community dwelling older women?

Hypothesis: A larger social network (i.e. larger household social network size, frequency of non-household family/friends contact and frequency of organizational contact) will have a significant, positive relationship with food security among community dwelling elderly women.

Independent variables: Social network variables-household social network size, frequency of telephone calls-non household family/friends, frequency of visits non household family/friends, frequency of church attendance, and frequency of organizational meeting attendance.

Dependent variable: Food security

Food security is a variable measured at the ordinal level, with three distinct categories. In this case, 'enough' represents the highest level or most positive level of

Table 22

*Frequency of Food Security*

Food Security N=2585 (unweighted)	Group Size	Percentage of Sample	Size after Regrouping
Enough (1)	2500	96.6	2500
Sometimes not enough (2)	79	3.1	58
Often not enough (3)	6	0.2	N/A
Total cases	2585	99.9	2585
Missing	3	0.1	3
Total	2588	100	2588

food security while ‘often not enough’ indicates the lowest level. As part of data management, weighted and unweighted frequencies were generated for each variable including food security (Table 22). Only 6 people (approximately 0.2%) reported ‘often not enough’ food. It was determined that this smaller group should be combined with the larger group above (i.e. sometimes not enough) for subsequent analysis. The revised group sizes are shown in Table 22.

For the original analysis, ordinal logistic regression was suggested. Ordinal logistic regression, an extension of binary logistic regression, simultaneously considers the independent variables as predictors of the dependent variable. In the completed study, the MULTLOG procedure, using cumulative logit models for ordinal responses, was used for this analysis. This procedure was appropriate because there was order to this variable. Having enough food ‘ranks’ higher, or was better than ‘sometimes not enough’ food.

The output generated for this analysis was similar to the output for BMI described above. In this case, there were only two ordered positions, or one comparison. The procedure produced logit coefficients that represented the rate of



change in the log odds (i.e. enough to sometimes not enough) as the independent variables (i.e. social network variables) change (Whitehead, 2005). Effects of one mean that the probability of one event is the same as the other. In this case, an effect of one means the probability of having enough food is the same as the probability of sometimes not having enough food. Significance tests are produced for each social network variable as well. From this analysis, it is possible to identify which social network variables, if any, have a significant effect on the odds of having enough vs. sometimes not enough food.

One secondary research question states “Is there a relationship between one’s household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?”

Hypothesis: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.

Independent variables: Social network variables as identified earlier

Dependent variable: food security

Covariates: age, education, ethnicity, income, exercise/physical activity, chronic health problems.

Logit coefficients represent the rate of change in the log odds (i.e. enough to sometimes not enough) as the independent variables (i.e. social network variables)

change, while holding the covariates constant (Whitehead, 2005). From this analysis, it is possible to identify which social network variables, if any, have a significant effect on the odds of having enough vs. sometimes not enough food, while controlling for age, ethnicity, income, education, physical activity and chronic health problems.

An additional question concerning food security asks: “Does food security differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?”

Hypothesis: There is a significant, positive difference between an individual’s age group and food security when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

Independent variables: age (continuous age)

Dependent variable: food security

Covariates: household social network size, frequency of non-household family/friend contact, frequency of organizational contact.

In this analysis, the MULTLOG procedure with the cumulative logit model for ordinal responses was used. Logit coefficients are produced. The logits represent the rate of change in the log odds (i.e. enough to sometimes not enough) as age changes, holding the social network variables constant (Whitehead, 2005).

Significance tests are produced for the overall model as well as for the effect of age on the ‘enough’. From this analysis, it is possible to identify the effect, if any, age has on the odds of having enough vs. sometimes not enough food.

## Limitations, Reliability and Validity

Limitations of this study are directly related to limitations associated with the design of NHANES III. While the complex sampling method used for NHANES III is useful for large surveys such as this one, there are several limitations with this design. A fundamental principle of sampling is that every individual in the population has an equal chance of being sampled into the survey (Korn & Graubard, 1999). Simple random sampling affords every one in the population an equal probability of selection. However, sampling in this way would potentially yield close to 34,000 different locations in the United States for interviewers to travel to gather data. The NHANES III designers determined that the multistage cluster sampling would yield a sample with a greater chance of representation in a more time and cost efficient manner. However, this sampling method has inherent bias because the sampling is disproportionate. For example, some geographic regions were identified as specified sampling units in NHANES III. Individuals from geographic clusters may have more characteristics in common than individuals selected using random techniques from the larger population (Korn & Graubard).

Another limitation relates to those sampled individuals who received a medical examination. The sampled individuals who were interviewed traveled to mobile examination centers (MEC) for the physical examination. Time and cost constraints necessitated a limited number of examination sites (Korn & Graubard, 1999). In some cases the physical examinations were completed in the home, but not all aspects of the exam could be performed in this setting. Some older adults sampled were unable to travel to the MEC and were excluded from certain data collection

strategies such as the 24-hour dietary recall. These older adults were subsequently eliminated from this study's sample. The potential impact of this sampling criterion is discussed later. The multistage sampling approach solves for many of these problems, but potentially excludes individuals who would have otherwise been included using simple random techniques. (The sampling strategy is described in detail earlier in this chapter.)

Additionally, over sampling some groups (minority populations, older adults and young children) in NHANES III increases the potential sampling error with this type of sampling. Over sampling was done to assure that appropriate representation of minority groups in the NHANES III sample. Over sampling of certain minority groups limits the data on other minority groups who were not over sampled such as Native American or Pacific Islanders. These design issues necessitated specialized analysis to control for potential sampling error.

Another limitation in this study was error due to non response bias in the original study. Two sources of non response bias exist in this or any survey: unit non response and item non response. In any sampling procedure, the survey would be less biased if every sampled household agreed to participate in the survey. Not every sampled individual agreed to participate. Failure to achieve this results in unit non response bias. Item non response bias is present when particular items on a survey are not answered by the respondent. When individuals who do not respond differ from those who do, biased results are obtained (Bierman & Bubolz, 2003). NHANES III incorporated various techniques to address potential non response bias (e.g. incentive payments and repeated call backs for refusal conversion).

Item non response represents a source of bias in any survey. NHANES III performed multiple observations on the same individual. Thus, the potential exists for missing or incomplete data through failure to obtain and record all items of information for the respondent. The potential for missing or incomplete data creates bias in any estimate derived from the survey data itself (Westat, Inc, 1994). In NHANES III, the overall household interview response rate was 66% and the medical examination response rate was 78% (Healthy People 2010, 11/15/03).

Some limitations are due to the particular design in this study. A secondary data analysis, part of this study's design, has inherent limitations. Existing data may be incomplete. For example, some community dwelling women were eliminated from inclusion in this study because of incomplete information on the dietary recall collected by NHANES III. Additionally, several variables contained information termed 'blank but applicable' or 'missing' and the particular case would be excluded from analysis. In secondary analysis, findings are generated from information as it exists. Some items from the original survey may not address directly the variable of interest. In this study, none of the social network items from NHANES III specifically addressed social network size. For this study, household size was used but will not give any indication of the social network size beyond the immediate household. Items may be absent from the original survey that have the potential to impact the outcome. Cognitive ability varies in each older adult and has the potential to affect the quality of the responses. However, objective measures of cognitive ability were not used in the original NHANES III survey. With secondary analysis,

some information may be older or potentially obsolete. This was a limitation with this study, since the NHANES III data was collected between 1988 and 1994.

In this study, several specific limitations relate to sampling. For example, inclusion in the proposed sample means an individual traveled to the MEC for the physical examination. This inclusion criterion was necessary to assure a 24-hour dietary recall was completed. Traveling to the MEC assumes at least minimal physical ability to leave the residence. In fact, those individuals who were homebound, and completed the physical exam in their home, potentially present a different picture of the size and frequency of contact from the social network. This inclusion criterion may have eliminated individuals from this study who were frailer, at greater nutritional risk and in more need of social network support. These limitations may limit generalizability of this study to the larger population.

All data collected on NHANES III, except for the actual physical examination, was self-reported data. In addition, the variables selected for use in this study rely on self-reported data. Inherent in this method is the possibility that the individual, intentionally or unintentionally, misrepresented some information reported to the interviewer or submitted on a written questionnaire. Another issue related to self-reported data is response set bias. This type of bias is the tendency of the respondent to provide an answer for a survey item without regard for the content of the item. In some cases, the respondent may give an answer he or she believes the interviewer is seeking, or may give an answer without regard for the content due to apathy. The 24-hour dietary recall relies on the memory of the respondent for accuracy. In some cases, the respondent may be inaccurate in their recollection of

intake during this period. Each respondent demonstrates differing levels of cognitive ability, potentially affecting the quality of the data. In addition, knowing that they are participating in a study, some respondents may lie about their intake or may give socially acceptable answers. Since NHANE III relies on this type of data, some limitations concerning the reliability of the data exist.

Previous NHANES (1971-1984) included the dietary recall as part of a dietary interview. Experts from dietary survey methodology, epidemiology, public health and biostatistics recommended the 24-hour dietary recall be continued as part of the NHANES III survey despite its issues related to data collection and analysis. Their recommendation stated that the 24-hour dietary recall should continue as a proven and detailed quantitative food and nutrient intake methodology (NCHS).

However, NHANES III took several steps to assure high reliability of the data collected. For example, the nutritional or dietary assessment components of NHANES III were designed to include several data sources, including dietary intake, interviews, anthropometric data, and biochemical measures (NCHS, 1994).

Methodology for the nutritional assessment was developed with a panel of experts from government, research, and academic agencies as well as from industry (NCHS).

The 24-hour recall was collected through an automated interview using the Dietary Data Collection (DDC) system (NCHS, 1994). The DDC system was specifically designed to probe for certain nutrients and food intake in the diet (e.g. fat and salt). Use of these methods help increase the consistency of the information generated with the 24-hour dietary intake and other dietary assessment techniques.

Another limitation was the cross-section design used in NHANES III. This design characteristic of NHANES III has a potential affect on the reliability of the data. The first phase occurred from 1988-1991; the second phase was from 1991 to 1994. Each participant was included in only one phase. Therefore, all information used for analysis in the study may have been different prior to or following the data collection interview. For example, the individual's social network may have changed due to changes in health. The cross-section design also affects dietary data collection. The dietary intake for an individual on the specific day of the interview may have been unusual in comparison to the individual's regular diet. Reliability is affected because true relationship between the social network and dietary intake may not be capture in a single data collection.

Another limitation relates to the operational definition of social network used for this study. A challenge in any social network support research is the inconsistent definitions of terms such as social network or social support in the existing literature. The most frequently used definition of social network found in the literature relates to network size and frequency of contact within the network. However, this is not completely compatible with the available data from NHANES III. While some information is available about the frequency of contact (items V1-V4 & V6), specific information about the size of the network outside the household is not available. Therefore, in this study, the operational definition for social network was amended to more closely match the available data in NHANES III.

Ethnicity in NHANES III was determined by self-reported information of the individual based on a selection of 12 possible ethnic or cultural groups (Mexican,



Mexican-American, other Latino or Spanish American group, Aleut, Eskimo, American Indian, Asian or Pacific Islander, Black, White, Other). The individual chose from one of these pre-determined ethnic/cultural categories. In some cases, the individual may have considered themselves a member of more than one ethnic group. The Census Bureau reported that 6.8 million people stated they were part of more than one ethnic group; 93% of these people said they were part of two ethnic groups (US Department of Commerce, 3/12/2001). Therefore, respondents in NHANES III may have chosen a category that was the 'best fit' for their ethnic group or race.

Another limitation of this study is mortality of observations in SUDAAN. If a case was missing a variable of interest, the entire observation was discarded. In some cases, the number of cases due to missing data was more than 1/3 of the total number of observations. The number of observations used in each analysis, therefore, may vary from one procedure to the next. The difference in the number of observations creates potential bias. The impact of this limitation on the findings will be discussed later in this document

Another limitation of this study was the inability to make cause-and-effect statements about the relationships between the independent and dependent variables. Each of the statistical procedures used in the analysis consider the association of the variables to each other. Regression fits data into a model to help explain the variance in the dependent variable by two or more independent variable. As a result of the analysis, statements about the estimated relationships of the variables were made. However, statements indicating that the independent variables caused the outcome variables are not possible.

## Generalizing to the Larger Population

Several characteristics of this study enhance the ability to generalize the findings to the larger population of older adult women. One characteristic that improves generalizability was the sample size. The number of people in the sample increases the probability of a more representative cross section of the population.

Another characteristic that improves generalizability is the sampling strategy in the original survey. The initial sample was chosen using a probability sampling strategy. Probability sampling techniques decrease bias and enhance the researcher's ability to generalize to larger populations. The multi-stage cluster sampling used in the original NHANES III study was selected because it was a more efficient method of sampling large portions of the population in a representative way. The sampling strategy created analysis issues described earlier in this document. Use of the weighting variable identified by NHANES III and a specialized computer program like SUDAAN helped compensate for biases created by this sampling strategy.

A few characteristics, however, limit the ability to generalize to the larger population. One characteristic that limits is the fact that participants in this study must have completed the physical examination at home. Older women who did not complete their physical examination in the MEC did not have a 24-hour dietary recall. Therefore, some older women were eliminated from this study's sample. This inclusion criterion creates a more homogenous sample, and but limits generalizability of the findings. Despite over sampling strategies that were used in the original study, this study's sample is primarily White women. The lack of ethnic diversity limits generalizability to more diverse populations of women in the community.

## Summary

This study was a secondary analysis of data from NHANES III. The study's sample was community dwelling women 60 years and older who completed of the physical examination at the MEC as well as a 24-hour dietary recall. Items from NHANES III used to provide data were obtained from the household interview, the physical examination and the 24-hour dietary recall data. Four main research questions and their respective hypotheses were presented. In addition, the analysis plan for each of these questions, along with secondary questions, was outlined. Study limitations were identified as well. The design of NHANES III provided unique challenges, including the specific sampling strategy used to recruit subjects. Because of this sampling strategy, a specialized computer program was used for the analysis of data in this study.

## CHAPTER 4: FINDINGS

### Introduction

This section outlines the demographic information about this sample as well as the findings for each research question and hypothesis. This sample was derived from NHANES III and the complex sampling design used by NHANES III required analysis using appropriate sample weights. Weighting the data produces statistical estimates as if the entire sampling frame had been used (NCHS, 1994). Sample weights are measures of the number of persons the particular sample observation represents (NCHS, 1994). As a result, unweighted data represents the actual findings for this specific sample; weighted data are adjusted to represent the population. Both weighted and unweighted data are shown as appropriate in the following section.

### Descriptive Findings

#### *Background*

This sample included women 60 years of age and older from NHANES III data. They had participated in a household interview, had a physical examination in the Medical Examination Center (MEC) and completed a 24-hour dietary recall. These criteria resulted in a sample of 2,588 women, representing 22,036, 174 from the population. Tables 23-26 provide specific information about age, marital status, race/ethnicity, education, income, exercise and chronic health problems.

#### *Demographic Information*

Most women in this sample were 60-69 years of age, followed by 70-79 years (mean=72.1 years, standard deviation (SD) =8.2). NHANES III does not differentiate any age over 90 years. In this study, the two oldest age groups (80-89 years and

Table 23

*Distribution of Women by Age Group and Marital Status*

Age Group	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
<b>60-69 years</b>	1,097	42.4	10,523,782	47.8
<b>70-79 years</b>	895	34.6	7,818,802	35.5
<b>80 &amp; over</b>	596	23.0	3,693,590	16.8
<b>Total</b>	<b>2,588</b>		<b>22,036,174</b>	
<b>Marital Status</b>				
<b>Never married</b>	127	4.9	979,119	4.5
<b>Married- Spouse in house, living as married</b>	1,043	40.4	10,251,836	46.6
<b>Married- Spouse not in house, separated</b>	98	3.8	539,905	2.5
<b>Widowed/ Divorced</b>	1314	50.9	10,228,200	46.5
<b>Total</b>	<b>2582</b>		<b>21,999,060</b>	<b>100</b>
<b>Missing values</b>	6	0.2	37,114	0

90+years) were combined into one group (i.e. 80 years and over) because the number of people in the 90+ group was relatively small (i.e. 54) in comparison with other age groups (Table 23). Combining these two groups assured that the oldest age group was large enough for analysis purposes. When combined, the oldest age group represented 16% of the sample. Most women sampled were widowed/divorced (50%); the next largest group (about 45%) was those married living with their spouse or living as married.

Although the original survey over sampled from minority groups to increase representation, more than 75% of this sample was White. Twenty percent of this sample was Black; other minority groups were under-represented (Table 24). The distribution of minority groups in this sample is discussed later in this document.

Respondents identified the last grade in school attended and their income from all sources during the preceding month. About 43% reported a 9-12<sup>th</sup> grade education; slightly more than one-third of the sample had an eighth grade education

or less (Table 25). About one-fourth of the sample (24.4%) reported income between \$500-999 in the preceding month, or \$6,000-11,988 annually.

Table 24

*Distribution of Minority Groups*

Minority Group	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
White	2,019	78.0	19,675,057	89.3
Black	525	20.3	1,933,399	8.8
Other Racial Group	43	1.7	426,850	1.9
Mexican/ Mexican-American /unknown race	1	0.04	868	0
Total	2,588		22,036,174	

Table 25

*Distribution of Educational Level and Reported Income Preceding Month*

Educational Level	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
No school/ kindergarten only	136	5.3	310,085.6	1.4
1-5 <sup>th</sup> grade	310	12	1,220,755	5.5
6-8 <sup>th</sup> grade	522	20.2	354,280	16.1
9-12 <sup>th</sup> grade	1,105	42.7	11,282,551	51.2
1-4 yrs college	397	15.3	4,534,778	20.6
≥ 5 yrs college	101	3.9	1,035,863	4.7
<b>Total</b>	<b>2571</b>			
Missing values	<b>17</b>	0.7	109,661.3	0.5
<b>Income Level</b>				
< \$100	14	0.5	62,685	0.3
\$100-499	317	12.2	1,756,382	8.0
\$500-999	631	24.4	4,604,218	20.9
\$1000-2199	825	31.9	7,739,817	35.1
\$2200-2999	194	7.5	2,052,513	9.3
≥ \$3000	281	10.9	3,394,833	15.4
<b>Total</b>	<b>2,262</b>		<b>19,610,448</b>	
Missing Values	326	12.6	2,425,726	11.0

Income and educational disparity was evident between ethnic groups in this sample. For example, about 56% of the Black women earned \$999 or less per month

as compared to about 39% of the White women, a finding consistent with other studies (Left Business Observer, 2000). More White women than Black women reported a 9-12<sup>th</sup> grade education (i.e. 44% compared to 40%). The literature supports this finding, identifying a Black-White educational gap of 2-8% (Federal Interagency Forum on Aging-Related Statistics, 2004; National Center for Education Statistics, 2001).

About 85% of the sample exercised less than recommended; a little more than one-third reported no exercise or physical activity at all (Table 26). The National Institute of Aging (2005) recommends 30 minutes of exercise most days of the week.

Table 26

*Distribution of Total Exercise/Physical Activity Weekly and Chronic Health Problems*

Total exercise sessions weekly	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
<b>None</b>	938	36.2	6,077,555	27.6
<b>1-2</b>	1,301	50.3	11,649,330	52.2
<b>3-4</b>	302	11.7	3,777,251	17.1
<b>5-6</b>	46	1.8	525,747	2.4
<b>≥ 7</b>	1	0.1	6,291	0.03
<b>Total</b>	2,588		22,036,174	
<b>Chronic Health Problems</b>				
<b>0</b>	460	17.8	4,144,193	18.8
<b>1-2</b>	1,437	55.5	11,942,493	54.2
<b>3-4</b>	623	24	5,372,233	24.4
<b>5-6</b>	65	2.5	569,330	2.6
<b>7</b>	3	0.1	7,925	0.0
<b>Total</b>	2,588	100	22,036,174	100

About 55% reported 1-2 chronic health problems and slightly less than 20% reported no health problems. Less than 1% (i.e. 3) reported all seven health conditions including diabetes, hypertension, high cholesterol, heart attack, stroke, arthritis and osteoporosis.

*Overview of Social Network Characteristics*

Most women sampled lived alone or with one other person. Most women did not attend club meetings, and less than half attended church weekly. About one-fourth (27%) of the women reported a single weekly visit from family/friends; close to 2/3 of the sample had no weekly visits from neighbors. About one-fourth averaged a phone call weekly from family/friends or neighbors. The following section outlines specific information about these variables with detailed data in Tables 27-31.

*Specific Social Network Characteristics of the Sample*

The social network characteristics were derived from six items on the household interview in NHANES III including household size, frequencies of phone calls to family/friends/neighbors weekly, getting together with family/friends weekly,

Table 27

*Descriptive Statistics-Social Network Variables-Unweighted Data*

Unweighted Statistics	Household Size	Frequency Weekly Organization Meetings	Frequency Weekly Church Attendance	Frequency Weekly Visits-Neighbors	Frequency Weekly Getting Together Family/Friends	Frequency Weekly Phone Calls Family/Friends/Neighbors
N	2588	2588	2587	2588	1933	2580
Missing Cases	0	0	1	0	655	8
Mean	2.3	0.2	0.9	2.3	5.1	12.7
Mode	2.0	0.0	1.0	0.0	2.0	7.0
Std. Deviation	1.6	0.7	1.2	37.9	55.0	15.1

visits with neighbors weekly, attendance at church weekly and attendance at club/association meetings weekly. Frequencies and measures of central tendency



for these items are presented in Table 27. Since the mean may be adversely affected by extreme values, the mode for each of these items is identified. It is important to note the number of missing cases for the variable ‘number of times together with family/friends weekly’ was larger than any other social network variable in this study.

Table 28

*Frequency of Household Size*

Number of Persons	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
1	906	35.0	7,827,369	35.5
2	1,045	40.4	10,651,936	48.3
3-4	276	15.3	2,487,711	11.3
5-6	163	6.3	818,754	3.7
7-8	53	2.1	187,132	0.8
≥9	25	1.0	63,272	0.3
Total	2,588		22,036,174	

Table 29

*Frequency of Club and Church Attendance-Weighted and Unweighted Data*

Frequency weekly attendance-clubs	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
0	2,304	89.0	19,159,745	86.9
1-2	232	9.0	2,359,903	10.7
≥3	52	2.0	516,526	2.3
Total	2,588		22,036,174	
Frequency weekly attendance-church				
0	1,098	42.4	9,950,603	45.2
1	1,131	43.7	9,244,974	41.9
2-3	275	10.6	2,218,390	10.1
≥4	83	3.2	604,417	2.8
Total	2,587		22,018,384	
Missing Cases	1	0.0	17,791	0.1
Total	2,588		22,036,174	

Approximately 35% of women reported a household size of one; another 40% lived with one other person (Table 28). A household size of one means the woman lived alone. The respondent’s relationship to other household members is unknown.

Most women did not participate in club or association activities weekly. In this sample, 89% did not attend any club meetings; another 9% attended once or twice weekly. Approximately 42% did not attend church and about 43% attended once weekly (Table 29).

Table 30

*Frequency of Telephone Calls Weekly-Weighted and Unweighted Data*

Number Phone Calls Weekly	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
Never	185	7.1	867,682	3.9
1	166	6.4	1,126,282	5.1
2	157	6.1	1,535,118	7.0
3	156	6.0	1,458,612	6.6
4-7	861	33.3	7,432,808	33.8
8-14	406	15.7	3,825,862	17.5
15-21	304	11.8	2,954,250	13.4
22-28	118	4.5	939,915	7.7
29-35	92	3.6	760,341	3.4
≥ 35	135	5.0	1,109,732	4.9
Total Cases	2,580	99.5	22,010,611	99.9
Missing	8	0.3	25,564	0.1
Total	2,588	100.0	22,036,174	100.0

About 25% of the sample had limited phone contact (0-3 calls) with family, friends or neighbors weekly (Table 30). About one-third had 4-7 calls weekly; a small group (5%) reported more than 35 phone calls per week.

Close to one-third of those sampled received weekly family/friends visits (Table 31 next page). However, for this item, about one-fourth of the cases were missing, resulting in an analysis sample of 1,933. A large portion of the sample had little contact with neighbors. Approximately 60% of the sample received no weekly neighbor visits and about 13% of the sample reported one visit per week.

*Overview-Characteristics of Dietary Intake*

In this study, there were eight variables related to dietary intake: total food energy intake (TFEI), body mass index (BMI), self reported food sufficiency, and total dietary intake of several specific vitamins/food components. More than half the

Table 31

*Frequency of Visits with Family/Friends and Visits with Neighbors Weekly*

<b>Weekly visits family/friends</b>	<b>Unweighted Frequency</b>	<b>Unweighted Percent</b>	<b>Weighted Frequency</b>	<b>Weighted Percent</b>
<b>1</b>	719	27.8	5,469,981	32.7
<b>2</b>	402	15.5	3,819,812	22.8
<b>3</b>	238	9.1	2,620,927	15.7
<b>4</b>	82	3.1	949,935	5.6
<b>5</b>	43	1.6	410,103	2.4
<b>6</b>	12	0.4	108,232	0.7
<b>7</b>	385	14.9	2,873,194	17.1
<b>≥ 8</b>	52	2.8	486,473	2.8
<b>Total</b>	1,933		16,738,658	
<b>Missing Cases</b>	655	25.3	5,297,517	
<b>Total</b>	2,588		22,036,174	
<b>Visits-Neighbors</b>				
<b>0</b>	1,558	60.2	12612475	57.2
<b>1</b>	357	13.7	3,145,046	14.2
<b>2</b>	199	7.7	1,912,867	8.7
<b>3</b>	88	3.4	919,291	4.2
<b>4</b>	31	1.2	261,631	1.2
<b>5</b>	7	.3	109,234	.5
<b>6</b>	1	.0	17,791	.1
<b>7</b>	302	11.7	2,643,404	12.0
<b>≥8</b>	47	1.7	414,435	2.0
<b>Total</b>	2,588	100.0	22,036,174	100.0
<b>Missing Cases</b>	0		0	

sample consumed less than the recommended TFEI (Table 32); despite this lower TFEI intake, the BMI for the majority was categorized as overweight or obese (Table 33). All other dietary intake measures were less than recommended. Most women reported adequate food security. These findings are described in the following section with detailed data in Tables 32-36.

*Specific Findings-Dietary Intake Measures*

Approximately 31% of the sample had a TFEI within the recommended range; more than half the sample consumed less TFEI than recommended. The average

Table 32

*Reported Total Food Energy Intake-Weighted and Unweighted Frequencies*

Kcal	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
Less than 1500	1,550	59.9	12,379,592	56.2
1500-2200	815	31.5	7,542,683	34.2
≥ 2201	223	8.6	2,113,899	9.6
Total	2,588	100	22,036,174	100

TFEI in the sample was 1,422.3 kcal (SD=600.6). The Dietary Reference Intake (DRI) for TFEI is 1,500-2,200 kcal/day (Institute of Medicine [IOM], 2002).

Table 33

*Frequency Distribution of BMI by Classification and Assessment*

BMI –By Classification N=2,588 or 22,036,174	Assessment	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
Underweight (<18.5)	Low	62	2.4	600,847	2.7
Normal-optimal (18.5-24.9)	Optimal	856	33.3	8,214,909	37.3
Overweight (25-29.9)	High	930	36.2	7,550,938	34.4
Obesity (≥ 30)	High	724	28.1	5,595,080	25.4
Total cases		2,572	100	21,997,464	100
Missing cases		16		38,711	0.2

The BMI for the majority of this sample was categorized as higher than optimal level (NHLBI, 1998). The BMI for this sample ranged from 11.7 to 60

(mean 27.4, SD=5.6). While 31% of women reported TFEI within the recommended range and another 59% reported less than recommended TFEI, BMI for about 59% of the sample was considered high. This finding is discussed in more detail later.

The dietary intake for folate, fiber and vitamin B12 was inadequate in this sample (Table 34). Three quarters of the sample consumed less than the recommended amount of folate. About 10% of those sampled consumed dietary

Table 34

*Frequency of Total Dietary Folate, Dietary Fiber and Dietary Vitamin B12*

<b>Folate</b>	<b>Unweighted Frequency</b>	<b>Unweighted Percent</b>	<b>Weighted Frequency</b>	<b>Weighted Percent</b>
<50	78	3.0	415,934.9	1.9
<b>51-350 mcg</b>	1,977	76.4	16,554,008	75.1
<b>351-450</b>	239	9.3	2,186,558	9.9
<b>451-550</b>	143	5.6	1,477,682	6.7
<b>≥ 551</b>	151	5.9	1,401,991	6.3
<b>Total</b>	2,588	100	22,036,174	100
<b>Fiber</b>	<b>Unweighted Frequency</b>	<b>Unweighted Percent</b>	<b>Weighted Frequency</b>	<b>Weighted Percent</b>
<21 gm	2,100	81.1	17,500,316	79.4
<b>21-21.9 gm</b>	67	2.6	591,104.9	2.7
<b>≥ 22 gm</b>	421	16.3	3,944,757	17.9
<b>Total</b>	2,588	100	22,036,174	100
<b>Vitamin B12</b>	<b>Unweighted Frequency</b>	<b>Unweighted Percent</b>	<b>Weighted Frequency</b>	<b>Weighted Percent</b>
≤ 2.39 mcg	1,268	49.0	10,217,958	46.4
<b>2.4-2.49 mcg</b>	57	2.2	539,415	2.5
<b>≥ 2.5</b>	1,263	48.8	11,278,801	50.9
<b>Total</b>	<b>2,588</b>	<b>100</b>	<b>22,036,174</b>	<b>100</b>

folate within a 50 mcg range of the recommended 400 mcg (+/- 50 mcg) for women over age 60 (IOM, 1998). The majority of respondents (81.1%) consumed less than the recommended daily dietary fiber intake; only 2.6% of the sample consumed the recommended 21 gms (IOM, 2002). Approximately 49% of the sample consumed inadequate amounts of vitamin B12.

Women in this study were deficient in dietary calcium and vitamin D intake when compared to the DRI for their respective age groups (Table 35 next page). Optimal dietary calcium intake for women over 51 years is 1200 mg/day; about 91% reported inadequate dietary calcium intake (IOM, 1997). In addition, about 98% reported vitamin D intake less than 15 mcg. Optimal vitamin D intake is 10 mcg for women age 51-70 years and 15 mcg for women older than 70 years (IOM).

Table 35

*Frequency of Total Dietary Calcium and Vitamin D Intake*

Calcium	Unweighted Frequency	Unweighted Percent	Weighted Frequency	Weighted Percent
<1200 mg	2,367	91.5	19,841,881	90.0
≥ 1200 mg	221	8.5	2,194,294	10.0
Total	2,588	100	22,036,174	100
Vitamin D				
< 10 mcg	2,411	93.2	40,209,054	91.3
10-15 mcg	140	5.4	1,495,770	6.8
≥ 15 mcg	37	1.4	420,070	1.9
Total	2,588	100	22,036,174	100

Table 36

*Distribution of Food Security*

Food Security	Unweighted Frequency-Original Categories	Unweighted Frequency-enough/not enough	Unweighted Percentage	Weighted Frequency	Weighted Percentage
Enough	2,500	2,500	96.6	21,670,017	98.3
Sometimes not enough	79	85	3.2	333,087	1.6
Often not enough	6				
Total cases	2,585	2,585	99.9	22,003,105	99.9
Missing Cases	3	3	0.1	33,069.7	0.15
Total	2,588	2,588	100	22,036,174	100

Most women reported they had enough food to eat (i.e.96%) (Table 36). However, TFEI for approximately 59% of the sample was less than recommended.

This implies that deficits in TFEI or other nutrients are unrelated to the ability to get enough food. Food security or 'enough to eat' was a dietary variable measured in three levels in the original survey. Two categories, 'sometimes not enough' and 'often not enough' were combined in the analyses because of the small frequency for 'often not enough'.

#### *Summary of Sample Description*

This sample of 2,588 community dwelling women represented 22,036,174 women in the larger population. Most of the sample was between 60-69 years; the mean age was about 72 years (SD=8.2). Most women were widowed or divorced. More than 75% of the sample was White; only 20% were Black. The number of Hispanic women in the sample was smaller than the US population. The largest percentage of the sample had a 9-12<sup>th</sup> grade education (42%) but about 38% had an 8<sup>th</sup> grade education or less. More than one-third reported income from the preceding month at \$500-999. About 1/3 of the sample engaged in no physical activity or exercise in a week; about 31% participated in one physical activity weekly. Almost half the sample reported 1-2 chronic health conditions related to dietary intake.

Many women sampled lived alone (35%) or with one other person (40). The largest percentage had one visit weekly from family/friends, had no visits from neighbors and talked on the phone with family/friends/neighbors 4-7 times weekly. An equal portion of the sample attended church weekly or did not attend church at all; most (85%) did not attend any club or association meetings.

Overall, the dietary intake for the women in this sample was inadequate based on the recommendations for their age. More than half had inadequate TFEI, yet

approximately one-third of the sample was considered overweight and another 28% were classified as obese. The majority consumed inadequate levels of dietary fiber, folate, calcium and vitamin D. Almost half the sample consumed inadequate amounts of vitamin B12. Most women reported adequate amounts of food to eat.

## Hypotheses Findings

### *Introduction*

The following section describes the findings for each hypothesis for the main research questions and their secondary questions. The analysis was performed using the computer program SUDAAN 9.0. This program is important because of the complex research design used in NHANES III. The specific characteristics of this program are described in chapter 3. SUDAAN eliminates any case with a missing value in any variable included in the analysis. Therefore, while the unweighted sample was 2,588, some cases were eliminated due to missing values on any one or more of the variables included in the observation. The analysis summary for each question/hypothesis includes the number of unweighted and weighted observations. The accepted level of significance was  $p \leq 0.05$ . Tables 37-47 present analysis summaries for the research questions.

### *Total Food Energy Intake*

Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal total food energy intake (TFEI) as defined by the Dietary Reference Intakes (DRI) for community dwelling elderly women?



Hypothesis 1: A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with optimal TFEI in community dwelling elderly women.

Table 37

*TFEI: Findings for Regression with Social Network Variables*

<b>Independent variables and effects</b>	<b>Beta Coefficient</b>	<b>SE Beta</b>	<b>T-test Beta=0</b>	<b>P-value</b>
<b>N=2,514/21,677,329 weighted Multiple R-square=0.02</b>				
<b>Intercept</b>	*****	39.40	37.97	0.00
<b>Together wkly family/friends</b>	-4.73	5.81	-0.81	0.42
<b>Church wkly</b>	21.42	9.81	2.18	0.034
<b>Clubs wkly</b>	52.42	26.18	2.00	0.051
<b>Visit neighbors wkly</b>	-15.50	3.33	-4.66	0.001
<b>Phone family/friends/neighbors</b>	0.67	1.25	0.53	0.60
<b>Household size</b>	-1.03	10.45	-0.10	0.92

The regression of TFEI on the social network variables accounted for 0.02 of the variance on the dependent variable (TFEI) and was significant at the 0.00 level (Table 37). Values of R-squared closer to 1.0 indicate that more of the variability is explained by the model; values closer to 0 mean less variability is explained by the model. The regression model for this relationship is shown below.

$$TFEI = **** + (-4.73 \text{ togetherwkly}) + 21.42 \text{ churchwkly} + 52.42 \text{ clubswkly} + (-15.50 \text{ visitwkly}) + 0.67 \text{ phone wkly} + (-1.03 \text{ household size}).$$

Being together with family/friends, weekly phone calls with family/friends and neighbors, weekly club attendance and household size were not significantly related to TFEI. The independent variables ‘visits with neighbors weekly’ (p=0.001) and ‘weekly church attendance’ (p=0.034) were significantly related to TFEI. The beta coefficient was negative for ‘visits with neighbors’ (-15.50); thus, when the

frequency of weekly neighbor visits was lower, TFEI was higher. On the other hand, the beta coefficient for 'weekly church attendance' (21.42) was positive; therefore, as the frequency of church attendance increases, the TFEI also increases.

The hypothesis for this research question was not supported. Two social network variables were significantly related to TFEI: frequency of weekly neighbor visits and frequency of weekly church attendance. Church attendance revealed a positive association; the variable 'visits with neighbors' was negatively associated.

Question 2: What is the relationship between social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) and the TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled?

Hypothesis 2: There is a significant, positive relationship between the social network and optimal TFEI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.

For the regression of TFEI on the social network predictor variables, holding age, education, ethnicity, income, exercise/physical activity and chronic health problems constant, multiple R-squared is 0.07 (Table 38 next page). Only the frequency of weekly visits with neighbors was significant ( $p=0.002$ ); it was inversely related to TFEI (-20.18). In this case, when the frequency of neighbor visits was lower, the TFEI was higher when the covariates were controlled. More of the variance on the dependent variable (TFEI) was explained by weekly club attendance when the covariates were controlled, although this variable was not statistically significant. The regression model is:

TFEI = 1,270.54 + (-4.44 together with family/friends weekly) + 21.91 weekly church attendance + 38.51 weekly club attendance + (-20.18 weekly neighbors visits) + 1.40 weekly phone calls +4.54 household size.

Table 38

*TFEI: Regression with Social Network Variables Controlling Covariates*

<b>Independent variables and effects</b>	<b>Beta Coefficient</b>	<b>SE Beta</b>	<b>T-test Beta=0</b>	<b>P-value</b>
<b>N=1,108/11183,854 weighted Multiple R-square=0.07</b>				
<b>Intercept</b>	1,270.54	260.0	4.89	0.00
<b>Together wkly family/friends</b>	-4.44	8.04	-0.55	0.58
<b>Church wkly</b>	21.91	15.34	1.43	0.16
<b>Clubs wkly</b>	38.51	39.64	0.97	0.34
<b>Visit neighbors wkly</b>	-20.18	6.03	-3.35	0.002
<b>Phone family/friends/neighbors</b>	1.40	1.66	0.85	0.40
<b>Household size</b>	4.54	16.69	0.27	0.79

The hypothesis for research question two was not supported. Only one social network variable was significantly related to TFEI: frequency of weekly neighbor visits. A positive association was hypothesized, but a negative, or inverse, relationship was found.

Question 3: Does TFEI differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?

Hypothesis 3: There is a significant, positive difference between age and optimal TFEI when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

In the regression of TFEI by age when household size, frequency of family/friend contact and frequency of organizational contact are controlled, 0.02 of

the variance in the dependent variable was accounted for by age (Table 39). Age was significantly related to TFEI in this model ( $p=0.002$ ); the beta coefficient (-6.29) indicates that as age increases, TFEI decreases.

Table 39

*TFEI: Regression by Age with Social Network Variables Controlled*

Independent variables and effects	Beta Coefficient	SE Beta	T-test Beta=0	P-value
<b>N=2,514/21,677,329 weighted Multiple R-square=0.02</b>				
<b>Intercept</b>	***	150.80	12.90	0.00
<b>Age</b>	-6.29	1.90	-3.30	0.002

This hypothesis was not supported. There was a significant relationship between TFEI and age but the positive relationship between the variables hypothesized was not supported.

#### *Body Mass Index*

Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal body mass index (BMI) in community dwelling elderly women

Hypothesis 1: A larger social network (i.e. household social network size, frequency of non-household social network contact and frequency of organizational contact) will have a significant, positive relationship with normal BMI in community dwelling elderly women.

For this hypothesis, multinomial logistic regression was used to determine the probability of being overweight or underweight as compared to a normal BMI. The coefficients can be used to construct models relating to the odds of being underweight vs. normal BMI or the odds of being overweight vs. normal BMI. Logits (log odds)

are natural logs of odds created by using the odds of an event occurring relative to the odds of the same event not occurring (Table 40). Logits help ‘linearize’ an inherently non linear relation between variables (Pampel, 2000).

Table 40

*BMI: Regression by Social Network Variables*

<b>BMI- log-odds (N=2,500/ 21,639,634)</b>		<b>Intercept</b>	<b>Together with family/ friends</b>	<b>Church weekly</b>	<b>Club weekly</b>	<b>Neighbor visits weekly</b>	<b>Weekly Phone Calls- family/ friends/ neighbors</b>	<b>House hold size</b>
<b>Under weight vs. Normal</b>	Beta Coeff	-2.6	0.01	-0.2	-0.9	0.05	0.01	0.07
	Lower 95% CI	-5.6	-0.07	-0.5	-2.1	-0.01	-0.01	-0.18
	Upper 95% CI	0.5	0.08	0.2	0.4	0.10	0.02	0.31
	P Value	0.1	0.9	0.4	0.2	0.11	0.27	0.58
<b>Over weight vs. Normal</b>	Beta Coeff	1.6	0.01	-0.1	0.0	0.01	0.01	0.09
	Lower 95% CI	0.4	-0.03	-0.2	-0.2	-0.01	-0.01	-0.18
	Upper 95% CI	2.9	0.05	-0.01	0.2	0.1	0.02	0.31
	P Value	0.009	0.6	0.04	0.97	0.7	0.05	0.05

The model for each regression is outlined below.

Underweight vs. Normal = -2.55 + 0.01 together with family/friends+ (-0.16 weekly church) + (-0.85 clubs weekly) +0.05 neighbor visits + 0.01 weekly phone calls + 0.07 household size.

Overweight vs. Normal = 1.64 + 0.01 together with family/friends + (-0.10 weekly church) + 0.00 clubs weekly + 0.01 neighbor visits + 0.01 weekly phone calls + 0.09 household size.

In the regression related to being underweight vs. normal BMI, the p values (i.e. levels of significance) for each social network variable are greater than 0.05. None of the social network variables are significantly related to the odds of being underweight vs. normal BMI.

In the model comparing the odds of being overweight vs. normal BMI, getting together with family/friends, weekly neighbor visits and weekly phone calls have the same relative importance (i.e. 0.01). Three social network variables are significantly related to the odds of being overweight vs. having a normal BMI: weekly phone calls (p=0.05), attending church weekly (p=0.04) and household size (p=0.05). The logit for attending church weekly is a negative value (-0.10), meaning

Table 41

*Odds Ratio for BMI for Overweight vs. Normal*

Over weight vs. normal	Intercept	Together family/ friends weekly	<b>Weekly Church</b>	Weekly Clubs	Weekly Neighbor Visits	<b>Weekly Phone Calls</b>	<b>House Hold Size</b>
Odds Ratio	1.19	1.01	<b>0.91</b>	1.01	1.00	<b>1.01</b>	<b>1.13</b>
Lower 95% limit	0.92	0.97	<b>0.83</b>	0.84	0.97	<b>1.00</b>	<b>1.03</b>
Upper 95% limit	1.54	1.05	<b>1.00</b>	1.21	1.04	<b>1.02</b>	<b>1.24</b>

the probability of being overweight rather than underweight is less than 0.5. The logits for weekly phone calls and household size are positive (0.01 and 0.09 respectively). In these cases, the odds are greater than one, or the probability of an

individual being overweight rather than having an optimal BMI is greater than 0.5 when weekly phone calls are higher and household size is larger.

Odds ratios also tell effect size and relative importance of the independent variables in relation to the dependent variable (Garson, 2006). The social network variables significantly related to being overweight are shown in bold italics (Table 41 preceding page). The effect size of the variable 'household size' is larger than the effect size of 'weekly phone calls' or 'weekly church attendance'. In this case, weekly church attendance decreases the odds of being overweight. However, the odds of being overweight are greater when the frequency values for phone calls and the number in the household are larger.

Garson (2004) states that if the 95% confidence interval on the odds ratio includes the value of 1.0, by convention the variables are not considered a useful predictor. For the three social network variables (i.e. church weekly, weekly phone calls and household size), the confidence interval includes the value of 1. Therefore, these variables are not considered strong predictors of BMI. (The model concerning being underweight vs. a normal BMI was not used since none of the social network variables were significant in the relationship). The hypothesis for this question was not supported.

Question 2: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and normal BMI when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?

Hypothesis 2: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal BMI when the effects of age, education, ethnicity, income, exercise/physical activity and chronic health problems are controlled.

The models for the social network variables, with the covariates controlled are shown below.

Table 42

*BMI by Social Network Variables Controlling Covariates*

BMI- log-odds (N=2172/ 19,205,298)		Intercept	Together with family/ friends	Church weekly	Clubs weekly	Neighbor visits weekly	Weekly Phone Calls	House hold size
Under weight vs. Normal	Beta Coeff	-21.44	0.01	-0.16	-0.80	0.04	0.01	0.18
	Lower 95% CI	-26.25	-0.08	-0.53	-2.03	-0.04	-0.01	-0.04
	Upper 95% CI	-16.63	0.10	0.22	0.43	0.12	0.02	0.41
	P Value	0.00	0.85	0.41	0.20	0.28	0.32	0.11
Over weight vs. Normal	Beta Coeff	-0.52	0.02	-0.08	0.17	0.01	0.01	0.11
	Lower 95% CI	-3.16	-0.02	-0.17	-0.03	-0.04	-0.00	-0.02
	Upper 95% CI	2.13	0.06	0.01	0.37	0.05	0.02	0.23
	P Value	0.70	0.32	0.10	0.10	0.77	0.08	0.10

Underweight vs. Normal = -21.44 + 0.01 together with family/friends -0.16 weekly church -0.80 clubs weekly +0.04 neighbor visits + 0.01 weekly phone calls + 0.18 household size.

Overweight vs. Normal = -0.52 + 0.02 together with family/friends -0.08 weekly church + 0.17 clubs weekly + 0.01 neighbor visits + 0.01 weekly phone calls + 0.11 household size.



In the model related to being underweight vs. normal BMI when the covariates are controlled, the coefficients indicate the relative importance of the social network variables in the model (Table 42). Attending 'church weekly' and 'clubs weekly' both show negative values, but attending clubs is relatively more important to the odds of being underweight rather than an optimal BMI. As the frequency of social network contacts decrease, the odds that the dependent variable equals one (i.e. probability of being underweight equals the probability of being a normal BMI) also decrease. On the other hand, getting together weekly with family/friends and weekly phone calls have the same relative importance. These coefficients are positive; as the frequency of these variables increase, the odds that the dependent variable equals one increase. In this model, the p values for each social network variable are greater than 0.05. Therefore, none of the social network variables are significant at the  $p \leq 0.05$  level. The social network variables are not significantly related to the odds of being underweight when covariates are controlled.

In the model that compares being overweight to a normal BMI, getting together with neighbors weekly and weekly phone calls have the same relative importance (i.e. 0.01). These coefficients are positive, indicating that as the independent variables increase, the odds that the dependent variable will reach one increases. Attending church weekly (-0.08) had a negative coefficient. However, in this analysis, none of the social network variables were significantly predictive of being overweight vs. having an optimal BMI. The odds ratios are not reported here since none of the social network variables are significant at the  $p \leq 0.05$  level.

The hypothesis was not supported. The findings do not indicate a significant relationship between BMI and the social network variables when age, ethnicity, education, income, physical activity and chronic health problems are controlled.

Question 3: Does optimal BMI differ based on age group when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?

Hypothesis 3: There is a significant, positive difference between one's age and optimal BMI when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

Table 43

*BMI by Age with Social Network Variables Controlled-Log odds and Odds ratios*

<b>BMI-log-odds (N=2500/21639634)</b>		Intercept	Age	<b>Underweight vs. Normal</b>	Intercept	Age
<b>Under weight vs. Normal</b>	Beta Coeff	-2.55	-0.00	<b>Odds Ratio</b>	0.08	1.00
	Lower 95% C I	-5.55	-0.04	<b>Lower 95% limit</b>	0.00	0.96
	Upper 95% CI	0.46	0.04	<b>Upper 95% limit</b>	1.59	1.04
	P Value	0.10	0.96			
<b>Over weight vs. Normal</b>	Beta Coeff	1.64	-0.02	<b>Over weight vs. normal</b>		
	Lower 95% CI	0.43	-0.04	<b>Odds Ratio</b>	5.16	0.98
	Upper 95% CI	2.85	-0.00	<b>Lower 95% limit</b>	1.54	0.97
	P Value	0.01	0.01	<b>Upper 95% limit</b>	17.32	1.00

Age is not a significant predictor of the odds of being underweight versus an optimal BMI. The p value for this relationship is greater than 0.05 (Table 43).

However, there is a significant relationship between age and the odds of being

overweight vs. optimal BMI ( $p=0.01$ ). The logit for age (-0.02) indicate that the odds of being overweight compared to having an optimal BMI is less than 1. The confidence interval for the odds ratio in this relationship contains the value of 1. Therefore, age is not considered a good predictor in this case.

### *Specific Vitamins/Food Components*

Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components (i.e. total dietary calcium, total dietary vitamin D, total dietary vitamin B12, total dietary folate and total dietary fiber) in community dwelling older women?

Hypothesis 1: A larger social network (i.e. household social network size, frequency of non-household family/friend contact and frequency of organizational contact) will have a significant, positive relationship with an optimal intake of specific vitamins/food components in community dwelling elderly women.

For this question, a regression was used for each individual vitamin or food component; each analysis included 2,514 unweighted or 21,677,329 weighted cases.

The model for total dietary calcium is shown below.

Total dietary calcium = 719.53 + (-7.95 together weekly with family/friends) +3.73 weekly church +21.59 weekly clubs + (-6.95 weekly visits with neighbors) + (-0.11 weekly phone calls) + (-11.33 household size)

In the overall model, 0.01 of the variance in total dietary calcium was explained by the social network variables. The strongest relationship, although not significant, was household size. The frequency of weekly visits with neighbors had a

significant relationship with total dietary calcium at the  $p=0.02$  level. The beta coefficient of -6.95 indicates the variable is inversely related to total dietary calcium: as weekly visits increases, total dietary calcium decreases.

The model for total dietary fiber and the social network variables is shown below. The multiple R-squared for dietary fiber is 0.02.

Total dietary fiber = 15.77 + 0.03 together weekly with family/friends + 0.58 weekly church + 0.3745 weekly clubs + (-0.26 weekly visits with neighbors) + (-0.01 weekly phone calls) + (-0.39 household size).

In this regression model, 0.02 of the variance in total dietary fiber was explained by the social network variables. Attending church weekly had a significant, positive relationship to total dietary fiber ( $p=0.005$ ). The beta coefficient for this variable was 0.58, indicating the degree of variance on total fiber intake explained by weekly church attendance. As the frequency of weekly church visits increased, the total dietary fiber increased. Weekly visits with neighbors was significant as well ( $p=0.00$ ). This variable was inversely related to total dietary fiber intake (-0.26); when the frequency of neighbor visits was lower, total dietary fiber intake was higher. Household size was also significantly and inversely related ( $p=0.01$ ). As household size increased, total dietary fiber intake decreased.

Total dietary folate was analyzed in relation to the social network variables; the regression model for dietary folate is shown below. The multiple R-squared for dietary folate is 0.004.

Total dietary folate = 276.02 + 0.26 together weekly with family/friends + 6.01 weekly church + 7.85 weekly clubs + (-2.43 weekly visits with neighbors) + (-0.34 weekly phone calls) + (-1.28 household size).

In this regression model, 0.004 of the variance on the dependent variable (total dietary fiber) was explained by the social network variables. The overall model was significant ( $p=0.00$ ), but none of the social network variables was significant at the  $p \leq 0.05$  level.

Total dietary vitamin D was analyzed in relation to the social network variables. The multiple R-squared for total dietary vitamin D is 0.008. The model for this relationship is shown below.

Total dietary vitamin D = 4.9384 + (-0.0708 together weekly family/friends) + 0.0616 weekly church + 0.1582 weekly clubs + (-0.04420 weekly visits neighbors) + (-0.0008 weekly phone calls) + (-0.1138 household size).

For this regression, 0.008 of the variance on the dependent variable, vitamin D, is explained by the social network variables, and the overall model was significant ( $p=0.00$ ). Only frequency of getting together weekly with family/friends was significant ( $p=0.03$ ). The beta coefficient for this variable was -0.07, indicating that when the frequency of getting together with family/friends was lower, vitamin D levels were higher.

Total dietary vitamin B12 was analyzed in relation to the social network variables. The multiple R-squared for dietary vitamin B12 is 0.002. The model for this relationship is shown below.

Total dietary vitamin B12 = 3.92 + 0.07 together weekly with family/friends + (-0.17 weekly church) + 0.004 weekly clubs + 0.001 weekly visits with neighbors + (-0.01 weekly phone calls) + 0.002 household size

For this regression, 0.002 of the variance on the dependent variable, total dietary vitamin B12, is explained by the social network variables. The model was significant ( $p=0.000$ ); however, none of the individual social network variables was significant at the  $p \leq 0.05$  level.

The hypothesis for this research question was not supported. Although each vitamin or food component was analyzed separately, only one social network variable had a positive relationship to any vitamin/food component; the frequency of attending church weekly had a significant, positive effect on total dietary fiber. Dietary vitamin B12 and folate revealed no significant relationship with the social network variables. For the remaining nutrients, some relationships with the social network variables were significant. However, these were inversely related.

Question 2: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?

Hypothesis 2: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and optimal intake of specific vitamins/food components when

age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.

Each vitamin or food component was individually analyzed for this question. For each analysis, the sample size was 1,110, or 11,094,263 weighted. The number of missing cases results from the manner in which SUDAAN handles missing data on any case: when any data is missing, the entire case is deleted from analysis. In each analysis for this question, the covariates age, ethnicity, income, education physical exercise/activity and chronic health problems were controlled

The multiple R-squared for total dietary calcium was 0.057 and the overall model was significant ( $p=0.008$ ). The model for this relationship is shown below.

Total dietary calcium =  $744.78 + (-9.28 \text{ togetherwkly}) + 5.09 \text{ churchwkly} + 3.22 \text{ clubswkly} + (-10.20 \text{ neighbor visits}) + 0.11 \text{ phone calls wkly} + 2.20 \text{ household size}$ .

The frequency of getting together weekly with family/friends ( $p=0.05$ ) was significantly related to total dietary calcium intake with covariates controlled. The beta coefficient for this social network variable was -9.28; when the frequency of getting together with family/friends was lower, total dietary calcium intake was higher.

The multiple R-squared for the regression of total dietary fiber by the social network variables with covariates controlled was 0.12; the overall model was significant ( $p=0.00$ ). The model for this relationship is shown below.

Total dietary fiber =  $6.78 + 0.06 \text{ togetherwkly} + 0.54 \text{ church wkly} + (-0.28 \text{ clubswkly}) + (-0.32 \text{ neighbor visits}) + (-0.02 \text{ phone calls wkly}) + (-0.32 \text{ household size})$ .

Two of the social network variables are significant in this model: the frequency of attending church weekly ( $p=0.02$ ) and the frequency of weekly visits with neighbors ( $p=0.001$ ). The frequency of weekly church attendance had a positive relationship with total dietary fiber; the frequency of weekly visits with neighbors was inversely related.

Total dietary folate was also analyzed in comparison to the social network variables, controlling for the covariates. The model for this regression is shown below.

Total dietary folate =  $409.29 + (-1.82 \text{ togetherwkly}) + 3.66 \text{ churchwkly} + 0.17 \text{ clubswkly} + (-4.11 \text{ neighbor visits}) (-0.69 \text{ phone calls wkly}) + (-7.09 \text{ household size})$ .

In this regression, 0.069 of the variance on total dietary folate was explained by the social network variables, when the covariates are controlled. The overall model was significant at the  $p=0.00$  level. The frequency of weekly visits with neighbors was significant ( $p=0.009$ ); the beta coefficient (-4.11) shows a negative relationship, indicating that when the frequency of weekly visits was low, dietary folate levels were higher.

Total dietary vitamin D intake was analyzed in relation to the social network variables with covariates controlled. The regression model is shown below.

Total dietary vitamin D =  $3.75 + (-0.10 \text{ togetherwkly}) + 0.11 \text{ churchwkly} + 0.09 \text{ clubswkly} + (-0.06 \text{ neighbor visits}) + (-0.01 \text{ phone calls}) + 0.06 \text{ household size}$ .

In this regression model, 0.050 of the variance on the total dietary vitamin D can be explained by the social network variables, with covariates are controlled. The overall model was significant at the  $p=0.00$  level. The frequency of getting together



with family/friends was significantly and inversely related to vitamin D in the model ( $p=0.002$ ). In this case, when the frequency of visits with family/friends was low, the total dietary intake of vitamin D was high. No other social network variables were significant in this model.

Total vitamin B12 intake was analyzed in relation to the social network variables when the covariates were controlled. The model for this regression is shown below.

Total vitamin B12 intake =  $7.20 + 0.02$  togetherwkly +  $0.00$  churchwkly +  $0.02$  clubswkly +  $(-0.02$  neighbor visits) +  $(-0.01$  phone calls) +  $(-0.06$  household size).

In this regression, 0.019 of the variance on the dependent variable was explained by the social network variables with covariates controlled. However, none of the individual social network variables were significant at the  $p \leq 0.05$  level.

The hypothesis was not supported. In most cases, there was no significant relationship between any individual social network variable and the specific vitamin or food components. Only one social network variable had a positive relationship to the nutrient; the frequency of attending church weekly had a significant, positive relationship with total dietary fiber when the covariates controlled. The frequency of getting together with family/friends had a significant but inverse relationship with both total dietary calcium and total dietary vitamin D.

### *Food Security*

Question 1: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security in community dwelling older women?

Hypothesis 1: A larger social network (i.e. larger household social network size, frequency of non-household family/friends contact and frequency of organizational contact) will have a significant, positive relationship with food security among community dwelling elderly women.

The model for this regression is outlined below.

Enough vs. Not enough = 5.16 + 0.06 together with family/friends + (-0.17 church weekly) + (-0.23 club attendance weekly) + (-0.01 neighbor visits weekly) + (-0.01 weekly phone calls) + (-0.18 household size)

Table 44

*Food Security by Social Network Variables-Log Odds and Odds Ratios*

<b>Enough N=2514/ 21,677,329 weighted (log odds)</b>		<b>Intercept</b>	<b>Together with family/ friends</b>	<b>Church weekly</b>	<b>Club weekly</b>	<b>Neighbor visits weekly</b>	<b>Weekly Phone Calls</b>	<b>House hold size</b>
<b>Enough vs. not enough</b>	Beta Coeff	5.16	0.06	-0.17	-0.23	-0.01	-0.01	-0.18
	Lower 95% CI	4.03	-0.13	0.48	-0.69	-0.11	-0.03	-0.43
	Upper 95% CI	6.29	0.26	0.13	0.24	0.10	0.02	0.07
	P Value	0.00	0.53	0.26	0.33	0.91	0.67	0.15
	Odds Ratio	173.54	1.06	0.84	0.80	0.99	0.99	0.83
	Lower 95% limit	56.00	0.87	0.62	0.50	0.90	0.97	0.65
	Upper 95% limit	537.78	1.30	1.14	1.27	1.10	1.02	1.07

In this regression, the frequency of weekly visits from neighbors and the frequency of weekly phone calls from family have the same relative importance on the dependent variable, 'enough' (Table 44). These variables have a negative

relationship. The p values for each of the social network variables were greater than  $p \leq 0.05$ . Therefore, none of the social network variables were significantly related to the dependent variable.

Except for the odds ratio of 'getting together family/friends', all odds ratios were less than one. The odds ratio for this variable was greater than one. Getting together with family/friends increased the odds that a person reported having enough food rather than not enough food. Since one is contained in each of the confidence intervals, the variable was not considered a useful predictor.

The findings from this analysis do not support the hypothesis.

Question 2: Is there a relationship between one's household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, physical activity and chronic health problems are controlled?

Hypothesis 2: There is a significant, positive relationship between household social network size, frequency of non-household family/friend contact, frequency of organizational contact and food security when the effects of age, education, ethnicity, income, exercise/physical activity, and chronic health problems are controlled.

The analysis sample included 438 observations. This implies that some variables included in the analysis contained missing data, and were eliminated.

The regression model is shown below.

Enough = 3.43 + (- 0.05 together with family/friends) + (-0.00 weekly church) + 0.77 weekly clubs + (-0.07 neighbor visits weekly) + (-0.01 weekly phone calls) + (-0.14 household size.

Table 45

*Food Security by Social Network Variables with Covariates Controlled*

<b>Enough Log odds &amp; odds ratios N=438/ 3,442,911 weighted</b>		<b>Intercept</b>	<b>Together with family/friends</b>	<b>Church weekly</b>	<b>Club weekly</b>	<b>Neighbor visits weekly</b>	<b>Weekly Phone Calls</b>	<b>House hold size</b>
<b>Enough vs. not enough</b>	<b>Beta Coeff</b>	3.43	-0.05	-0.00	0.77	-0.07	-0.01	-0.14
	<b>Lower 95% CI</b>	-4.16	-0.16	-0.39	-0.23	-0.23	-0.05	-0.97
	<b>Upper 95% CI</b>	11.01	0.06	0.39	0.09	0.09	0.02	0.69
	<b>P Value</b>	0.37	0.36	0.98	0.001	0.37	0.38	0.74
	<b>Odds Ratios</b>	30.81	0.95	1.00	2.15	0.93	0.99	0.87
	<b>Lower 95% confidence limit</b>	0.02	0.85	0.67	1.37	0.79	0.95	0.38
	<b>Upper 95% confidence limit</b>	60,556.58	1.06	1.47	3.38	1.09	1.02	1.99

Only one social network variable was statistically significant in this model: weekly club attendance ( $p = 0.001$ ) (Table 45). For weekly club meetings, the odds ratio of 2.15 indicated that with more frequent club meetings, the odds of having enough food is 2.15 times higher than not having enough.

This hypothesis was not supported. Only one social network variable, the frequency of weekly club attendance, was significant when covariates were controlled.

Question 3: Does food security differ based on age when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled?

Hypothesis 3: There is a significant, positive difference between an individual’s age group and food security when the effects of household social network size, frequency of non-household family/friend contact and frequency of organizational contact are controlled.

Table 46

*Food Security by Age with Social Network Variables*

<b>Enough N=2511/ 21,644,259</b>		<b>Intercept</b>	<b>Age</b>	<b>Enough</b>	<b>Intercept</b>	<b>Age</b>	
<b>Enough vs. not enough</b>	<b>Beta Coeff</b>	4.60	0.01	<b>Odds Ratio</b>	99.30	1.01	
	<b>Lower 95% CI</b>	0.80	-0.05	<b>Lower 95% limit</b>	2.23	0.95	
	<b>Upper 95% CI</b>	8.40	0.06	<b>Upper 95% limit</b>	4430.72	1.07	
	<b>P Value</b>	0.0187	0.78				

For this model, both log odds and odds ratios are displayed (Table 46). The p value of 0.78 indicates that age was not significantly related to food security. The odds ratio for age was slightly higher than one, indicating minimal effect by age on food security. Since the value of one was within the 95% confidence interval, age was not considered a useful predictor. The hypothesis was not supported.

Summary

Four broad research questions and secondary questions were addressed in this study using various forms of regression. In some models, selected social network variables demonstrated a significant relationship to dietary intake measures. The hypotheses in this project were not supported.

## CHAPTER 5: DISCUSSION AND IMPLICATIONS

### Introduction

The purpose of this study was to analyze the association between specific social network elements and selected dietary intake measures in community dwelling older women. Dietary intake measures included in this study were total food energy intake (TFEI), body mass index (BMI), total dietary intake of selected vitamins and food components (calcium, folate, fiber, vitamin D and vitamin B12) and food security. The findings make a valuable contribution to the existing knowledge concerning social network and dietary intake in this population. These findings are particularly useful because a specialized computer program (i.e. SUDAAN) and analysis strategies increased the possibility of generalizing the findings to the larger population of community dwelling older women. In addition, the sampling strategy (i.e. probability, multi-stage sampling) increased the probability of a representative sample.

This chapter identifies and discusses noteworthy characteristics of the sample, describes significant findings related to the research questions and compares the findings to existing literature. It also outlines limitations of this study as well as reliability and validity issues. Finally, it describes implications of this study and makes recommendations for researchers, health educators, health care providers and policy makers.

### Background Information-Findings

Throughout this chapter, both weighted and unweighted findings are discussed. Weighted and unweighted findings are important because of the multi-

stage, stratified sampling used in NHANES III, described in more detail earlier. This sampling strategy increases the possibility that ‘clusters’ of individuals are sampled (Korn & Graubard, 1999). In addition, NHANES III over sampled certain types of participants such as minority groups and older adults. Over sampling in this way increased the probability that some individuals are included in the sample. These sampling characteristics contributed to the unequal distribution of observations in this study, and increased the chance of bias in the results. Therefore, weighted estimators, or weighting variables, identified by NHANES III, statistically compensated for potential bias created by this type of design. Unweighted findings are derived without using weighting variables and represent data specific to the study’s sample. Weighted findings are derived by analysis with a specialized computer program using the weighting variables and are representative of the larger population.

### Descriptive Findings of the Study’s Sample

#### *Introduction-Demographic Characteristics*

The characteristics of the sample closely approximate the characteristics found in the US population for this age group (AoA, 2004; US Census Bureau, Census 2000, Summary File 3). In the US population, the largest percentage of older adults is between 65-74 years; in this sample the mean age is approximately 72 years. About half of the sample was widowed/divorced and approximately 40% were married/living as married, a finding similar to the US population. Most women in this sample lived in a two person household, (i.e. one other individual and the respondent); approximately one-third lived alone. In the US population, approximately 41% of older women live with a spouse; about 30% live alone (AoA,

2004). In this sample, the older woman's relationship to the second person in the household was not identified.

Income level for a portion of the sample was alarmingly low. The average annual income for individuals 65 years and over was between \$21,454 in 1988 and \$26,645 in 1994, the first and last year of NHANES III. The majority of this sample earned \$26,388 annually. Income data for NHANES III was collected during a single visit with the respondent during the original study. In this study, it is impossible to identify in which year the respondent reported her income for an accurate comparison to the Census data. However, the finding is important because income is an important risk factor in determining nutritional adequacy (ADA, 2000).

Despite over sampling in the original NHANES III sampling strategy, some minority groups, such as Hispanics, were under represented in this sample. The number of Hispanic women in this sample (1%) was inconsistent with the current 5.5% Hispanic older adults in the US population (AoA, 2004). The majority of this sample is White. About 8% of the weighted sample is Black, a finding consistent with US population (AoA).

Under representation of some racial/ethnic groups increases the potential bias in this design. Minority populations are vulnerable to health risks due to lower income, limited education and reduced access to health care (Jackson, 2005). Alwin and Wray (2005) describe differences in disease, disability and mortality across racial-ethnic groups. African American and Hispanic American adults show poorer health than their Asian American or European American counterparts (Alwin &



Wray). The lack of representation of some racial/ethnic groups in this sample has implications for future research which will be described later.

When compared to high school completion rates for women 60 years and older during the period of NHANES III, the educational level in this sample was slightly lower. More than 42% of the sample completed 9-12<sup>th</sup> grade of high school; another 15% of the sample completed 1-4 years of college. The high school completion rate for women of all races 60 years and over in 1988, the first year of NHANES III was about 58%; the rate in 1994, the last year of NHANES III, was 55% (US Census Bureau, August 1991; US Census Bureau, January, 2001). Educational completion is one of the most common indicators of social status and health (Alwin & Wray, 2005). Higher education improves health outcomes. Education level among White populations is usually higher as compared to more diverse groups. Since about 70% of this sample was White, one would have hypothesized higher educational levels rather than lower in comparison to national statistics.

More than three-quarters of the sample engaged in exercise less frequently than recommended. The National Institute of Aging (2005) recommends 30 minutes of exercise most days of the week. In this study, the length of time for each exercise session was not available; analysis focused on the total number of physical activities/exercise sessions weekly. However, the large percentage of women not exercising the recommended frequency is important because about 64% of the sample was classified as overweight or obese.

The majority of this sample (55%) reported one or two chronic health problems. However, the chronic health problems examined in this sample related to dietary intake; data for the US population were not limited in this way. Despite the difference in specific health conditions surveyed, this finding is consistent with the US population of older adults (Agency for Health Care Research and Quality, 2002).

*Specific Dietary Intake Measures-TFEI, Vitamins, Minerals & Food Components*

About 60% of the women sample had inadequate total food energy intake (TFEI); only 1/3 of women in this study consumed TFEI within the normal range,

Table 47

*Dietary Reference Intake for TFEI and Selected Vitamins/Food Components*

<b>Dietary Intake Measure</b>	<b>Dietary Reference Intake (DRI)</b>	<b>Potential Dietary Sources</b>
TFEI	1550-2200 kcal/day	All food and beverages, not including water
Fiber	21 gm/day	Breads, starches, cereals, cooked and raw vegetables, some fruits, beans, nuts, seeds
Folate	400 mcg/day	Green leafy vegetables, fortified ready-to-eat cereal, some fruits or fruit juice
Vitamin B12	2.4 mcg/day	Milk, dairy products, fortified breakfast cereals, meat, fish, poultry, eggs, legumes
Vitamin D	<69 yrs-10 mcg/day ≥70 years 15 mcg/day	Fortified Milk, some fish, liver, cheese, exposure to sun
Calcium	1200 mg/day	Dairy products, dark green leafy vegetables, dried beans, calcium fortified juices and cereals.

a finding consistent with other studies (Wurtman et al., 1988). Each vitamin or food component analyzed was consumed at inadequate levels as well. These findings are particularly important because few researchers examine older women specifically and these nutrients play an important role in the overall health of women. The recommended TFEI for this population and Dietary Reference Intake (DRI) for each

vitamin and/or food component are identified in Table 47 along with food sources (IOM, 1997; 1999; 2002; NIH Office of Dietary Supplements, 2004).

Approximately 80% of the women consumed dietary fiber below the recommended level for this age group, a finding consistent with the existing literature (ADA, 2002). Dietary fiber is important for the prevention of constipation, colon cancer and has been shown to prevent heart disease.

In the current study, approximately 81% sample consumed inadequate amounts of folate; about 50% sample consumed inadequate amounts of vitamin B12. Both these findings are consistent with the existing literature. Folate and vitamin B12 are important in lowering homocysteine levels in the blood, a compound associated with the increased risk of coronary artery disease, cognitive decline and age-related hearing loss (Associated Press, June 20, 2005; ADA, 2000; Grodner, et al., 2000).

More than 90% of the sample consumed less than the daily recommended dietary level of calcium and vitamin D. This finding is consistent with reported calcium and vitamin D levels in the older population as well as in the US population (ADA, 2004; Greenspan, Resnick & Parker, 2005; Holick, Siris, Binkley, Beard, Khan, Katzer, Petruschke, Chen & de Papp, 2005; Kinyamu, Gallagher, Rafferty & Balhorn, 1998; Marshall, Stumbo, Warren & Xie, 2001; Newmark, Heaney & Lachance, 2004; NIH Consensus Statement, 1994; NIH Office of Dietary Supplements, August 1, 2004). The proportion of women who are vitamin D deficient in this sample is slightly higher than in some other studies, but those samples were smaller and less representative of the US population (Holick, et al., 2005; Marshal, Stumbo et al., 2001). Calcium and vitamin D are important for bone

health, including the prevention of osteoporosis. Calcium is needed for muscle contraction, secretion of hormones and enzymes and function within the nervous system and vitamin D plays a major role in calcium absorption (ADA; NIH Office of Dietary Supplements, August 1, 2004).

*Specific Dietary Measure: Body Mass Index*

More than 64% of this sample had a body mass index (BMI) classified as overweight or obese; only 2% were considered underweight. However, the majority of individuals in this sample consumed less than adequate TFEI. These findings are important because much attention has been given to the risk of undernourishment in older adults (American Academy of Family Physicians, 2001; DiMaria-Ghalili & Amella, 2005; Gentleman, 2000). This study required completion of the physical examination at the MEC rather than the participant's home. It is possible that individuals excluded because of the home examination may have been more frail, i.e. at greater risk of under nutrition. The percentage of women considered underweight may have been larger if women examined at home were included in the sample. The potential inclusion of home examined women is discussed later.

*Specific Dietary Measures: Factors Affecting Outcomes*

Several factors may impact the dietary intake findings. One factor, a threat to reliability due to history, results from folate food fortification. NHANES III data was collected between 1988 and 1994. However, in September, 1992, the US Public Health Service (PHS) recommended that all women of childbearing age consume 400 mcg of folic acid daily to reduce the risk of spina bifida or neural tube defects in children (US FDA, 2/29/1996). Folic acid fortification was mandated in January,

1998 (CDC, National Center on Birth Defects & Developmental Disabilities, 2004) Although folic acid fortification was mandated after NHANES III was completed, older women sampled may have been more aware of the importance of folate from media coverage, ultimately potentially affecting dietary intake.

Researchers should use caution in interpreting reported intakes that are less than recommended from dietary surveys (ADA, 2001). The 24-hour dietary recall survey was one source of data in NHANES III. Although researchers consider self-reported food intake an accepted method of data collection and it is the basis of several national surveys, this methodology may underestimate true food intake by approximately 20% (ADA). The 24-hour dietary recall collects information about the respondent's most recent dietary intake rather than usual intake, a limitation of this methodology. Clinical and blood biochemistries do not support the dietary survey data (ADA). NHANES III used the 24-hour dietary recall as the basis for developing the Food Frequency Questionnaire (FFQ), a tool used for the purpose of describing the frequency of intake of particular food groups and targeted food sources, such as vitamins A and C, and calcium. However, the FFQ was never validated against other dietary intake measures and was not intended for quantifying nutrient intake in NHANES III (personal communication, R.Briefel, 10/8/03). Despite these concerns, the findings related to specific TFEI, vitamins/minerals and food components obtained have important implications which will be discussed later.

The appropriate range for BMI in the older adult is not clear (ADA, 2000; DiMaria-Ghalili & Amella, 2005; Horani & Mooradian, 2002). The Nutrition Screening Initiative (2002) identifies optimal or acceptable BMI for the older adult as

22-27, rather than 18-24.9 suggested by the National Heart, Lung and Blood Institute. Some suggest that BMI is correlated with total body fat content, but may underestimate body fat in individuals who have lost muscle mass like the elderly (Reports of the Surgeon General, 2001). Still others found that a relatively high BMI (i.e. 30-35 for women) was associated with minimal mortality risk in adults over 70 years of age (ADA, 2000). The current findings at least identify a high percentage of overweight and obese older women, a finding with implications for future research addressed later.

In this sample, most women's BMI was higher than optimal while inadequate TFEI was reported. There are several potential reasons for this discrepancy. First, age related changes to the gastrointestinal system, such as decreased digestive enzyme production, may affect the absorption and distribution of nutrients in the body. Resting metabolism decreases by about 10% with aging and less TFEI may be required (Shephard, 1998). Despite lower TFEI, women may consume more kilocalories than required by their individual metabolic needs.

Lack of food quality and variety may offer another explanation for the discrepancy between higher BMI and inadequate TFEI. In other studies, the majority of older people (67%) reported diets that needed improvement or were poor in quality (14%), factors that play a role in obesity (Federal Interagency Forum on Aging Related Statistics, 2000). Marshall, Stumbo, et al. (2001) suggested that increased dietary variety may be necessary to achieve adequate nutrient intake. In this sample, reported dietary intake may include foods with fewer nutrients than needed for optimal health.

## Findings Related to Hypotheses

### *Introduction*

Originally, it was hypothesized that a significant, positive association existed between household size, the frequency of organizational contact and the frequency of individual contact for each of the dietary outcome measures (TFEI, BMI, specific nutrients & food security). It was hypothesized that two domains, frequency of organizational contact and frequency of individual contact, would emerge from the factor analysis of specific NHANES III social network items. Frequency of weekly attendance in church or religious activities and the frequency of weekly attendance at organization or club meetings were social network items hypothesized to factor as the frequency of organizational contact. The frequency of phone calls weekly with family, friends or neighbors, the frequency of weekly visits with friends or relatives, and the frequency of weekly visits with neighbors were hypothesized to factor as frequency of individual contact. Because the factor analysis did not reveal these two social network domains, each individual social network item (i.e. 5 NHANES III items) and household size were analyzed in regression models relative to each dietary outcome measure (i.e. TFEI, BMI, specific vitamins/food components, and food security).

Although the original hypotheses were not supported, several individual social network elements were significantly associated with selected dietary outcome measures. In most cases, these were inverse rather than positive associations. This section will compare the findings from this study with existing literature and offer

some potential explanations for the differences between the findings in the literature and in this study.

### *Social Network and Dietary Intake*

The findings from this study suggest that social network and social support may be too complex to understand through the analysis of a single dimension such as the isolated structural features used here. Analysis of structural features in the social network ignores more qualitative characteristics such as whether the contact with social network members was considered positive or negative. This study suggests that the quality of interactions within the social network should be analyzed along with structural features.

While some social network literature found that social integration was associated with lower morbidity and mortality, other studies are consistent with the more mixed findings outlined here (Broadhead, Kaplan, James, et al., 1983; Ford et al., 2000. House, et al., 1988; Seeman, 1996). While evidence continues to accumulate concerning the association between social relationships and health; not all studies have found this association (Jorm, 2005).

Ford et al's (2000) research was originally thought to closely parallel this study. Ford et al. used the same NHANES III social network items to analyze social relationships and cardiovascular disease risk factors and found that social relationships 'favorably enhance' these health behaviors (Ford et al., p. 89). There are several reasons for the difference in the findings between this study and Ford et al's. Their sample was approximately 19,500 for either organizational or individual interactions, and included both men and women, 18 years of age and older. This study



included only 2,588 women, age 60 years and over. Based on factor analysis, Ford et al. divided the NHANES III social network items into two distinct domains. These domains (i.e. frequency of individual contact and frequency of organizational contact) were the same domains hypothesized in this study. However, the factor analysis for this study did not support these domains. This difference is important because Ford et al. were able to combine frequency of contact data for two items related to organizational contact into one variable and three items for frequency of individual contact into a second variable. In this study, the frequency data for each individual item related to the social network was analyzed. Because Ford et al. used the sum of the frequency of contact with individuals and the sum of frequency of contact within organizations, larger values were used in the analysis and may account for the difference in the two studies' findings.

#### *Significant Associations*

This study explored the potential relationships between social network variables and dietary intake measures by examining associations and not the cause-and-effect relationship between variables. Therefore, only significant relationships and the direction and strength of that relationship are identified.

Some social network elements were significantly related to specific dietary outcome measures. For example, weekly church attendance was positively associated with TFEI, as well as dietary fiber intake, with or without controlling the covariates. Other significant associations were inversely related to their respective dietary intake measures. For example, the frequency of neighbor visits was inversely related to TFEI. This study's mixed findings are consistent with some of the existing literature.

McIntosh and Shifflet found that some social network members had a positive effect on dietary intake, while other members exerted a more negative impact (1984). The findings from this current study suggest the need for further research, particularly research that examines both the frequency and quality of interactions. This issue is discussed later.

The frequency of neighbor visits was significantly and inversely associated with various dietary outcome measures more often than other social network element in this study. For example, the frequency of neighbor visits was inversely related to TFEI, with or without controlling the covariates (age, ethnicity, income, education, total exercise and chronic health problems), to BMI categorized as overweight (described above), to total dietary calcium, total dietary fiber with and without controlling covariates, and total dietary folate controlling for covariates. Visits with family/friends were the second most frequent social network element found to be significant in this study. Getting together with family/friends was inversely associated with three dietary outcome measures: dietary intake of vitamin D when covariates were controlled, dietary intake vitamin D without controlling covariates and dietary calcium intake. These findings are consistent with existing literature in some ways. Some literature suggests neighbors and friends were more supportive than family (Marcoux, et al., 1990; McIntosh & Shifflet; 1984; McIntosh, Shifflett & Picou, 1989). Generally neighbors and friends were significantly associated, but with more positive dietary outcomes (McIntosh & Shifflet; McIntosh, Shifflet & Picou). Other existing research found that social support from relatives lowered caloric intake, while friend support lowered only a few specific nutrients (McIntosh &

Shifflet). In this study, visits from neighbors was associated with negative, rather than positive, dietary outcomes. Despite this difference, the current study is consistent with other research that indicates neighbors have an important role in dietary intake.

Larger network size has been associated with positive health outcomes, suggesting that having more individuals within one's social network affords more opportunities for support (Seeman, Berkman, Blazer & Rowe, 1994). By definition, an individual's social network includes household members. In this study, household size was positively associated with an optimal BMI as well as dietary fiber intake. Literature examining household size alone is limited; however this finding is consistent the literature related to network size.

There were no significant relationships between frequency of club attendance and dietary intake in this study; several significant relationships with the frequency of church attendance are described above. Ford et al. (2000), using NHANES III data, combined the frequency of church attendance and frequency of club attendance into one item, i.e. 'organizational relationships'; they found that organizational relationships decreased negative health behaviors related to heart disease. Other literature examining this specific association is limited.

In the current study, age was significantly related to TFEI and BMI. Age was inversely associated with TFEI; as age increased, TFEI decreased, a finding consistent with the literature. This finding likely reflects a decreased metabolic rate considered a normal age related change. In addition, women in older age groups were more likely to be overweight. This finding parallels the higher rate of obesity in the

US population. Finally, age was not significantly related to food security. A sample that includes more racial and ethnic diversity as well as older women who are unable to travel for medical examinations may generate different findings related to TFEI, BMI and food security. The specific effect of age relative to each nutrient/food component was not analyzed in this study.

Only the frequency of club attendance was significantly related to food security. This positive association occurred when the covariates (i.e. age, ethnicity, income, education, chronic health problems and physical activity/exercise) were controlled. Food security occurs when nutritionally adequate food is available; food insecurity means the individual is unable to acquire nutritionally adequate food (Food Security Institute, 2003). This finding is consistent with existing literature; 94% of households with an older adult as part of the household are more likely to report food security, and households with two or more people are considered the most food secure (Food Security Institute; USDA, 2000).

#### *Potential Explanations for Findings*

There are several potential explanations for the unsupported hypotheses. Under representation of some racial/ethnic groups in this sample may explain these findings, as race and ethnicity contribute to differences in disease, disability and mortality (Alwin & Wray, 2005). As outlined earlier, this study's unweighted sample included 20% African American and less than 1% Hispanic respondents; approximately  $\frac{3}{4}$  of the sample was White. This sample does not adequately represent the minority populations most likely to experience these health disparities.

Using BMI as an outcome measure in this study limited the older women included in the sample; BMI was obtained only for individuals whose physical examination occurred at the MEC. There were 637 women, 60 years and over, who were excluded from the sample because they did not have a physical examination in the MEC. Of this number, 253 were home examined; the remainder of these women did not complete a physical examination at either location for unknown reasons. Physical examination response rates decreased as age increased, despite efforts to increase individual participation (i.e., extensive publicity, providing transportation to the MEC, financial incentives and appeals to individual philanthropy) (NCHS, 1996). Sampled people 60 years and older who were bed or wheel chair bound were immediate candidates for home examination (NCHS, 1994). In other cases, the home examination was offered when all efforts to persuade the respondent to go to the MEC were futile. Most home examined individuals were 80 years of age or older (NCHS, 1996). These women may have been more frail and had mobility limitations or other health issues that prevented travel. These characteristics potentially impacted the frequency of social network contact and the outcome of this analysis.

Additional limitations emerge if home examined individuals are included in the sample. The home examination was an abbreviated physical examination; items needed to calculate BMI not be available for home examined respondent (NCHS, 1996). Using both MEC and home examined women affects the weighting variable used for this analysis as well (NCHS, 1994). In addition, home examined respondents did not complete the 24-hour dietary recall and would continue to be excluded from the analyses of TFEI and specific vitamins/food components.

Use of secondary data analysis, a design with inherent limitations, may offer another explanation for the unsupported hypotheses. The items used for data collection are limited to those on the original survey which may not examine the research questions with adequate specificity. For example, household members represent only one part of an individual's social network; in this study, household size, not network size, was part of the operational definition of social network. Network size, not included in the original data, would have been a more accurate measure and may have resulted in different findings.

Original social network items did not clearly differentiate network members, another limitation of a secondary analysis. More clearly differentiating network members (i.e. spouse, non-household family, household family members, friends, and neighbors) potentially changes the frequencies obtained for each of these items, and may alter the results. For example, the original item "frequency of weekly phone calls" includes family, friends and neighbors; a more accurate measurement would be obtained by creating separate items for phone calls from family, phone calls from friends and phone calls from neighbors. 'Frequency of visits with family and friends' would be more accurate as two separate items: visits/family and visits/friends. The absence of social network items that address the quality (i.e. positive or negative) of social network interactions, a characteristic that impacts health outcomes, is another limitation with secondary analysis.

Self-reported data was used for all outcome measures except BMI. As mentioned, self-reported dietary data, including 24-hour dietary recall, is less reliable

than chemical or other biophysical data; survey results likely underestimate true dietary intake (ADA, 2001). This threat to reliability may have affected the findings.

### *Relationship to the Conceptual Framework*

Berkman and Glass (2000) described a comprehensive model to demonstrate the relationship between the social network, social support and health that was the framework for this study. The model is described in detail in Chapter 2. In the model, health outcomes are influenced by the social network through a variety of different and dynamic mechanisms. This study analyzed the relationships between several elements depicted in this model. For example, social networks are ‘embedded’ in larger social and cultural contexts, including cultural conditions, socioeconomic factors, political conditions and social change experiences. Ethnicity and income, covariates in the current study, are reflected in the social and cultural perspective.

Within this model, the social network has two domains: structure of the social network and characteristics of the ties. Each domain (i.e. structure or network size and characteristics of ties) was represented in this study by household size and frequency of individual and organizational contact respectively. Social network impacts health through psychosocial mechanisms in this model. Although social support was not specifically analyzed in this study, social support extends through the social network to the individual.

The model shows the complex relationship between the social network, social support and health. Only a portion of the model is applied to this study. The study’s findings parallel several pathways depicted by this model, illustrating that some

aspects of the social network impact specific health outcomes, i.e. diet. The findings suggest other important aspects of the social network, such as characteristics of interactions with neighbors, friends or family, are more complicated than the structural path analyzed in this research.

To understand the complex nature of social network interactions, a larger area of the model needs to be analyzed so that structural characteristics and the quality of the social interactions are included. For example, the model shows that the social network provides opportunities for psychosocial mechanisms to occur. Psychosocial mechanisms reflect ways the social network exert positive and negative influences on health (Berkman & Glass, 2000).

## Implications and Recommendations

### *Introduction*

Despite that lack of support of the individual hypotheses, some practical implications emerge from this study. This study contributes to the available body of knowledge about a particularly vulnerable portion of the aged population, i.e. older women in the community. For example, specific information about dietary intake in this population is limited. These dietary intake findings indicate that community dwelling older women have inadequate TFEI and less than recommended intake of several specific vitamins/food components. This study also has implications as a catalyst for additional research. For example, this study suggests that one-dimensional measures of social support are inadequate; social network research must include both qualitative and quantitative measures. In addition, interactions with some social network members are associated with specific measures of dietary intake.



However, the mixed results highlight the need to better understand these critical associations since dietary intake plays a significant role in overall health, productivity and quality of life. Finally, this study has practical implications for care providers and health educators working with the elderly in the community. This population needs to better understand adequate dietary intake, the importance of nutrient dense food and food variety and food sources for needed nutrients.

The following section outlines specific implications and recommendations for researchers, practitioners, health educators and policy makers.

#### *Research Implications and Recommendations*

The majority of social epidemiological research focuses on the beneficial effects of the social network. Some research has explored the potential for damaging health outcomes from social network relationships. Gordon and Zrull (1991) found that the social network promoted negative health behaviors related to alcohol use. Others describe interactions that are stressful, conflicted and other wise unsatisfying to the recipient (Dean & Lin, 1977; George, 1990; Newsome, Rook, Nishishiba, Sorkin & Mahan, 2005; Seeman, 2000; Rook, 1987). Some studies suggest that negative interactions have a more potent effect than positive or helpful interactions (Krause, 1995; Rook, 1984). The current study's results identify some potential network relationships that are not positive or supportive and highlight the need to better understand the frequency and quality of contact with social network members in relation to health behaviors such as dietary intake.

If this study is replicated using the same sample, two changes should be considered. In this study, the covariate 'chronic health problems' was limited to self-

reported health conditions related to dietary intake. When replicated, the variable ‘chronic health problems’ should include all health conditions surveyed on the HAQ. Some of the conditions included would be bronchitis, thyroid disease, asthma, skin conditions, cancer as well as those related to dietary intake. This change gives a more accurate picture of the number of chronic health problems the respondent manages.

If replicated, researchers should include self-reported health status as demographic information as well as a covariate. For NHANES III, there are five levels of self assessed health: excellent, very good, good, fair and poor. Self reported health has been associated with a variety of health outcomes including mortality (Idler & Benyamini, 1997). Analyses with this variable may determine the role, if any, of self-perceived health on various dietary intake measures.

Other specific recommendations for future research are identified in the following section.

Recommendation 1: More clearly differentiate specific social network members in subsequent research.

Subsequent research must more clearly differentiate each group in the social network. While this study found some social network relationships were significantly related to dietary intake, comparisons to the existing literature were difficult since groups of social network members were not clearly differentiated. For example, in the current study, the frequency of phone calls included family, friends and neighbors and the spouse was included as family rather than as a unique member. One potential differentiation more compatible with existing literature classifies members as the spouse, children, other family, friends/neighbors and confidantes. Giles, Glonek,

Luszcza & Andrews (2005) agree that differentiating friends, children and other relatives is important to understanding specific social network relationships.

Organizational support was differentiated as club attendance and church attendance in this study, a classification that would be useful in future research.

Recommendation 2: Develop consistent definitions for terminology used in the literature.

Another challenge with social epidemiological research of this type is the inconsistent definitions in the literature for some terms such as social network, social support, social ties and social relationships. The literature outlines a multitude of definitions for these terms. A consistent definition for the terminology should be developed so that more meaningful comparisons can be made with existing literature.

Recommendation 3: Include information about the quality of the interactions between individuals or groups (i.e. neighbors or family) in the social network.

Subsequent research should include information about the characteristics of the relationships and the quality of the interactions between individuals or groups (i.e. neighbors or family) in the social network. Interactions between social network members are characterized in the literature in several ways. In some cases, the interactions are described in terms of costs versus benefits. Benefits include improved self-esteem, a sense of belonging and positive supportive actions (Seeman, 2000). Costs include demands, conflict, embarrassment, devaluation or disappointment (Seeman). In the current study, the specific nature or quality of the interactions within the social network is not known. Knowledge concerning the quality of the

relationships or interactions may offer some explanation for the negative relationships that have emerged in this study.

Recommendation 4: Focus subsequent research on the relationship between friends or neighbors and dietary intake.

More research should focus on the relationship between friends or neighbors and dietary intake. In this study, many of the significant relationships, albeit negative, involved neighbors or friends rather than family. Mendes de Leon (2005) suggests that the exact mechanisms by which friendship affects health are not clearly defined. Other researchers have found that social networks that include more friends rather than family have a protective effect against mortality (Giles et al., 2005). Additional research should continue to examine the friendship network in older populations, especially women since women represent the largest portion of the older population.

Recommendation 5: Develop more intervention studies.

The designs for subsequent research should include more intervention studies. One of this study's limitations is the inability of the design to establish a cause-and-effect relationship between the variables. This research examined whether a relationship existed between the social network variables and dietary intake; the analysis used statistical models to predict the amount of variance on each dietary outcome measure that was explained by the social network variables. However, from this research it is not possible to conclude that any social network variable, alone or in combination with others, affected the specific dietary intake measure. The exact mechanism by which any social relationship affects health is not known. Researchers

need to identify and measure the biochemical effects of social relationships on health outcomes (Jorm, 2005). Jorm suggests researchers need to identify the biological or chemical effect of social relationships, measure the effects, and determine the degree to which health is affected. For example, one study might analyze the effect of friends, neighbors or family members on health outcomes such as optimum dietary intake or exercise patterns using. Another study might test the effects of different types of relationships among social network members (i.e. supportive or conflictive) and dietary intake. In addition, intervention studies should evaluate specific, objective measures of health outcomes, such as biochemical dietary markers.

Recommendation 6: Use more diverse samples in subsequent research.

Future research should include a larger proportion of older women from minority populations. Although the original NHANES III survey over sampled minority populations and older adults, only one minority group, Blacks, was adequately represented in this sample. As the number of minority elders increases over the next several decades, it is important to improve our understanding of the relationship between the social network and dietary intake in these populations. Because of disparities in education, income or health exist among minority groups, research in samples with more minorities may have different outcomes than were evident in this study.

The current sample excluded women whose physical examination was not completed in the medical examination center (MEC). As suggested earlier, home examined women may have been more frail, less mobile, or have other disabilities

more consistent with under nutrition. Subsequent research should include these women, using appropriate analysis strategies, to determine if outcomes are different.

Recommendation 7: Develop research to identify an appropriate BMI for older adults, including older women.

The classifications for BMI used in this study are considered acceptable for the majority of the adult population. However, there is some controversy, described earlier, about appropriate BMI classifications for older adults (ADA, 2000; DiMaria-Ghalili & Amella, 2005). Additional research concerning BMI classifications for older adults, including women, will provide more accurate guidelines for identification of older adults at risk for negative health outcomes.

In the current study, the majority of older women were overweight/obese rather than underweight as was expected. Using new or revised BMI guidelines, survey research should be developed to identify the number of older women in each BMI classification. This information will be helpful in targeting health education programs that meet the needs of older adult women. More information concerning the long-term health outcomes of overweight/obese BMI levels indicating in older women is needed.

Recommendation 8: Replicate the research questions in this study with original data rather than a secondary analysis.

The research questions from this study should be replicated with original data. Secondary analysis, the design used here, has inherent limitations that were evident in this study. Existing data may not address the research questions or the variables directly. For example, the items used to operationally define the social

network in this study were limited by the items in the original survey. Information about the quality of the interactions or the respondents' reactions to network members was not available at all. These are important considerations for the understanding the information derived from this study.

*Recommendations for Health Care Providers and Health Educators*

As the number of older adults, especially older women, increases over the next several years, health care providers and health educators will have more opportunities to interact with this population. This study has implications for both health care providers and health educators; recommendations for these health professionals are outlined below.

Recommendation 1: Regular, ongoing evaluation of dietary intake in older women by health care providers and health educators.

The descriptive data in this study shows dietary intake was less than optimal for this sample of community dwelling older women, a finding that was consistent with existing research. Health care providers must be aware of the important contribution each nutrient or food component makes in the overall health of older women. Regular and ongoing evaluation of dietary intake, i.e. a dietary history or food diary, is necessary to identify those individuals at risk of under or over nutrition. Nutritionists, dieticians, health educators and nurses should partner and coordinate these evaluations. Nutritionists and dieticians are well versed on nutrients important for optimal health and health educators are well-prepared in dietary risk assessment. The basic educational preparation for nurses includes information about healthy nutrition and dietary intake. In addition, in many health care settings nurses perform

an initial assessment and health history to gather important information to plan the client's care. These health care providers and health educators make natural partners in the ongoing evaluation of dietary intake for older women. The variety of foods consumed by older adults may need to be increased in order to prevent micronutrient deficiencies (ADA, 2005; Marshall, Stumbo, Warren & Xie, 2001). Dietary intake, dietary variety and overall nutritional health should be considered an important treatment modality in the client's care plan.

Recommendation 2: Increase awareness of health care providers and health educators of the potential beneficial and detrimental effects of interactions with social network members

As more research in this area is disseminated, health care providers, such as nurses, social workers, dieticians and health educators must be more aware of the potential beneficial and detrimental effects of social network interactions. Each older woman's health history should include an assessment of the social network completed by the nurse, social worker or health educator. This assessment should identify specific network members by name and relationship (i.e. spouse, family in the home, family outside the home, friend, and neighbor), the frequency of contact with the care recipient and the care recipient's assessment of the quality (i.e. supportive or non-supportive) of these specific relationships. The information will help health care providers and health educators understand the client's social network and the potential role that some members may have.

Recommendation 3: Develop health education programs with detailed information about important nutrients/food components for health in older women.



Health educators must develop programs for practitioners as well as older women, their family and other social network members that include detailed information about important nutrients and food components for older women's health in the older. These programs should identify the amount of each nutrient for a healthy diet and the specific foods where these nutrients can be acquired. Health educators should emphasize the importance of ongoing dietary evaluation and teach various strategies to accomplish this activity, such as using a food diary. This type of assessment is important since health needs and cognitive abilities in older women may change over time.

#### *Policy Implications*

Policy implications are more difficult to identify. In light of this study's limited significant findings and unsupported hypotheses, policy makers must be cautious in making significant policy changes as a result of this study's findings. In addition, several suggestions for subsequent research were generated from this study; making significant policy changes as a result of this study alone would not be prudent. Policy recommendations are described below.

Recommendation 1: Evaluate possible funding increases and/or expansion of existing services for Elderly Nutrition Program and Cooperative Extension Service.

This study indicates dietary intake deficits for all of the dietary measures used; this information may be useful to the US Department of Health and Human Services, Administration on Aging (AoA). The AoA funds the Elderly Nutrition Program (ENP), which supports nutrition programs throughout the country through grants for various services in local communities (AoA, ENP, 2001). Along with support for

meals and other nutrition services in a variety of settings, the ENP fosters opportunities for new friendships and enhanced informal social networks (AoA, ENP). Expansion of nutrition services through ENP may decrease the number of community dwelling older women with dietary deficits. Additional funding would provide more grants for new nutrition centers to provide nutritionally sound meals to greater numbers of older women in the community.

This study's findings may stimulate community agencies such as the Cooperative Extension Service and Family and Consumer Services to develop education materials or programs focused on the potential role of social network members on dietary intake. The Cooperative Extension Service, and its federal partner, the Cooperative States Research Education and Extension Service (CSREES) collaborate with specially selected colleges and universities in each state on outreach activities within the respective state. Family and Consumer Services are involved in teaching nutrition, food preparation skills and strategies for positive overall health (CSREES).

Recommendation 2: Develop education programs for individuals or organizations who lobby or advocate for older adults.

Education programs for lobbyists and advocates should include information about the potential relationship between dietary intake and the social network in older women. For example, American Association of Retired Persons, Policy and Research section features authoritative information on issues related to aging (AARP, 2005). Experts in aging communicate with a variety of individuals at the federal, state and local level concerned with legislation, program and policy development and

education in aging. These experts from AARP represent and advocate on behalf of older adults, including women, in public forums such as conferences, congressional hearings or policy development meetings. Information about the potential impact of social network members on dietary intake and other health behaviors may serve as the foundation for program development for the older women.

### Summary and Conclusions

Although the hypotheses in this study were not supported, several significant relationships between specific social network elements and selected dietary intake measures were revealed. In most cases, the results indicated negative or inverse relationships between the various social network variables and dietary outcome measures rather than the positive associations that were hypothesized. Older women in this sample were deficient in TFEI and each of the mineral/vitamins or food components analyzed (i.e. calcium, folate, vitamin B12, vitamin D and fiber); these dietary deficits have health implications on their own or in combination with other nutrients. For example, the dietary deficits in this study may increase women's risk for heart disease, type II diabetes, osteoporosis and several types of cancer.

Much attention has been given in the literature to under nutrition in this population but the findings related to BMI in this sample suggest that being overweight or obese is more prevalent. Research with specific age groups to determine rates of under nutrition, malnutrition or frailty are recommended in the future.

This study validates the need for a consistent definition of 'social network' and other terminology related to social relationships as well as clear differentiation of

network members such as family, friend, spouse or neighbor in the literature. The current study's results have been challenging to compare to other studies because of these inconsistencies. This study also emphasizes the need to evaluate social network structure as well as the quality of social network interactions. For example, in this study visits from neighbors were significantly associated with some dietary intake measures. However, the findings indicated that less frequent visits produce a more beneficial outcome. Understanding the quality of the interactions between members of the social network might reveal the reason for a negative relationship between so many associations in this study.

This study has a wide range of implications which were described in detail earlier. Future research should include investigations of social network structure along with the quality of network interactions; intervention studies to more fully understand the cause-and-effect relationship between the social network and health outcomes would also be useful. Health education programs for older women and their family or friends should emphasize the impact of the social network on health outcomes. Health care providers such as nurses, social workers or dieticians should identify the social network members and the client's assessment of their interactions with these network members to understand sources of supportive and conflictive relationships. Finally, the current study suggests the need for funding for more nutrition and education services for older women and their family or friends.

No research study is perfect. Despite the limitations associated with this design, this study contributes to the body of knowledge concerning the relationship

between the social network and dietary intake as well as stimulates ideas for research in the future.

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