AN ABSTRACT OF THE THESIS

Kathleen A. Bell for the degree of Master of Science in Nutrition and Food Management presented on March 15, 1993.

Title: Dietary Behavior and Body Composition Parameters among Self-Reported Exercising and Non-Exercising Elderly Women

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The percentage of the American population who are 65 years old or older is rapidly increasing, especially the proportion of women. It is becoming crucial to encourage lifestyle behaviors that will enable senior women to remain in optimal health. Following the 1990 Dietary Guidelines' recommendations to limit fat intake and consume adequate amounts of dietary fiber has been shown to positively impact longevity and health status in the elderly by decreasing risk factors for chronic diseases. An expected outcome of engaging in regular exercise is a reduction in body fat, which is also associated with a lowered incidence of several chronic illnesses. However, the literature clearly indicates that nutritional quality of the diet and involvement in regular exercise decrease with increasing age. There is evidence

that, with the adoption of one health enhancing behavior, there is a greater tendency to engage in other health promoting behaviors, but little data exist on the health-seeking behaviors of older adults.

The purpose of this study was to ascertain if there were identifiable differences between self-defined exercising and self-defined non-exercising elderly women with respect to their nutrient intake, food sources of dietary fat and fiber, dietary change behavior, and body composition parameters, considering their age and education and income levels. The objective was to determine whether those women who had consciously undertaken a regular exercise program would also have higher micronutrient intakes, make lower fat and higher fiber food choices, report having made more dietary changes in the direction of the 1990 Dietary Guidelines, and have leaner body compositions than those who had not undertaken such a program.

Thirty-three elderly women self-reported exercisers (mean age 74.1 years) and 30 self-reported non-exercisers (mean age 71.3 years) were enrolled in a 14 week study. Exercisers were defined as those who reported having engaged in a regular program of planned exercise a minimum of 15 minutes per session, 2 times per week, for at least the last year, and non-exercisers were those who had not. They kept three, 7-day food records at 5 week intervals. Nutrient intake was estimated from 9 days of food records, 3 predetermined days from each recording period, using the Food Processor II software. Dietary intakes were analyzed for energy, macronutrients, dietary fiber, and selected micronutrients. Food sources of

dietary fat and fiber were determined using a food categorization adapted from Popkin and coworkers (1989). Information concerning dietary change behavior, obtained from questionnaire responses, was compared between groups using chi-square tests. Body composition, assessed through repeat measurements during each dietary recording period, included determination of percent body fat through skinfolds, waist-to-hip-ratio and body mass index. Average 9-day nutrient intakes and anthropometric measures were compared between groups using t-tests or Mann-Whitney U tests.

Both elderly women exercisers and non-exercisers had similar energy, macronutrient, and dietary fiber intakes based on 9-day means. Their total fat intakes, expressed in grams and as percentages of energy, were not significantly different. Both groups consumed a lower percentage of their daily kcalories as total fat (32%) compared with national surveys of women over 65 (36%). Exercisers consumed more total vitamin A ($p=.03$) and carotene ($p=.00$) than the non-exercising women. A great proportion of both groups did not meet 75% of the Recommended Dietary Allowances for calcium and zinc. A larger proportion of the exercisers than the non-exercisers reported using lower fat cheese ($p=.02$) and green and yellow vegetables ($p=.03$), which partially explained their higher total vitamin A and carotene intakes. Exercisers obtained less of their total fat intake from lower fat milk ($p=.02$) and more of their fat intake from lower fat lunch meats ($p=.04$) than the non-exercisers. The categories of legumes ($p=.02$) and lower fiber vegetables ($p=.05$) supplied greater amounts of dietary fiber for the exercisers

compared with the non-exercisers. When asked about dietary changes made over the past decade, a greater percentage of the exercisers than non-exercisers reported having decreased red meat intake ($p=.05$) and increased consumption of cereals ($p=.05$) and legumes ($p=.00$). Actual intake data showed that the legume food category contributed more dietary fiber to the diets of the exercisers than the non-exercisers ($p=.02$).

No differences were found in body fat measures between the exercisers and non-exercisers. The lack of observed differences between the two groups reinforces what other researchers have found, that a large number of factors influence body composition, of which exercise is only one. More research is needed to distinguish the interactions of age, energy intake, and physical activity on the body fatness of elderly women, as well as the most accurate instruments for assessing body composition for this age group.

Exercise participation among elderly women in this study appeared to be associated with several positive dietary behaviors. Elderly women exercisers compared to non-exercisers made food choices leading to higher total vitamin A and carotene intakes, and also reported making more changes in food consumption behaviors in the direction of current dietary recommendations. These observed outcomes provide support for designing health-promotion programs for elderly women which include both nutrition education and exercise components.

DIETARY BEHAVIOR AND BODY COMPOSITION PARAMETERS AMONG SELF-REPORTED EXERCISING AND NON-EXERCISING ELDERLY WOMEN

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INTRODUCTION

The proportion of Americans who are 65 years old or older is projected to increase from approximately 13% in 1990, to almost 20% by the year 2025 (Kannel, 1988; Munro, 1989; Smiciklas-Wright, 1990). In view of this forecast, issues pertaining to the maintenance of health and prevention of disease, especially among elderly women, who currently outnumber men 2.3 to 1 by age 85, are of growing concern (O'Brien and Vertinsky, 1991). Seniors at present use about one-third of all medical care provided (Kerstetter et al., 1992). Because of these extensive and disproportionate costs of health care for the elderly, it has become crucial to encourage lifestyle behaviors that will enable seniors to retain their health and functional capacity as late into the life span as possible (Burdman, 1986; Fischer et al., 1991; Munro, 1981; Sutter and Russell, 1989).

Both daily dietary and physical activity patterns have been shown to be directly related to the health of Americans. Following the Dietary Guidelines' (USDA/DHHS, 1990) recommendations to choose a diet lower in fat, especially saturated fat, and higher in dietary fiber has been shown to positively impact longevity and health status by decreasing risk factors for chronic diseases, such as cardiovascular disease, cancer, hypertension, and non-insulin dependent diabetes

mellitus (DHHS, 1988; Duda and Tappe, 1988; Paffenbarger et al., 1986; Teague and Hunnicutt, 1989). In addition to proper nutrition, adequate physical activity is an essential lifestyle component to improve chances of maintaining health and functional independence in the later years of life (Elward and Larson, 1992; Kubena et al., 1991). Expected outcomes of engaging in regular exercise for older adults, in addition to enhancement of strength, flexibility, and endurance, include favorable changes in body composition parameters which are associated with a lowered incidence of several chronic illnesses (DHHS, 1988; Jensen, 1992; Thompson et al., 1982). These changes include a reduction in body fat and lower body mass index and waist-to-hip ratio values (Elward and Larson, 1992). However, the literature clearly indicates that diet adequacy and involvement in regular exercise decreases with increasing age (Burdman, 1986; Duda and Tappe, 1988).

In general, there is an observed decrease in energy requirements with age due to both a change in body composition and a reduction in physical activity (Vellas et al., 1992; Voorrips et al., 1991). It is assumed, however, that the apparently healthy elderly's requirements for nutrients do not diminish (Hegsted, 1989). Since the total caloric requirements decrease with age, choosing nutrient-dense foods is of greater importance for the elderly. Selecting foods low in fat and high in dietary fiber, which are generally high in nutrients relative to energy, can help contribute to overall nutritional adequacy while avoiding excess body fat from unnecessary caloric intake (Rudman, 1989; Voorrips et al., 1991). It has been

hypothesized by other researchers (Mensink and Arab, 1989; Vellas et al., 1992; Voorrips et al., 1991) that by being physically active and increasing their energy needs, older people can obtain recommended nutrient intakes without becoming overweight.

There is evidence that with the adoption of one health-enhancing behavior, there is a greater tendency to engage in other health-seeking behaviors (Armstrong et al., 1990; Bausell, 1986; Teague and Hunnicutt, 1989). Research shows that older people, especially women, are more likely to make changes in behaviors related to health than their younger counterparts, perhaps due to heightened awareness of disease risk (Bausell, 1986; Contento and Murphy, 1990). If this is true for health-conscious elderly women, the health behavior of consciously choosing to participate in regular exercise may be associated with eating a diet which is lower in fat and higher in dietary fiber. The combination of exercise and a diet which follows the Dietary Guidelines (USDA/DHHS, 1990) also may contribute significantly to leanness.

Not much is known about the health-seeking lifestyle differences between older women who exercise and those who do not, or the effects of these behaviors on body composition. Gathering information about nutrient and food intake patterns and body composition characteristics of elderly women with different activity patterns, can contribute to our knowledge concerning the health-promoting and chronic disease-preventing behaviors of this rapidly growing proportion of the

population (Armstrong et al., 1990; Miller et al., 1990). Several studies have reported relationships between exercise participation and positive dietary habits (Armstrong et al., 1990; Bausell, 1986; Contento and Murphy, 1990; Munro, 1981), as well as exercise and a leaner body composition (Bergman and Boyungs, 1990; Miller et al., 1990; Thompson et al., 1982; Tremblay et al., 1990). Since aging is associated with an increased heterogeneity in many health-related variables, further research is needed to better understand their complex interactions (Burdman, 1986). Little data exist on the health-seeking behaviors of older adults (Bausell, 1986).

The purpose of this study was to examine the differences between 33 self-defined exercising and 30 self-defined non-exercising elderly women with respect to their nutrient intake, food sources of dietary fat and fiber, dietary behavior change, and body composition parameters, considering their age and education and income levels. Data were collected to determine whether those women who had consciously undertaken a regular exercise program would also have more adequate micronutrient intakes, make lower fat and higher fiber food choices, report having made more recommended dietary changes, and have leaner body compositions than those who had not undertaken such a program.

REVIEW OF THE LITERATURE

The Aging of America

The fastest growing segment of the US population is the proportion of Americans who are 65 years and older, especially those over 85 years of age (Cresenta et al., 1990; Fischer et al., 1991; Kannel, 1988). This age bulge affects our society as the demands for health care and social services steadily increase (Evans and Meredith, 1989; Fischer et al., 1991). Therefore, it is crucial to encourage behaviors that have the potential for helping seniors remain in optimal health (Fischer et al., 1991).

At age 65, women now have an average life expectancy of 18.7 years, compared to 14.8 years for men (DHHS, 1990). Thus by the age of 85, there are twice as many women as men (O'Brien and Vertinsky, 1991). The overall increase in life expectancy since the early part of the century has been attributed, in part, to more favorable environmental conditions, including improvements in the food supply and dietary intake, as well as advanced medical technology and more widespread public health education (Ahmed, 1992; James et al., 1988; Patrick et al., 1982). The explanations for gender differences in longevity are still unclear, but both biological and lifestyle factors have been suggested (O'Brien and Vertinsky, 1991).

Although many women outlive their male counterparts, their extra years of life often mean extra years of chronic illness (O'Brien and Vertinsky, 1991). The major causes of death among women aged 65 and older include cardiovascular disease, cerebrovascular disease, cancer, chronic obstructive pulmonary disease, pneumonia, and influenza (Collins, 1988; DHHS, 1990; Smiciklas-Wright, 1990). Important sources of morbidity and disability for older women include arthritis, hypertension, diabetes and its complications, osteoporosis, obesity, and general functional decline (Collins, 1988; Munro, 1981; Smiciklas-Wright, 1990). Cardiovascular disease is the main cause of mortality and reduced quality of life in both men and women over 50 years (DHHS, 1988; James et al., 1988; Patrick et al., 1982). It is estimated that 80% of those 65 and older have one or more chronic conditions (Hegsted, 1989; Kerstetter et al., 1992). Comorbidity, or the coexistence of chronic diseases, increases with age and is higher for women than men (Ahmed, 1992; Smiciklas-Wright, 1990).

The relatively long period of life remaining after age 65 offers time for risk reduction and health promotion efforts to produce meaningful benefits for elderly women (Elward and Larson, 1992). Increasing the span of healthy life, not just the length of life, is an important goal of the US Public Health Service for this group (DHHS, 1990; Kaplan, 1988; Rowe and Kahn, 1990). The quality of life of an aging individual is dependent on the complex interactions between both intrinsic factors, which are uncontrollable elements directly related to aging alone, and

extrinsic factors, which are controllable lifestyle components (Goodwin, 1989; James et al., 1988; Kannel, 1988; Kaplan, 1988; Rowe and Kahn, 1990). Rowe and Kahn (1990) intimate that past research has overemphasized the effects of aging itself and has underestimated the modifying effects of diet and exercise habits and other psychosocial dimensions, when examining the determinants of what they term successful aging. A growing body of evidence suggests that changing certain health behaviors, even in old age, can benefit health and quality of life (DHHS, 1990; Smith et al., 1988).

Research on the elderly has often failed to recognize the heterogeneity among older adults (Kohrs et al., 1989; Rowe and Kahn, 1990; Schneider et al., 1986). This diversity results from exposure to a greater variety of environmental factors as well as physiologic and anatomic changes (Rowe and Kahn, 1990; Taren and Schler, 1990). These numerous and potentially confounding variables collectively make older adults a difficult population to study for nutritional research (Taren and Schler, 1990). Due to the complexity of the aging process, gaining a greater knowledge-base concerning the factors which are associated with the health of the aged is critical if cost-effective health promotion strategies for intervention and education are to be developed (Goodwin, 1989; Rowe and Kahn, 1990; Shepherd, 1989).

Both exercise and dietary patterns have been shown to have a substantial impact upon the health of older Americans (DHHS, 1988; Elward and Larson, 1992). Because the development and progression of many chronic conditions may

be modified by altering lifestyle habits, such as maintaining a healthy body weight, limiting dietary fat intake, and remaining physically active, health promotion for seniors needs to focus on these elements (Elward, 1992; NRC, 1989a; Rudman, 1989; Slattery and Randall, 1988; Smith et al., 1988; US Public Health Service, 1992). Little is known about the influences and interrelationships of the current health-seeking behaviors of the elderly, particularly among women (Bausell, 1986).

Theories of Health-Related Behaviors among the Elderly

Several studies have indicated that older people, more than any other age group, are concerned about their health and are willing to change their behaviors to improve their well-being (Blair et al., 1980; Contento and Murphy, 1990; McIntosh et al., 1990; Popkin et al., 1992). The concept of improving the health of older adults by practicing better preventive medicine is appealing (Blair et al., 1980). However, not much research has examined the factors associated with health-related behaviors of the elderly (Bausell, 1986).

Since food patterns and exercise habits are significant aspects of an older person's lifestyle and collectively have a major impact on an individual's health, some insight into what psychological factors may influence these behaviors is warranted, although these psychological variables were not examined in this study. There are several behavioral theories which may help explain why seniors may be

willing to adopt or change their lifestyle habits to improve their health, and due to the complexity of behaviors related to health, more than one model is probably required to describe and explain these associations (Contento and Murphy, 1990). The main models mentioned in the literature concerning the elderly are the Health Locus of Control, Fishbein-Ajzen theory of reasoned action, and the Health Belief Model.

Health Locus of Control

Health locus of control (HLC) has been one concept to help clarify and predict the potential for adopting healthy habits (Kist-Kline and Lipnickey, 1989; Blair et al., 1980; Contento and Murphy, 1990). A construct based on Rotter's social learning theory, the HLC theory contends that beliefs influence personal decisions to change lifestyles, based on the extent to which individuals perceive themselves to be in control of circumstances and/or environments which affect their own personal health (Blair et al., 1980; Kist-Kline and Lipnickey, 1989). Internally controlled individuals are more likely to take steps to better themselves and engage in healthier lifestyles such as weight loss, smoking cessation and the adoption of other preventive behavior since they feel responsible for what happens to themselves (Kist-Kline and Lipnickey, 1989; Kivett et al., 1977). Externally controlled individuals, on the other hand, believe that they have little or no control over their

health and attribute their status to powerful others or chance (Blair et al., 1980; Kist-Kline and Lipnickey, 1989).

In older individuals this relationship between health and a sense of control may grow stronger (Kist-Kline and Lipnickey, 1989; Rodin, 1986). Rodin (1986) suggested that elderly people who rate high in perceived control may be healthier because they are more likely to take actions that enhance health, such as obtaining health information from various sources, interacting actively with health care providers, and adhering better to health regimens involving lifestyle changes (eg, exercise and weight loss). The HLC theory has been shown to be useful in predicting and understanding nutrition as well as exercise behavior in older adults (Eden et al., 1984; Kist-Kline and Lipnickey, 1989; Lumpkin, 1985).

Houts and Warland (1989), in a study examining locus of control and food behavior of participants in a telephone survey, found that those who are internally controlled scored higher on reported nutritious food behavior than those who had a more external locus of control. Lumpkin (1985), in a study focusing on health and activity of the elderly, reported that increased physical activity was associated with an internal locus of control among his 600 subjects. Duda and Tappe (1988), in researching predictors for exercising among older adults, noted that program participants who were high in internal control reported exercising for physical fitness and stress reduction and also reported the greatest amount of physical activity. Other researchers have found that leisure time physical activity may have a

synergistic effect leading to improved health and a more internal locus of control among the elderly (Blair et al., 1980; Kist-Kline and Lipnickey, 1989).

The Fishbein-Ajzen Theory of Reasoned Action

The Fishbein-Ajzen theory of reasoned action proposes that behavior intention (decision to behave in a particular way) can be predicted from a person's attitude towards the behavior (whether the person sees the behavior as good or bad) and the person's perception of significant others' expectations or the subjective norm (Glanz et al., 1990; Saunders and Rahilly, 1990; Shepherd and Stockley, 1987; Tuorila and Pangborn, 1988).

The theory of reasoned action has been used successfully to predict intention to perform several health behaviors, including intentions to exercise, to eat at fast food restaurants, and to drink alcohol (Saunders and Rahilly, 1990; Shepherd, 1989). Several studies have used the Fishbein-Ajzen theory to examine behavior changes in older adults (Saunders and Rahilly, 1990; Shepherd and Stockely, 1987). Grotkowski and Sims (1978), examining the relationships between nutrition knowledge, attitudes and dietary practices of 64 elderly participants in Pennsylvania, found support for the paradigm that attitudes about health and diet were important determinants of whether nutrition knowledge was translated into food-related behavior concerning reducing fat and sodium. Likewise, other researchers (Saunders and Rahilly, 1990; Shepherd and Stockley, 1985; Tuorila and Pangborn,

1988) have found that personal attitudes, such as their food preferences or concern about weight, were better predictors of consumption of high-fat foods and restriction of sugar intake than was knowledge about nutrition alone.

Shepherd (1989), using both the HLC and the reasoned action theory to examine exercise behavior, found that the intention to exercise among older adults is shaped by attitudes, social norms and habits, but that the intent is most frequently expressed as actual behavior in individuals who are more internally controlled.

The Health Belief Model

The Health Belief Model posits that individuals perceiving a threat to health will be more inclined to exhibit behavior towards that probability than those who do not perceive this threat (Bausell, 1986). Compliance with health-seeking behaviors is considered to be a function of perceived susceptibility to illness (Bausell, 1986). The literature shows that those persons holding health beliefs associated with knowledge of disease and trust in the medical profession, practice more preventive health measures and have better health than those who have health beliefs associated with folk or popular views of illness and distrust of medical authorities (McIntosh et al., 1990).

Past research has generally been supportive of the health belief model, but most of the studies have focused on preventive health behaviors such as inoculations or compliance with medication regimens. Little of this work has been directed at

dietary behavior or exercise among the elderly (McIntosh et al., 1990). Bausell (1986) proposed that the Health Belief Model's message that elderly persons view themselves as more susceptible to illness as a function of their age may represent a partial explanation of why those 65 and older were more likely to avoid salt, fat and sugar and to consume foods rich in fiber and calcium than a younger population 18-64 years of age.

It is apparent from these three different theoretical approaches that many factors may influence and direct health-related behavior in seniors, including their perceived control of their own health, their attitudes towards the behavior, and their perceived susceptibility to illness. Additional research is needed to delineate more clearly the predictors of health-seeking behaviors among elderly women to better devise strategies for designing nutrition education and counseling programs.

Exercise Behavior among the Elderly

Physical activity is consistently identified as one of the most significant interventions towards promoting health of the elderly, although the literature clearly indicates that involvement in regular exercise decreases with advancing age (DHHS, 1990; Duda and Tappe, 1988; O'Brien and Vertinsky, 1991). How active a person remains throughout their life span can become a critical factor in the prevention or postponement of disease and disability (Rowe and Kahn, 1990).

Data from the 1985 National Health Interview Survey Health Promotion Disease Prevention Supplement (US Public Health Service, 1992) show that about 70% of older adults, especially those over 75, reported either an inactive or an irregular pattern of leisure-time physical activity; less than one-third participated in regular moderate physical activity such as walking, gardening or conditioning activities on a regular basis; and less than 10% routinely engaged in vigorous physical activity (Collins, 1986; DHHS, 1990; O'Brien and Vertinsky, 1991; US Public Health Service, 1992). The current estimate is that the 1990 objective of 50% participation by individuals 65 years old and older in appropriate physical activity has not been met (O'Brien and Vertinsky, 1991). The health objectives for the year 2000 concerning activity patterns among Americans aged 65 years of age or older include the following (DHHS, 1986):

* 30% participating in physical activity, 3 or more days per week, 30 min or more per session at least 50% of maximal oxygen capacity.

* 50% participating in physical activity at least as vigorous as a sustained slow walk 3 or more days per week, 30 or more minutes per session.

* 50% participating in physical activity 3 or more times per week for at least 30 min per session in activities designed to promote or maintain flexibility, ambulatory skills, arm and hand strength, or other skills of daily living.

Inability to perform day-to-day activities is a major problem for many elderly (DHHS, 1990; Elward and Larson, 1992). Elward and Larson (1992)

reported that 21% of US females and 16% of males over age 65 experience limitations in activities of daily living. After the age of 35, functional capacity declines in almost every organ system (Kris-Etherton, 1986). Both genetic and environmental factors contribute to this deterioration (Evans and Meredith, 1989; Haskell et al., 1985; Teague and Hunnicutt, 1989). There is increasing evidence that as much as 50% of the physiological changes which occur later in life are a result of hypokinesia, or lack of use, rather than simply aging alone. Thus, much of this debilitating change could be prevented or delayed (Haskell et al., 1985; Kubena et al., 1991; O'Brien and Vertinsky, 1991; Rudman, 1989).

Inactivity itself has been linked to increased morbidity and mortality from cardiovascular disease, hypertension, diabetes, obesity, and osteoporosis (DHHS, 1988; Kannel, 1988; Schectman et al., 1991; Sicscovik et al., 1985). It is well-established that physically active older people exhibit fewer health problems than the very sedentary (Elward and Larson, 1992; Haskell et al., 1985; Paffenbarger et al., 1984). Remaining active throughout the life span and into old age has been shown to be directly related to longevity (Paffenbarger et al., 1986).

Studies have demonstrated that improvements in health for seniors can be achieved through regular participation, even in low to moderate intensity exercise programs (Blumenthal et al., 1989; DHHS, 1990; Haskell et al., 1985; Paffenbarger et al., 1986; Teague and Hunnicutt, 1989). Some of these benefits of habitual exercise include: 1) improved strength and flexibility, which help to maintain

functional independence and may reduce the likelihood of falls (Buchner and Wagner, 1992); 2) more favorable body composition due to the decreased rate of lean body and bone mass loss (Buchner and Wagner, 1992; Smith and Gilligan, 1990) and the potential decrease in excess fat depots with greater energy expenditure (Blumenthal et al., 1989; Kris-Etherton, 1986; Paffenbarger et al., 1986; Sicscovik et al., 1985); 3) increased energy requirements and which may allow for a more adequate intake of nutrients (Astrand, 1992); 4) improved cardiovascular function (eg, slower heart rate, lower blood pressure, increased stroke volume) (Teague and Hunnicutt, 1989); 5) enhanced metabolic function (eg, improved lipid profile and glucose tolerance) (Sicscovik et al., 1985); 6) augmentation of emotional well-being and morale (Astrand, 1992; US Public Health Service, 1992), and 7) the adoption or triggering of other healthy behaviors, such as nutritious eating practices (Blumenthal et al., 1989; Haskell et al., 1985; Paffenbarger et al., 1986; Sicscovik et al., 1985; Teague and Hunnicutt, 1989).

Four recent research projects on the elderly have also delineated many health benefits of exercise for sedentary elderly persons or those already experiencing morbidity, who initiate exercise at an advanced age (Blumenthal et al., 1989; Elward and Larson, 1992; Teague and Hunnicutt, 1989; US Public Health Service, 1992). Two of these were intervention studies. Blumenthal et al. (1989) randomly assigned 101 elderly men and women subjects aged 60 to 83 to one of three groups: aerobic exercise group, yoga and flexibility group, and a waiting list control group. After

four months, they found that those in the aerobic exercise group greatly improved their cardiorespiratory fitness, had lower serum cholesterol levels and lower diastolic blood pressures, showed a trend toward an increase in bone mineral content, and perceived improving on a number of psychological and behavioral dimensions of quality of life as compared to the other two groups. In another study, Hopkins and colleagues (1990) examined 53 sedentary elderly women (mean age 65 $\pm$ 3.7) participating in a dance-oriented fitness program. After 12 weeks of low-impact aerobic dance, the intervention group improved in cardiovascular endurance, strength, body agility, flexibility, and balance as compared with the control group. By contrast, the control group deteriorated in these same functional parameters over the same period of time.

The other two studies were population-based. Elward and Larson (1992) compared 561 randomly selected elderly men and women, both non-exercisers and exercisers (defined as persons exercising vigorously at least three times a week for at least 15 minutes per session). They found that exercisers were: 1) half as likely to report high blood pressure and arthritis, 2) 50% less likely to report 2 or more of the following: heart disease, high blood pressure, arthritis, emphysema; and 3) more positive about their outlook regarding health. In a study by Posner et al. (cited in Elward and Larson, 1992), 184 subjects aged 60 to 86 were divided into three groups: those who had exercised for the past 2 years, those who had exercised for the past 4 months, and a control group. They found that those men and women who

had been exercising for the past two years had significantly longer mean times to the onset of cardiac diagnosis, which the researchers suggested indicated that regular exercise, even when started late in life, can delay the onset of symptomatic cardiovascular disease.

There is still controversy regarding the appropriate intensity level of participation and modes of physical activities necessary for health benefits in older adults, as well as whether the goal of exercise participation should focus on improvement in cardiovascular fitness or general increase and maintenance of mobility (Teague and Hunnicutt, 1991). Current data support the promotion of an exercise program for older adults of at least 3 times per week for 15-30 minutes per session at an intensity of between 50-65% of maximal oxygen capacity, although benefits can be obtained at lower levels of intensity (Astrand, 1992; Blair et al., 1988; Elward and Larson, 1992; O'Brien and Vertinsky, 1991).

Both endurance and strength were found to be substantially impaired in the majority of women over 65 (Evans and Meredith, 1989). Most experts agree that the key components to include in a planned exercise regimen for older women are low-intensity endurance exercise (defined as any activity that uses large muscle groups, is rhythmical in nature and can be sustained for a long time such as walking, cycling, rowing, or swimming), supplemented with strength training and activities aimed at maintaining flexibility of the joints (Haskell et al., 1985; Smith, 1982). Evans and Meredith (1989) suggested that an increase in energy expenditure

for the elderly with the purpose of improving appetite and nutrient intake can best be achieved by prolonging the time spent in light to moderate activities, such as walking, cycling, playing golf, doing calisthenics or dancing, which allow increased caloric expenditure with the least risk of injury.

The most frequently reported reasons for exercising among older adults include responses which focus on the health benefits (Armstrong et al., 1990; Voorrips et al., 1991). Unfortunately, among the elderly an adequate exercise program is difficult to sustain. Buchner and Wagner (1992) suggested that many factors can contribute to the lack of exercise in this age group. Healthy older adults now generally acknowledge the importance of staying active to preserve good health, but may not understand how best to do this and may exercise too much, too little, or inappropriately. Other common inhibitors of activity in older adults include lack of motivation, disability, potential for injury, side effects of medication use, stressful life events, and depressive illness (Buchner and Wagner, 1992; O'Brien and Vertinsky, 1991). In order for the activity objectives for the year 2000 (DHHS, 1990) concerning older adults to be attained, exercise program development must address these issues.

Obtaining an accurate assessment of exercise behavior in elderly women for research purposes is problematic and most methods available, such as multi-day records, are costly and difficult to acquire (Godin et al., 1986). Other researchers have experimented with one or two self-administered questions to determine who is

and is not engaging in regular exercise. Schectman et al. (1991) validated a single question method for the determination of regular exercise participation in men and women, which corresponded to significant age-adjusted associations with several fitness parameters, including body mass index, HDL-cholesterol levels and oxygen capacity. These simplistic techniques do have limitations, but they have been proven to be cost-effective and accurate for basic categorization of the active and the sedentary (Godin et al., 1986; Schectman et al., 1991).

Exercise appears to be an essential ingredient for promoting and maintaining health, and in turn improving the quality of life of seniors (Kris-Etherton, 1986). However, it is hard to determine whether intervention with exercise alone is the most important health benefit for seniors, since exercise may also influence other influential behaviors such as diet selection (Elward and Larson, 1992; Haskell et al., 1985). Therefore, the impact that engaging in exercise may have on the adoption of other health-seeking behaviors is an important concept variable to examine among the elderly.

Nutrient Intakes of Elderly Women

The well known relationship between diet and the development and progression of chronic, degenerative diseases has resulted in a growing concern about the diets of older adults (DHHS, 1988; NRC, 1989a). Among this population

nutritional concerns vary greatly with problems of both undernutrition, such as underconsumption of micronutrients and dietary fiber, and overnutrition, such as overconsumption of total and saturated fat (DHHS, 1988; Grotkowski and Sims, 1978; Haines et al., 1990; Murphy et al., 1992).

Dietary Fat and Fiber Consumption

When considering the energy need of older adults, it is important to assess the macronutrient composition of the diet, specifically dietary fat and carbohydrate (Young, 1992). High intakes of fat, especially saturated fat, have been implicated in the etiology of cardiovascular disease, some cancers, non-insulin dependent diabetes mellitus, and obesity (DHHS, 1988). Conversely, there is evidence for a protective role of dietary fiber against the development of coronary heart disease, non-insulin dependent diabetes mellitus, colon and rectal cancers, diverticulitis, and constipation (DHHS, 1988; NRC, 1989a). In response, nutrition priorities include limiting total fat intake to 30%, saturated fat to 10% of energy intake, and increasing consumption of foods high in complex carbohydrates and dietary fiber (Block et al., 1988; DHHS, 1988; Krebs-Smith et al., 1992; Popkin et al., 1992; USDA/DHHS, 1990).

Surveys show that elderly women in the US consume more of their energy from total fat and saturated fat than is advised for optimal health (Block et al., 1988; Morley, 1986; Popkin et al., 1992). Data from the Second National Health and

Nutrition Examination Survey (NHANES II) of 1977-1980 showed that women aged 65 to 74 consumed an estimated 35% of kcalories as total fat (51 g), with 12% coming from saturated fat (17 g) (Abraham and Carrol, 1981; Block et al., 1988). Mean intakes of women participating in the 1977-1978 Nationwide Food Consumption Survey (NFCS) showed slight differences in two age groups of elderly women; those 65-74 years reportedly consumed 39.8% (63.2 g/day) of their total energy as fat, while those aged 75+ consumed approximately 38.8% (59.5 g/day) (Fanelli and Stevenhagen, 1986). Read et al. (1989), in the Western Regional Project 153 of the US Department of Agriculture, found that women aged 60-69 consumed, on the average, 39.7% of total kcalories as fat, whereas those aged $\geq$ 70 consumed 35.2%.

Although values for fat consumption among elderly women are higher than those recommended (DHHS, 1988; USDA/DHHS, 1990), dietary fat intake patterns for older Americans have shown consistent reduction trends. Popkin et al. (1992), studied the dietary practices of older adults aged $\geq$ 65 years surveyed in the 1977-78 and 1987-88 NFCS and found that mean total fat intakes for women expressed as a percentage of daily energy have fallen from 37.1% (58.3 g/day) in 1977 to 35.8% (55.5 g/day) in 1987, with saturated fat showing reductions from 13.5% of kcalories to 12.6%, respectively. Similar trends have been found by Stephen and Wald (1990), who examined a comprehensive compilation of dietary fat consumption studies of elderly subjects from the 1940's through 1985. They found that the

average total fat and saturated fat intake for older adults has steadily decreased since the 1970's from about 39% of kcalories coming from total fat and 15% from saturated fat to approximately 37% of kcalories from total fat with about 14% coming from saturated fat in the 1980's.

Elevated serum cholesterol has been accepted as one measure of risk for development of cardiovascular disease (Collins, 1988). Serum cholesterol levels of those over age 60 tend to be higher in females than males (Morley, 1986). Reductions in serum cholesterol concentrations and heart disease rates have paralleled decreases in fat intake among US adults (Patrick and Erickson, 1988; Stephen and Wald, 1990). The greatest declines were observed among older women aged 65-74 years, whose mean serum cholesterol levels dropped significantly from 266 to 246 mg/dL in the period from 1960 to 1980 (Collins, 1988; Popkin et al., 1992; Stephen and Wald, 1990). Although direct evidence for diet and heart disease associations is lacking due to inadequate information about food consumption patterns, the changes reported in fat intake, including the amount and the type, among older Americans have been implicated as significant contributors (Stephens and Wald, 1990).

Mean intakes among elderly women for carbohydrate consumption as a percentage of energy have shown increases from 46% as reported in the 1977-78 NFCS to 48% in the 1987-88 NFCS (Popkin et al., 1992). Documentation of dietary fiber intakes for the US population is limited (NRC, 1989a). Databases for

dietary fiber content in foods until recently have been very incomplete, so comparisons for trend analysis should be made with caution (NRC, 1989a). Results from national surveys show that dietary fiber intake for elderly women has increased from the 1977-78 NFCS reported intake of 11.6 g/day to 12.2 g/day as reported in the 1987-88 NFCS, but this is still considerably lower than the 20-30 g/day advocated by many nutritionists (Popkin et al., 1992).

Speculations as to the reasons for these positive shifts in dietary fat and fiber consumption in the diets of older women include greater health-consciousness due to increased publicity on the association of these dietary components with disease or their importance in controlling body weight (Garcia et al., 1975; Popkin et al., 1992). However, improved interviewing techniques and food composition data used in the latest surveys may be responsible for some of the differences in observed food consumption shifts since the 1970's (Peterkin, 1986).

The optimum time to implement dietary modifications for controlling the nutrition-sensitive risk factors for the major chronic diseases is said to be prior to age 65. However, research has shown that for those at risk and to prevent further progression, the potential health benefits from promoting and adopting food-related behavior aimed at reducing dietary fat, particularly saturated fat, and increasing dietary fiber while maintaining an appropriate body weight can be substantial even in old age (DHHS, 1988; James et al., 1988; Kristal et al., 1990; Miller et al., 1990; Munro, 1981; Young, 1992).

Micronutrient Intake

Studies of younger women suggest that when fat is reduced, carbohydrate in the form of grains, fruits and vegetables is increased, providing an improvement in the vitamin and mineral content of the diet (Dougherty et al., 1988). Research among elderly women, however, shows that their diets are seldom both low in fat and high in nutrients due to low food intake and inappropriate food selection, specifically the exclusion of food groups they may perceive as fattening (Betts and Vivian, 1984; Murphy et al., 1992; Sobal and Cassidy, 1990). Thus, nutrition guidance efforts must focus on ways to educate seniors to accomplish both of these goals (Murphy et al., 1992).

The 1989 RDA represent the nutrient needs for most healthy people, and address nutrient recommendations for older women as one group, 51 years old and over (NRC, 1989b). Controversy still exists on what the nutrient needs are of those well beyond 50 years since many age-related metabolic changes occur (Gupta et al., 1988; Munro, 1981; Schneider et al., 1986; Smiciklas-Wright, 1990). In addition, a large number of the elderly population have chronic disease conditions and are taking medications which may interact with the absorption and metabolism of some nutrients and further compromise nutritional status by influencing appetite (Krondl et al., 1982; Schneider et al., 1986; Taren and Schler, 1990).

With age, there is a progressive reduction in energy requirements due to loss of lean body tissue and an observed adoption of a more sedentary lifestyle (Munro,

1980; Rudman, 1989). The 1989 recommended energy allowance (NRC, 1989b; Young, 1992) for women aged 11 to 50 is 2200 kcal/day and decreases to 1900 kcal/day for females of average body size over 50 years who engage in light-to-moderate activity. Regardless of reduced energy needs, nutrient needs and diet composition recommendations remain similar for older women (NRC, 1989b; Young 1992).

This lowered need for energy with age reduces total food intake and presumably affects intake of most nutrients (Munro, 1980). Currently elderly women in the US consume approximately 1300-1500 kcal/day which is less than the recommended 1900 kcal/day (Block et al., 1988; Murphy et al., 1990; Popkin et al., 1992). Researchers who have studied the dietary adequacy of older American women have generally concluded that a sizable proportion of this population consume suboptimal levels of several nutrients, including vitamin A, vitamin C, vitamin E, vitamin B6, folate, and iron, but especially calcium and zinc (Ahmed, 1992; Betts and Vivian, 1984; Bowman and Rosenberg, 1982; Murphy et al., 1990).

In the US, calcium intake declines with age, and data show that many older adults consume far less than the 800 mg RDA for calcium (Ahmed, 1992). The NHANES I and the 1977-78 NFCS reported mean intakes of 540 to 590 mg. day for older women (DHHS, 1988; NRC, 1989b). Low calcium intakes usually result from a decreased intake of all foods, which is associated with declining physical activity, and from a tendency for older women specifically to avoid dairy products

rich in calcium because of the high fat and cholesterol content of these foods or their intolerance to lactose containing products (Evans and Meredith, 1989; Goodwin, 1989; Sobal and Cassidy, 1990). Calcium is necessary for maintenance of bone density. Bone mineral loss associated with osteoporosis accelerates during the decades following menopause. Low intakes of calcium, phosphorous, and vitamin D, and excessive intakes of dietary fiber, phytate, and protein contribute to the severity of osteoporosis. Lack of weight-bearing exercise, caffeine intake, and some medications have also been shown to be related to bone mineral loss with age (Ahmed, 1992; Evans and Meredith, 1989).

Zinc intake of older adults seems to decline with advancing age. Studies have shown that elderly women consume an average of 7 mg/day, which is much lower that the 1989 RDA of 12 mg/day for this age group (Ahmed, 1992; Morley, 1986). Several surveys show that up to 95% of healthy elderly do not meet the RDA for zinc from diet alone (Ahmed, 1992). The most bioavailable form of zinc in the diet comes from animal products, such as eggs, milk, and meat, all foods which have been declining in the diets of older women (Ahmed, 1992; Popkin et al., 1992). Zinc deficiency has been found to impair immune function and wound healing, as well as possibly alter taste acuity (Ahmed, 1992; Morley, 1986).

Murphy et al. (1990), studying older American participants in the 1977-78 NFCS, found that energy intake was the most significant variable associated with nutrient adequacy. Even a 100 kcal/day increase in energy has been shown to

improve overall diet quality (Munro, 1989). Thus, promoting activities that raise the requirements for energy may improve nutrient intakes for elderly individuals (Ahmed, 1992; DHHS, 1988; Voorrips et al., 1992).

Other researchers have noted the positive relationship between energy intake and consumption of dietary fat (Morley, 1986; Murphy et al., 1992). Therefore, if senior women are to effectively lower dietary fat and achieve nutrient adequacy in spite of reduced energy requirements observed with age, they must be encouraged to choose foods from all food groups and implement the concept of nutrient-density (Betts and Vivian, 1984; Block et al., 1988; Bowman and Rosenberg, 1982; Murphy et al., 1992; Rudman, 1989; Yearick et al., 1980; Yurkiw et al., 1983).

Food Intake Patterns Among Elderly Women

Factors Affecting Food Choice

Food habits and nutrient intakes of older adults are influenced by the characteristics of their lifestyles, which in turn are related to other intervening variables including socioeconomic, psychological, ethnic, and physiological components (Davidson et al., 1962; Kohrs et al., 1989; Popkin et al., 1989).

Both income and education levels have been shown to be major determinants of total caloric intake, diet adequacy, and frequency of food group use for aging individuals (Bowman and Rosenberg, 1982; Taren and Schler, 1990; Yearick et al.,

1980). Patterson and Block (1988) reported a negative relationship between consumption of fruits and vegetables and higher fiber cereals and whole grain breads with income levels of the participants aged 65 to 74 years old in the NHANES II. Read et al. (1985) found that fat intake and meat consumption for older adults were positively and significantly related to their education and income status. Grotkowski and Sims (1986) found positive relationships between socioeconomic status and nutrient intakes among elderly women. Other researchers have noted the importance of housing conditions, especially cooking facilities; availability of transportation; and convenience of food preparation as factors which can affect the food habits of this population (Bowman and Rosenberg, 1982; Taren and Schler, 1990).

The results of nutrition intervention studies in the elderly indicate the importance of social factors. Currently 36% of elderly women and 15% of elderly men live alone (Bowman and Rosenberg, 1982). Research shows that low or fixed incomes, loss of spouse, and loneliness are all factors which have been strongly negatively-related to health and food consumption patterns of the aged (Garcia et al., 1975; Krondl et al., 1982; Taren and Schler, 1990). Food choices made by the elderly tend to be affected by physiologic factors, including decreased taste acuity and sense of smell, health status, depression, illness, and physical activity, as well as medication use (Ahmed, 1992; Davidson et al., 1962; Holt et al., 1987; Kannel, 1988).

Few studies have investigated the food preferences of the elderly, since there are so many contributing influences (Holt et al., 1987). Some studies suggested that the elderly may choose foods higher in fat since they are generally more flavorful and often more palatable (Burdman, 1986; Holt et al., 1987; Kannel, 1988; Morley, 1986). Other investigators revealed that perceived healthfulness of different food groups may be the strongest factor affecting food choice for elderly women today (Krondl et al., 1982; Popkin et al., 1989).

Many researchers (Goodwin, 1989; Popkin et al., 1992) recounted that seniors are interested in eating to stay healthy and are receptive to nutrition education support focused on moderate dietary changes. However, the complex intervening factors which affect older adults' ability to make these food choice changes must taken into account and more fully understood if effective nutrition education measures are to be developed.

Food Sources of Dietary Fat and Fiber

It is important to determine what foods seniors are eating, and in particular, what sources are the main contributors of fat and dietary fiber, in order to better assess the associations between nutrition and disease risk and for the development of effective intervention programs and acceptable food products (Brewer et al., 1987; Fanelli and Stevenhagen, 1986; Fischer et al., 1991). Studies have shown that public health nutrition education for older adults may be more effective when

recommendations are defined in terms of specific foods rather than individual nutrients, since this approach enables clearer understanding of how to implement better eating habits (Block et al., 1985; Brewer et al., 1987; Fischer et al., 1991; Krebs-Smith et al., 1992).

Since the 1970's, it appears that older Americans have made some of the modifications in their food consumption behaviors promoted by public health experts, with the largest changes apparent among women (Popkin et al., 1992). According to comparisons of the 1977-78 and 1987-88 NFCS (Popkin et al., 1992), women aged 65 and over have significantly decreased their consumption of higher-fat beef and pork, eggs, and whole milk, and have significantly increased their consumption of lower-fat meat varieties of poultry, fish, beef and pork, as well as lower-fat milk. But little change has occurred in the proportion of older women consuming sources of hidden fats, including rich desserts, high fat snacks, and grain-based mixed dishes (Popkin et al., 1992). There have been virtually no changes in consumption patterns of butter and margarine and high-fat poultry products (Popkin et al., 1992).

To reflect food groups that make substantial contributions to fat and dietary fiber intake, Popkin et al. (1992) separated all foods in both the 1977-87 and 1987-88 NFCS by their fat and dietary fiber content. The top three food groups contributing collectively approximately one-third of elderly women's total fat intake according to the 1987-88 NFCS included butter and margarine (9.5%), high-fat

desserts (9.2%), and medium fat beef and pork (8.2%), which were the same top contributors ten years prior (Popkin et al., 1992).

Little change has been noted in the consumption of the main sources of dietary fiber since 1977 (Popkin et al., 1992). Among elderly women, there has been a modest increase in the proportion consuming high-fiber ready-to-eat cereals and a relatively small elevation in pasta, rice and cereal, but an actual decline in proportion eating high fiber vegetables (Popkin et al., 1992). For elderly women surveyed in the 1987-88 NFCS, the food source contributing the greatest amount of fiber was low-fat/high-fiber breads (11.1%), followed by high-fiber ready-to-eat cereals (9.3%) and low-fiber vegetables (9.2%) (Popkin et al., 1992).

Patterson and Block (1988) reported that, of participants in NHANES II, older adults were more likely than younger people, and women were more likely than men, to report consuming foods possibly protective against cancer, namely lower fat meats and fruits and vegetables. However, a large segment (about 70%) of older women aged 55 to 74 years old reported consuming no fruits or vegetables rich in vitamin A, and approximately 80% had consumed no high fiber cereal or bread on the day evaluated (Patterson and Block, 1988).

Although national surveys suggest a number of positive changes in the diets of elderly, particularly in foods where presence of fat is obvious (meats, poultry, dairy), this risk-avoidance food behavior has not been accompanied by consistent health-seeking behaviors such as consumption of more fruits, vegetables and whole

grains (Popkin et al., 1992; Popkin et al., 1989). Furthermore, these overall food consumption trends have resulted in only modest changes in overall nutrient intakes. The apparent substitution of higher fat foods with lower fat alternatives and some minor adjustments in portion sizes seen among the population of elderly women may not be adequate to effect the desired changes in fat and dietary fiber intakes. Popkin and coworkers (1992) found that the percentage of energy from fat and saturated fat still surpassed the recommended level of 30% and 10%, respectively, and the consumption of dietary fiber still fell short of the advocated amount (Popkin et al., 1992).

These results suggest that seniors know what foods to avoid, but may not be sure how to transfer this information into what foods to choose to meet the current diet and health recommendations (Popkin et al., 1992). Also, health promoters need to communicate the fat content of those foods with hidden fat more clearly (Rathje and Ho, 1987). More information is needed on how elderly women can successfully make food choices which will lower fat intake (Kristal et al., 1990). Connor et al. (1992) pointed out that increasing consumption of complex carbohydrate foods is as important as decreasing higher-fat food choices for effective reduction of dietary fat. Education efforts concerning dietary change need to be focused on positive and practical application if behavior modification for this population is to be successful (Connor et al., 1992; Popkin et al., 1992).

Relationship Between Exercise and Dietary Behavior among Elderly Women

The literature suggests that diet and exercise behavior may be related (Armstrong et al., 1990; Contento and Murphy, 1990). Those women who choose to exercise in their latter years have been shown to be more health and diet conscious, and thus may make more nutritious food choices resulting in diets lower in fat and higher in dietary fiber and micronutrients (Ahmed, 1992; Kohrs et al., 1989; Voorrips et al., 1992).

Few studies have examined the relationship between intake of total fat or fat as a percentage of total kcalories and exercise in American elderly women, but research covering broader age ranges and studies abroad have shown that more active people may be more likely to consume less fat (Contento and Murphy, 1990; Miller et al., 1990). Miller et al. (1990) found that leaner women aged 18-71 who exercised more frequently also derived significantly less energy from fat (29%) than women who exercised less (35%). Voorrips et al. (1991), studying the dietary intakes of two groups of 48 elderly Dutch women with different patterns of daily physical activity, reported that those who were active, compared with their sedentary peers, consumed slightly less total fat (67g vs 75g/day) and less fat as a percentage of their total kcalories (35.6% vs 37.6%). Mensink and Arab (1989) described similar findings among a group of older German women; those who reported

engaging in exercise activities at least 2 hours per week, consumed slightly, but not significantly, less fat and had diets richer in carbohydrates.

Limited studies have examined the association of activity and food group consumption or dietary behavior change among elderly women specifically, but there is evidence that choosing foods lower in fat and higher in dietary fiber can accompany the adoption of an exercise program among men and women of various ages (Armstrong et al., 1990; Barr, 1986; Lampman, 1987; Miller et al., 1990). Among the male and female recreational exercisers in the study by Armstrong and colleagues (1990), those participating in more frequent exercise reported eating less red meat and eggs, and eating more whole grain products and fresh fruits and vegetables. In addition, they found that women aged 50 and over, who exercised more frequently, were more concerned about controlling their intake of fat and were more apt to report making food choice changes to lower dietary fat. (Armstrong et al., 1990). Contento and Murphy (1990) showed that in a study of men and women, ranging in age from 18-75, approximately 56% had reported a decreased intake of red meat and/or butter, and those who ate less fat-dense foods, were also more likely to participate in regular exercise. Furthermore, they found that exercise appeared to be a strong consistent, and independent predictor of both short and long term success of dietary behavior change. Middle-aged runners (Community Nutrition Institute, 1979), after taking up running, reported reducing intakes of meat, sweets and fat and increasing carbohydrates, fruits and vegetables.

Mensink and Arab (1989) found few differences in food consumption between active and inactive elderly German women, but the active women did report consuming more fruit and fish than the inactive. Comparison of micronutrient intakes showed a slightly higher carotene intake for the active women. Voorrips et al. (1991) revealed that in general the food patterns of their more physically active group included more vegetables, fruits, and legumes. As a result of these food group intakes, Voorrips and co-workers (1991) also found a significantly higher intake of fiber per 1000 kcalories among the exercisers.

These studies together suggest that older women who participate in exercise may be more likely to choose a diet lower in fat by eating less dense sources of fat, mainly higher fat meats (Armstrong et al., 1990; Contento and Murphy, 1990), and eating more foods high in dietary fiber, such as fruits and vegetables, which may collectively result in higher nutrient consumption (Mensink and Arab, 1989; Voorrips et al., 1991). It is difficult, however, to conclude that exercise behavior is directly or even indirectly responsible for any of the differences noted in food consumption patterns (Pi-Sunyer and Woo, 1985). More research is needed on the many psychological and behavioral influences of adopting health-related behaviors among this age group.

Body Composition and Aging

Effects of Aging on Body Composition

Changes which occur in body composition and conformation with age reflect the interaction of genetic factors, physical activity patterns, nutrition, and disease (Bowman and Rosenberg, 1982; Chumlea and Baumgartner, 1989; James et al., 1988; Taren and Schler, 1990; Yearick et al., 1980). Peak bone mass is achieved at approximately age 30 to 35 and decreases thereafter (Chumlea and Baumgartner, 1989). For women there is a precipitous decline in bone mass during the postmenopausal years, resulting in varying degrees of osteoporosis and susceptibility to bone fractures (Kuczmarski, 1989; Smiciklas-Wright, 1990). Height begins to decline after the age of 40 years in both sexes (Frisancho, 1990; Taren and Schler, 1990). The maximum lifetime loss of stature for women is approximately 4.9 cm (Bowman and Rosenberg, 1982; Taren and Schler, 1990).

From the years of 30 to 70, there is progressive decrease of lean body mass with a gradual increase in fat mass (Kuczmarski, 1989; Smith et al., 1988). Longitudinal research has revealed a decrease in lean body mass of about 11 pounds in women from the age of 25 to 70 years, with an increase in fat weight of 33 pounds, which corresponds to an increase in the percentage of body fat from about 33% to 45% (Kuczmarski, 1989; Thompson et al., 1982).

Women reach their lifetime maximum weight between the ages of 55 to 65, and after 70 weight tends to decline, although the proportion of body fat appears to increase until about age 75 (Frisancho, 1990; Steen, 1988; Taren and Schler, 1990). There is also a redistribution of body fat from the extremities to the trunk, as well as an increase in visceral adipose tissue relative to subcutaneous fat (Deurenberg et al., 1989; Kubena and McIntosh, 1991; Smiciklas-Wright, 1990; Steen, 1988; Taren and Schler, 1990). With a significant accumulation of body fatness, there is also an increased risk for coronary heart disease, hypertension, hyperlipidemia, non-insulin dependent diabetes mellitus, and osteoarthritis (DHHS, 1988; Jensen, 1992; Rudman, 1989; Taren and Schler, 1990; Thompson et al., 1982). The prevalence of obesity, defined by Garrow and Webster (1985) as $\geq$ 120% of healthy body weight, rises with advancing age especially among women (Rudman, 1989; Taren and Schler, 1990). Data from the 1974 Ten-State Nutrition Survey revealed that 18% of the males and 50% of the females over the age of 60 were obese (Yearick et al., 1980).

Body Composition Assessment Methods for the Elderly

Body composition assessment, in addition to dietary evaluation, is an integral part of health appraisal among the elderly (Chumlea et al., 1991). The characteristic changes in body composition experienced by elderly subjects can confound anthropometric measurements in this population (Kuczmarski, 1989).

Further research is needed to determine the most reliable and valid tools for accurate assessment of the body composition in this age group as well as adequate standards for comparison (Frisancho, 1984; Frisancho, 1990; Heymsfield et al., 1989; Kuczmarski, 1989). Three of the most common non-invasive methods for indication of body fatness among older adults include body mass index, waist-to-hip ratio, and percent body fat estimated from skinfold measurements.

Body Mass Index

The body mass index measurement (BMI) is the ratio of weight (kg) divided by height (m) squared (Deuernberg et al., 1989a). As an indicator of adiposity, BMI is complicated by the loss of height with age, as well as the fact that fat constitutes a variable fraction of the total body weight in an elderly person (Kuczmarski, 1989; Steen, 1988). However, this method has been shown to be an accurate predictor of obesity (Garrow and Webster, 1985; Taren and Schler, 1990), and has correlated well with percent body fat determined through hydrostatic weighing (Deuernberg et al., 1989a). Body mass index values between 22 and 25 kg/m^2 have been associated with the lowest overall risk to health, but as age increases so do BMI values that are associated with the lowest mortality, according to the 1983 Metropolitan Life Insurance Tables (Kubena et al., 1991). Therefore, BMI values of 24 to 29 are suggested for optimal health among the elderly (Bray, 1990; Kubena et al., 1991; NRC, 1989a).

Waist-to-Hip Ratio

Waist-to-hip ratio (WHR) measurement, the circumference of the waist divided by the circumference of the hips, offers information concerning body fat apportionment (Bray, 1990; Krotkiewski et al., 1983). Recent data suggest that not only total body fat, but also the distribution of the fat, or body conformation, may be related to health risk (Krotkiewski et al., 1983; Vague, 1956). Among women, an increase in abdominal fat, or an android fat pattern characterized by a WHR measurement > 0.8, has been shown to be associated with increased risk for cardiovascular disease, hypertension, and diabetes mellitus compared with fat deposited more on the hips, or a gynoid fat pattern marked by a WHR measurement < 0.8 (Chumlea et al., 1992; Krotkiewski et al., 1983; Kuczmarski, 1989; Vague, 1956).

Percent Body Fat Estimated from Skinfolds

The measurement of skinfold thicknesses as a technique to assess body composition has been used in population studies because it is an easy and cost-effective method from which estimations of body density and percent body fat (PBF) can be made (Durnin and Womersley, 1974). Skinfold testing is based on the two-compartmental model which divides the body into fat mass and fat-free mass (Wilmore, 1983). Predictions of body fatness rely on the assumptions that approximately 50% of body fat is located at the subcutaneous level, and that there is

a constant relationship between subcutaneous and visceral fat of the body (Chumlea and Baumgartner, 1989; Durnin and Womersley, 1974; Jensen, 1992). These presumptions concerning body tissue distributions have been challenged and the validity of their application to elderly women is still unknown (Vogel and Friedl, 1992).

Several investigators have generated linear regression equations for older adults to determine body density, which are based on comparisons of body density measured by hydrostatic weighing with skinfold thicknesses (Durnin and Womersley, 1974; Jackson and Pollock, 1985). Estimates of PBF from skinfolds can be made by the prediction of body density from these equations using Siri's (1956) formula. Skinfolds of older adults have shown less correlation for the estimation of PBF using hydrostatic weighing compared to younger individuals, largely due to assumptions about the densities of body fat and lean tissue which may not hold true over the life span (Chumlea et al., 1992; Kuczmarski, 1989).

The use of skinfolds as a method to estimate body fatness in the elderly is complicated by the significant changes in body composition that occur with aging, particularly the redistribution of fat, and marked alterations in the thickness, turgor, elasticity, and compressibility of the skin that could affect accuracy and precision of the measurements, as well as the basic assumptions (Bowman and Rosenberg, 1982; Haskell et al., 1985; Jackson and Pollock, 1985; Kubena et al., 1991). Skinfold testing using the triceps, biceps, subscapular, and suprailiac sites, has been shown to

be a valid indirect method for estimation of body fatness in the elderly when age-specific linear regression equations are used (Chumlea et al., 1984; Deurenberg et al., 1989b; Durnin and Womersley, 1974; Lohman, 1981; Lukaski, 1987). However, the accuracy of skinfold measurements depends on the precision and skill of the measurer (Lukaski, 1987). The error in estimating PBF from skinfolds for younger groups is established to be approximately 3-5%, but may be larger for elderly populations (Lohman, 1981; Lukaski, 1987).

Relationship between Exercise Behavior and Body Fatness among Elderly women

The body composition of older adults is affected by the physiological changes associated with aging and has also been shown to be closely related to exercise behavior (Dreon et al., 1988; James et al., 1988; Kris-Etherton, 1986; Kubena et al., 1991; Miller et al., 1990; NRC, 1989a; Thompson et al., 1982). Exercise has been shown to increase muscle mass and decrease body fat in young and old subjects (Thompson et al., 1982; Tremblay et al., 1990). Limited studies have specifically investigated the relationship of body composition parameters using BMI, WHR or PBF and exercise behavior among older women (Bergman and Boyungs, 1990; Kuczmarski, 1989).

Bergman and Boyungs (1990) found that older women aged 40 to 82, who participated in a 10 week walking program, showed no significant changes in mean body weight or BMI, but had altered the composition of their weight. During the exercise intervention period, their elderly women subjects lowered their PBF and total body fat, and increased their lean body mass measured by bioelectrical impedance analysis. In another study, comparisons of elderly controls with those who had increased their activity levels, demonstrated that increased exercise resulted in greater lean body mass at the expense of body fat within 4 months (Thompson et al., 1982). Voorrips et al. (1991) found that, among a group of elderly Dutch women, those who were active had significantly lower PBF than the sedentary peer group. Miller et al. (1990) examined the relationship between body fat and exercise in adults aged 19-71 and found that exercise frequency at all ages was positively related to leanness. Kubena et al. (1991) investigated relationships between anthropometric measurements and certain health behaviors among women aged 58-74 years old and found that those women, who rated themselves as more active than their peers, had a lower mean waist circumference and total body weight, but no differences in BMI or suprailiac and triceps skinfolds were found. Tremblay et al. (1990), exploring the effect of the level of regular physical activity on body fatness characteristics in a wide age-range sample of both men and women, reported that those women subjects who practiced the highest level of exercise had lower WHR, due mainly to a decreased waist circumference, and had significantly

smaller triceps, biceps, subscapular, and suprailiac skinfold measurements, compared to less active women in the study.

Some studies have found limited changes in the body compositions of elderly women with increased activity. Mensink and Arab (1989) found no difference in the BMI values between active and inactive elderly German women. Others report that the amount of physical activity of the elderly participants may not be sufficient to significantly alter body composition at this age, especially among healthy seniors, since body composition and its changes through life are also affected by genetics, as well as past and present health and energy intake (Yurkiw et al., 1983).

Increased physical activity patterns among the elderly has been associated with reduced body fatness, which in turn may have favorable effects on health, but more research is needed to further delineate this association (Evans and Meredith, 1989).

METHODS

Study Design

This research project was designed as a cross-sectional study to examine, among a sample of elderly women (N=63), the associations between exercise participation and nutrient intake; food sources of dietary fat and fiber; dietary behavior change; and body composition indices including percent body fat, waist-to-hip ratio, and body mass index, considering the effects of the potentially intervening variables of age, education and income. The purpose of this project was to determine whether those women who had consciously undertaken a regular exercise program would also have more adequate micronutrient intakes, make lower fat and higher dietary fiber food choices, report having made more recommended dietary changes, and have leaner body compositions, than those who had not undertaken such a program.

This 14-week diet and activity study was divided into 3 phases, each approximately 5 weeks apart. During each phase, subjects were scheduled in a staggered design to keep a 7-day food record, to come to the Oregon State University campus for anthropometric measurements, and to complete questionnaires concerning dietary and activity habits. The first data collection period started at the beginning of August, the second started in the middle of September, and the final period started early in November, 1991.

Sample Selection

Seventy free-living, elderly women volunteers aged 65 and over were recruited in the Corvallis, Oregon, area from the following sources: Corvallis Gazette-Times newspaper article, senior center congregate meal programs and senior exercise classes in Corvallis and Albany, and local elderly living groups. Potential subjects were screened by telephone or in person using the form in Appendix A, to meet the following criteria: 1) aged 65 or over, 2) lived independently, 3) had no physical conditions which would limit their ability to perform moderate activity, 4) were able to provide transportation to Oregon State University campus on three separate occasions for body composition measurements, 5) were willing to keep 7-day food records during three different periods, 6) agreed not to change either their diet or activity patterns during the course of the study.

All subjects gave their informed consent to participate and all supplied information about their age and education, although only 49 reported their incomes. Copies of the informed consent document and the confidential information form asking for this demographic information are shown in Appendices B and C, respectively. At the end of the study, each subject was sent a summary packet including a 3-day dietary analysis and a printout of her body composition information, as well as the option to schedule a nutrition consultation to answer individual questions, as promised at the start of the project. Of the 70 elderly

women recruited, 7 women were unable to complete all aspects of the study for various health reasons. The final sample included 63 elderly women.

Approval

This study was part of a larger research project investigating the relationships between diet and exercise among older women. All of the procedures and forms were approved by the Institutional Review Board for the Protection of Human Subjects at Oregon State University.

Data Collection Procedures and Instruments

Exerciser and Non-exerciser Group Designation

The sample of elderly women was initially divided into exerciser and non-exerciser groups according to responses to a screening question (Appendix A) validated by Schectman et al. (1991): "Do you currently participate in any regular activity or program (either on your own or in a formal class) designed to improve or maintain your physical fitness?". Elderly women responding "yes" to this question were categorized as exercisers if they also self-reported in a confidential information form (Appendix C, questions, #22-24) having engaged in a regular program of planned exercise a minimum of 15 minutes per session, 2 times per week, for at

least the past year. Non-exercisers were defined as those not meeting all of these criteria. The final sample contained 33 self-reported exercisers and 30 self-reported non-exercisers. Subjects were not aware that their responses concerning self-reported exercise participation were being used as a group designation variable for this study. In a questionnaire concerning activity habits given in Appendix D (questions #13 and #14), all subjects also supplied information about why they did (exercisers) or did not (non-exercisers) engage in a regular exercise program.

Estimation of Nutrient Intake and Food Sources of Dietary Fat and Fiber

Estimated food and nutrient intake were based on analysis of 9 days (7 weekdays, a Saturday and a Sunday) of self-maintained food records. The instructions given for record keeping and a sample of the food record sheets are provided in Appendix E. Subjects kept a total of 3 weekly records at 5 week intervals, recording all food and beverages consumed. From these, 3 predetermined days were selected from each set of 7-day food records to be analyzed. Prior to the initial dietary recording period, each subject was individually instructed in the procedure for recording and estimating their food intake using household measures. A completed sample food record was provided to all participants as well as a phone number to call if questions arose during record keeping.

Home interviews were conducted by trained Nutrition and Food Management majors soon after each record keeping period using food models and measuring

utensils to confirm or fill in estimated portion sizes, inquire about preparation methods and brand names used, clarify ambiguities, and probe for potential missing information. A detailed list of the food models used appears in Appendix F. During the interviews, the 3 key days to be analyzed from each 7-day period were singled out for in-depth review.

Nutrient intake for each elderly woman was estimated using The Food Processor II Nutrition & Diet Analysis System, version 3.05 with ASCII (ESHA Research, Salem, OR, 1990) computer software. In addition to energy, the specific nutrients examined included the macronutrients - protein, carbohydrate, types of fat (total, saturated, monounsaturated, and polyunsaturated fats), cholesterol, and dietary fiber; 11 selected micronutrients - vitamin A (including total vitamin A, retinol, and carotene), vitamin C, thiamin, riboflavin, niacin, vitamin B6, vitamin B12, folate, calcium, iron, and zinc. Comparisons were made for both groups with the 1989 RDA for women aged 51 years old and over shown in Appendix G.

Approximately 30 foods were added to the data base. Nutrient data were complete for kcalories, protein, carbohydrate, and total fat. The percent of missing values for other reported nutrients in the data base ranged from 0.3% for riboflavin to 3.0% for vitamin B6. A complete list for all nutrients is given in Appendix H.

Sources of nutrient data for foods not found in the original data base included: the Frozen Convenience Foods Database for The Food Processor II Program (ESHA Research, Salem, OR, 1992) computer software; food package

labels; and nutrition information requested from manufactures or fast food restaurants. The Pillsbury Cookbook (1989) and Better Homes and Garden's Complete Guide to Food and Cooking (1991) were consulted for ingredient proportion of mixed dishes or recipes not obtained from written records. A default list (Appendix I) was developed for entering food items when quantities, sizes, or types were not clearly specified or missing. Foods and portion sizes chosen as default items were those most often consumed by the women in the sample or as cited in Foods Commonly Eaten by Individuals: Amount Per Day Per Eating Occasion (Pao et al., 1982) for women 65 years and older.

Food sources of total fat and dietary fiber were identified using a classification scheme developed by Popkin et al. (1989) which arranges foods into 30 food categories (Appendix J) according to fat and fiber content per 100 g of food item. Nine-day gram intake of total fat and dietary fiber, as well as the top ten food category contributors to total fat and dietary fiber intake were determined and compared between elderly women exercisers and non-exercisers. None of the participants indicated that they were vegetarians.

Dietary Change Behavior

Data about dietary change behavior were obtained from responses to one question on an Eating Behavior Questionnaire (Appendix K, questions #1), which was administered orally to each subject to ensure uniform understanding among

participants. Subjects were asked, among other foods, about their consumption of 5 foods high in fat/cholesterol (red meat, eggs, cheese, butter, and sweets) and 5 foods higher in complex carbohydrates (cereal, fresh fruits and vegetables, breads or pasta, rice or potatoes, dried beans and peas). Only responses concerning these ten foods were used for comparisons between groups.

Body Composition Indices

Body composition was assessed through the following anthropometric parameters: weight, height, body mass index (BMI), waist and hip circumferences, waist-hip ratio (WHR), and four skinfold measurements (triceps, biceps, subscapular, suprailiac) to estimate percent body fat (PBF). All measurements were taken by trained technicians, following protocols corresponding to methods cited in the Anthropometric Standardization Reference Manual (Lohman et al., 1988). Anthropometric measures were taken during lab appointments during each of the three study phases. All subjects were instructed to wear light, loose-fitting clothing to their lab appointments. The mean values of these triplicate repeat measures were used for all comparisons between the two groups.

Weight measured to the nearest 0.25 pound and height measured to the nearest 0.25 inch were taken without shoes using a Health-O-Meter beam scale and the height attachment bar, respectively. The BMI was calculated from the formula weight in kg/height in m^2.

Waist and hip circumferences were measured to the nearest 0.25 inch using a flexible tape with the subject standing, feet together. The waist measurement was taken at the natural waist, which is the narrowest part of the torso. The hip circumference was taken at the maximal protrusion of the buttocks. The WHR was calculated by dividing the waist circumference by the hip circumference.

Percent body fat was estimated from the mean of triplicate skinfold thicknesses taken three times at five week intervals, measured according to Durnin and Rahaman (1967) at the following sites: 1) triceps, taken midway between the acromion and the olecranon processes; 2) biceps, taken at the midpoint of the muscle belly; 3) subscapular, measured 1 cm from the tip of the inferior angle of the scapula; and 4) suprailiac, taken 3 cm above the anterior, superior iliac crest, at a 45 degree angle from the midline of the body. All fat folds were taken on the right side of the body (except one exercising subject whose measurements were taken on the left side due to mastectomy swelling) with Lange calipers (Cambridge Scientific Industries, Inc, Cambridge, MD) read to the nearest 1 mm. Percent body fat was estimated from the average sum of the above four skinfolds taken during the three phases using the logarithmic, regression equation for women aged 50 years old and over, developed by Durnin and Womersley (1972) for body density determination, which was then converted to PBF using Siri's (1956) equation. An excerpt for the estimation of PBF from skinfolds is given in Appendix L.

Statistical Analysis

The Statistical Package for the Social Sciences software, version 4.0 (SPSS/Main Frame) (SPSS, Inc., Chicago, IL, 1988), was used for all statistical analyses of the data. A two-tailed p-value of equal to or less than .05 was considered to be statistically significant.

Exercisers and non-exercisers, when compared statistically on the basis of age, education and income, were not found to be different from each other. Therefore, exercisers and non-exercisers were compared with respect to dependent variables without consideration of the effects of these potentially intervening variables.

T-tests were conducted to identify any significant differences between the exercisers and non-exercisers with respect to age, macro- and micro- nutrient intake, and body composition parameters for variables which were symmetrically distributed among both groups. Mann-Whitney U tests were used to identify significant differences between the exercisers and non-exercisers when distributions of nutrients or body composition variables were asymmetrical in either group, and for determination of differences in total fat and dietary fiber contributions from each of the 30 food categories. An excerpt for the use of the Mann-Whitney U test is given in Appendix M.

Chi-square analyses were used to identify differences between the elderly women exercisers and non-exercisers for the categorical variables of education and income levels (for those reporting), percent of subjects meeting or exceeding 75% of the 1989 RDA, and questionnaire responses concerning eating behaviors.

Limitations of Study Methods

Generalizability of our results from this cross-sectional study is limited due to the possible self-selection bias of the volunteers. Our sample of 63 subjects was a relatively small, non-random, fairly homogeneous group, who may have been more health-conscious than the entire population of elderly women.

Grouping subjects in the sample into exercisers and non-exercisers according to their self-reported physical activity pattern may have limited the strength of the comparisons of food and nutrient intake and body composition measures made in this study, since this methodology is based solely on the women's qualitative perception of their exercise behavior and not quantitative assessment through activity records. The purpose of this study, however, was to examine exercise as a conscious health-behavior.

One potential limitation in the estimation of food intake is obtaining an adequate number of recorded days to reflect actual intake of the nutrients of interest. Basiotis et al. (1987) showed that the use of at least 7 days of food intake is required

for an accurate estimation of the true average of groups of individuals for total fat and saturated fat. The use of 9 days of food records including all days of the week, selected from three, 7-day records kept at 5 week intervals, was expected to provide a valid estimate of average actual food intake. However, under-reporting of food intake in nutrition-focused studies is a potential problem (Murphy et al., 1992), since the very act of measuring a phenomenon may alter that phenomenon (Pi-Sunyer and Woo, 1985).

Another potential limitation is the subject's ability to accurately record all food consumed and accurately estimate quantities. Food record keeping instructions were given to each subject, and during the home interviews, intakes were reviewed for completeness and accuracy using food models. Using records from each of the three phases of record keeping hopefully minimized the possible lack of recording skill at the beginning of the study and somewhat accounted for seasonal differences in intake over the course of the project.

The use of 30 food categories based on Popkin and coworkers' (1989) scheme, like any food grouping method, is restrictive. The relative amount of dietary fat and fiber derived from these food groups and the percent contribution of these categories to dietary fat and fiber intake among a sample are influenced by the way foods are combined, especially with respect to mixed dishes (Block et al., 1985; Krebs-Smith et al., 1992). In the food groupings we employed, similar foods were grouped together and food mixtures such as casseroles were treated as single items

categorized according to their main ingredients. Other researchers (Krebs-Smith et al., 1990; Popkin et al., 1992) have reported that the assumptions regarding the coding of food mixtures involving meat especially, may influence the estimated fats and nutrient contributions of basic food groups. Having utilized a different categorizing plan for food groups may have altered the outcome of group comparisons. However, using the food categories adapted from Popkin et al. (1989) allowed a more detailed exploration of food choice behavior of the subjects with respect to foods lower or higher in dietary fat and fiber.

Using skinfolds to estimate body fat in the elderly is complicated by the significant changes in body composition that occur with aging, particularly the redistribution of fat, and marked alterations in the thickness, turgor, elasticity, and compressibility of the skin that could affect accuracy and precision (Bowman and Rosenberg, 1982; Haskell et al., 1985; Jackson and Pollock, 1985). Four-site skinfold testing has been shown to be a valid indirect method for estimation of body fatness in the elderly when age-specific densiometrically determined regression equations are used (Chumlea et al., 1981; Deurenberg et al., 1989b; Durnin and Womersley, 1972; Lohman, 1981; Lukaski, 1997). However, the accuracy of skinfold measurements depends on the precision and skill of the measurer (Lukaski, 1987). Trained anthropometric technicians conducted all measures, and values were averaged for the three measurement periods of four sites, taken in triplicate for each subject. Acceptable error in estimating body composition from skinfolds in

comparison with hydrostatic weighing has been established to be approximately 3-5% body fat (Durnin and Womersley, 1974; Jensen, 1992; Lohman, 1981; Lukaski, 1987). We were able to compare the percent body fat estimated from our skinfold measurements with the body fat values obtained from dual energy X-ray absorptiometry (DEXA) for five of our subjects who were also enrolled in a separate bone density study. Our mean percent error using caliper measurements to determine percent body fat was 5.4%, very close to the accepted range of error.

RESULTS AND DISCUSSION

Description of the Sample

The subjects (N=63) in this study included 33 elderly women who were self-reported exercisers and 30 elderly women who were self-reported non-exercisers. There were no significant differences between the groups in age and education and income levels (Table 1). Non-exercisers were slightly older than exercisers with mean age of 74.9 years vs 71.3. The majority of both groups reported some college or professional training. A somewhat larger proportion of the exercisers had income levels above $20,000 per year than did the non-exercising women, but data were incomplete for this variable. Compared to data from the National Center for Health Statistics for women aged 65+ in the US, these participants as a whole could be described as a sample of well-educated individuals who were more affluent than the average elderly population (Kovar, 1986).

There were no significant differences between the marital status, living arrangements, or place of residence of the women exercisers and non-exercisers (Table 2). The largest proportion of each group was married and lived in an individual residence either alone or with other family members. Data from the National Center for Health Statistics indicated that the majority of women aged 65+ show similar percentages for these variables (Kovar, 1986).

Table 1. Self-reported age and education and income levels for elderly women exercisers and non-exercisers.

VARIABLES	EXERCISERS		NON-EXERCISERS	
	(n=33)		(n=29)	
AGE[a]	Mean±SD	Range	Mean±SD	Range
years	71.3±5.1	65-83	74.9±7.5	66-98
	(n=33)		(n=30)	
EDUCATION[b]	no.	%	no.	%
Equal or less than high school	7	21	10	33
Some college or professional training	20	61	16	53
College or graduate degree	6	18	4	13
	(n=25)		(n=24)	
INCOME[c]	no.	%	no.	%
< $10,000/year	0	0	3	12
Between $10,000-20,000/year	8	32	10	42
Between $20,000-30,000/year	8	32	7	29
> $30,000/year	9	36	4	17

[a] Means were compared between groups using t-test. Not significant at $p \leq .05$ ($p = .06$).

[b] Percents were compared between groups using chi-square tests. Not significant at $p \leq .05$ ($p = .54$).

[c] Percents were compared between groups using chi-square tests. Not significant at $p \leq .05$ ($p = .16$).

Table 2. Self-reported marital status, place of residence, and living arrangements for elderly women exercisers and non-exercisers.

VARIABLES[a]	EXERCISERS		NON-EXERCISERS	
	no.	%	no.	%
MARITAL STATUS	(n=33)		(n=27)	
Married	18	54	11	41
Divorced	2	6	2	7
Widowed	11	33	11	41
Divorced/widowed	1	3	1	4
Separated	0	0	1	4
Single	1	3	1	4
RESIDENCE	(n=33)		(n=30)	
Individual house, duplex, mobile home	31	94	25	83
Apartment without in-home service or meals	2	6	4	13
Apartment with in-home service or meals	0	0	1	3
LIVING ARRANGEMENT	(n=32)		(n=30)	
Alone	13	41	16	53
With other family members	19	59	13	43
With one or more non-family members	0	0	1	3

[a] Variables were not compared between groups statistically.

Self-reported medical conditions for both groups are listed in Table 3. All participants reported at least one medical ailment. When compared statistically, no significant differences were found between elderly women exercisers and non-exercisers. The most common medical problem among this sample was arthritis, indicated by 61% of the exercising women and 43% of the non-exercisers. Kubena et al. (1991) also found in a study of men and women aged 65 and over, that arthritis was the most prevalent medical disorder among elderly women, reported by almost 60% of participants. National data show that arthritis and high blood pressure are the first and second ranked chronic conditions, respectively, reported by Americans aged 65 and over (Collins, 1988; Rudman, 1989). It has been reported that 80-85 % of all older persons have one or more chronic, potentially debilitating diseases (Hegsted, 1989; Kerstetter et al., 1992), which may have a greater influence on nutrient intake and physical activity than does their age alone.

A large portion of both groups of women (78% of the exercisers and 70% of the non-exercisers) reported taking at least one prescribed medication, and many were taking more than two. It was beyond the scope of this thesis to examine drug-nutrient interactions so medications were not categorized, but the most commonly reported drugs among this group of elderly women were diuretics and various estrogen therapies. Other researchers (Hegsted, 1989; Krondl et al., 1986) have reported that on the average 60%-80% of elderly use prescription or nonprescription

Table 3. Self-reported medical conditions for elderly women exercisers and non-exercisers.

REPORTED MEDICAL CONDITIONS	EXERCISERS (n=33)		NON-EXERCISERS (n=30)		SIGNIFICANCE[b]
	no.	%[a]	no.	%	
Diabetes Mellitus	1	3	3	10	.26
Hypertension	12	36	8	27	.41
Osteoporosis	7	21	4	13	.41
Bone fracture	3	10	5	17	.37
Arthritis	20	61	13	43	.17
Heart problems	3	9	3	23	.12
Spastic colon/diverticulitis	5	15	3	10	.54
Mental depression	2	6	2	7	.92
Allergies	8	24	11	37	.28
Cancer	6	18	5	17	.87
Ulcer	2	6	4	13	.32
Angina	0	0	3	10	.06

[a] Percents were compared between groups using chi-square tests.
[b] Significance level $p \leq .05$. No significant differences found.

drugs on a regular basis, comparable to twice as many drugs as the general population. Krondl et al. (1986) found, among a group of older women enrolled in a study focusing on influences of food choice, that 62% were using at least one prescription medication which affected dietary habits. More research is needed to examine the effect of drugs on food choice behavior, drug-nutrient relationships, and drug-drug interactions among the elderly, who are the greatest users of medication and supplements in the population (Hegsted, 1989).

More than three-fourths of the elderly exercisers and approximately two-thirds of the non-exercisers reported using vitamin or mineral supplements on a regular basis. Calcium and multi-vitamin supplements were the most frequently reported. Since the focus of this study was on food patterns and resultant nutrient intake, the nutrient analysis did not include supplement consumption. However, it is interesting to examine this behavior as indicative of these women's perceived nutritional need beyond their own food intake. Bender et al. (1992) reported that only about 46% of a nationwide sample of women of this age group, participating in the 1986 National Health Interview Survey, took supplements. Studies by Armstrong et al. (1989) and Krondl et al. (1986) have shown that among health conscious, active seniors supplement use is often high, although usually unrelated to actual need.

Characteristics of Exercise Behavior

The purpose of this study was to examine exercise as a conscious, planned behavior. Information on characteristics of our exercisers' regular physical activity habits (Appendix C, questions #22-24) and the reported reason for participating or not participating in regular exercise (Appendix D, questions #13 and #14) were obtained from responses from questionnaires.

The mean frequency of exerciser reported by the self-described exercisers was 4 times per week, with a mean of 46 minutes per exercise session. The exercisers indicated having engaged in their current activity pattern for an average of 9 years. The types of activities reported by exercisers are displayed in Table 4. Exercisers most frequently reported walking (64%) and aerobic dancing (39%) as the main activities that they participated in for exercise.

The recommendations for exercise participation to be of health benefit for older adults, according to the American College of Sports Medicine (Blair et al. 1988), include a regular program of exercise involving aerobic activities using large muscle groups at least three times per week, for at least 30 minutes per session, which our group of exercisers on the average reported following (Blair et al., 1988; Elward and Larson, 1992). Munro (1989) contended that for the elderly, an increase in energy expenditure with the purpose of improving appetite and nutrient intake can best be achieved by prolonging the time spent in light to moderate

Table 4. The types of physical activity in which elderly women exercisers reported participating.

PHYSICAL ACTIVITIES	EXERCISERS (n=33)	
	no.	%
Walking	21	64
Dance aerobics	13	39
Swimming	5	15
Yoga	5	15
Gardening	3	9
Ballroom/square dancing	2	6
Calisthenics/stretching	2	6
Stationary biking	2	6
Bowling	1	3
Cross-country skiing	1	3
Running	1	3
Golf	1	3

activities such as walking, cycling, playing golf, doing calisthenics or dancing, without having to engage in more intense activities which may potentially increase the risk of injury. Our elderly exercisers appeared to be choosing recommended activities for the enhancement of health.

The reasons, in descending order, that the exercisers gave for engaging in physical activity and the non-exercisers gave for not participating in regular exercise are shown in Tables 5 and 6, respectively. "To enhance sense of well-being" was the most frequently selected reason for exercising (70%), followed by several health-benefit responses. The largest number of non-exercisers reported that they were "not motivated to exercise" (43%).

Other studies have discovered similar findings. The US Public Health Service (1992) mentioned exercise's effectiveness in improving the psychological well-being of older adults as being an important motivator for participation. The most frequently selected reason for exercising among older subjects (aged 51+) of Armstrong et al. (1990) was "for health benefits" (67%). Voorrips et al. (1991) mentioned that the main reason for their elderly women not participating in exercise was "loss of interest". Buchner and Wagner (1992) intimated that "lack of motivation" is one of the common physical activity inhibitors of the elderly, often making an adequate program of exercise difficult to sustain in older adults. They feel that the health industry has an important role in both promoting exercise and motivating participation, which was also indicated as the area of needed focus for

Table 5. The reasons reported by elderly women exercisers for engaging in a regular exercise program.

REPORTED REASONS FOR EXERCISING[a]	EXERCISERS (n=33)	
	no.	%
To enhance sense of well-being	23	70
To improve flexibility	20	61
To strengthen muscles	18	54
To strengthen heart	17	52
To control/reduce body weight	13	39
To feel more energetic	13	39
To cope with stress	11	33
Other reasons	2	6

[a] Respondents could choose all that applied so total is greater than 100%.

Table 6. The reasons reported by elderly women non-exercisers for not engaging in a regular exercise program.

REPORTED REASONS FOR NOT EXERCISING[a]	NON-EXERCISERS (n=30)	
	no.	%
Not motivated to exercise	13	43
Other reasons	8	27
Lack the time	7	23
Do not enjoy exercise	7	23
Disability limits your activity	6	20
Feel all ready healthy enough	2	7
Doctor advised against exercise	1	3
Want to avoid the risk of injury	0	0

[a] Respondents could choose all that applied so the total is greater than 100%.

the present study's elderly non-exercising women. Since exercise must be prolonged for physiologic benefits to occur, program elements associated with continuous involvement in exercise may be far more important than the initial exercise regime itself (Buchner and Wagner, 1992).

Nine-day Mean Energy and Macronutrient Intake

The 9-day mean energy and macronutrient intakes among the two groups of elderly women are shown in Table 7. There were no significant differences in mean daily energy, protein, carbohydrate, total fat, saturated fat, polyunsaturated fat, monounsaturated fat, cholesterol, or dietary fiber consumption between the exercisers and non-exercisers, nor were there significant differences between the two groups with respect to the proportion of kcalories coming from the various types of fat, protein, or carbohydrate.

Mean daily energy intakes for both groups (exercisers 1626 kcal and non-exercisers 1530 kcal) were below the 1989 RDA for energy of 1900 kcal/day for women over 50 years, of average body size, engaging in light-to-moderate activity (NRC, 1989b). Daily energy requirements for adults past age 75 are projected to be lower than 1900 kcal due to decreased basal metabolic rate, decline in physical activity, and smaller body size, but nutrient needs remain essentially the same (NRC, 1989b; Young, 1992). In this sample, both the elderly women exercisers'

Table 7. Nine-day mean, median, and range for intakes of energy and macronutrients among elderly women exercisers and non-exercisers.

NUTRIENTS[a]	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			SIGNIFICANCE[b]
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Energy (kcal)	1624±364	1609	1046-2603	1561±291	1528	1111-2109	.46
Protein (g)	66±17	67	28-96	61±13	60	40-99	.14
(% kcal)	16±3	16	11-22	16±2	16	12-20	.20
Carbohydrate (g)	219±52	204	135-355	214±45	213	133-302	.67
(% kcal)	54±5	53	43-65	55±6	55	37-67	.63
Total fat (g)	57±16	59	27-91	57±16	54	27-111	.92
(% kcal)[a]	32±5	32	21-39	32±6	33	18-52	.50
Saturated fat (g)[a]	19±6	19	6-33	19±8	18	10-58	.85
(% kcal)[a]	10±2	11	5-16	11±4	11	7-27	.59
Polyunsaturated fat (g)[a]	13±4	13	5-20	11±4	11	6-26	.41
(% kcal)	7±2	7	4-12	7±4	7	4-11	.84
Monounsaturated fat (g)	20±6	20	9-33	20±5	19	9-33	.86
(% kcal)	11±2	11	7-16	11±2	11	6-16	.58
Cholesterol (mg)	197±78	192	48-355	181±68	171	105-382	.42
Fiber (g)	20±5	19	12-32	19±4	20	12-29	.52

[a] Nutrients compared between groups using Mann-Whitney U tests. All other nutrients compared using t-tests.

[b] Significance level $p \leq .05$. No significant differences found.

and the non-exercisers' mean ages (71.3 vs 74.9 years, respectively) were close to the 75 year old age range where requirements for energy are expected to be less than 1900 kcal/day (NRC, 1989b).

Second to basal metabolic requirement, physical activity is the largest component of total energy expenditure. Thus, subjects reporting regular exercise would be expected to require more kcalories than those of similar age and weight who were not engaging in regularly scheduled exercise. Although the difference was not significant, the exercisers as a whole ate somewhat more kcalories, about 60-80 kcal/day, than the non-exercising women. In a larger sample, such a difference may have reached statistical significance.

Although energy intake for both of our sample groups was lower than the 1989 RDA for energy (1900 kcal/day), both groups consumed substantially more kcalories than those reported in national surveys. Block et al. (1988) reported, according to the Second National Health and Nutrition Examination Survey (NHANES II) of 1977-1980, that the mean daily energy intake for white women aged 65 to 74 was 1309 kcal. Popkin et al. (1992) found the mean daily kcalorie intake among women beyond 65 years, studied in the 1987-88 National Food Consumption Survey (NFCS), to be 1374 kcal. The findings from this study were very close to those reported by Garry et al. (1982) who found, in a sample of healthy elderly, that the mean energy intake from 3-day food records for women 65-76 years old was 1685 kcal/day. Shepherd (1989) stressed the importance of

assessing physical activity as a component of nutrition surveys to put energy and nutrient intakes in perspective.

The composition of the diet is as important as the level of energy intake in maintaining energy balance and health for older adults (Young, 1992). There is strong evidence supporting a positive association between high fat intake and increased incidence of several degenerative diseases, namely cardiovascular disease and cancer (NRC, 1989a). Thus, the Dietary Guidelines (USDA/DHHS, 1990) recommend limiting the intake of fat to no more than 30% of kcalories from fat.

One of the research questions for this study was to determine whether elderly women who exercised were more likely to eat diets lower in fat, expressed in grams/day and as a percent of total daily kcalories, than those choosing not to exercise. No differences were found between exercisers and non-exercisers. Mean total fat intake of 57 g/day for both groups was slightly higher than the mean value of 51 g/day for white women aged 65-74 in NHANES I & II (Abraham and Carrol, 1981; Block et al. 1988) and 56 g/day for women in the 1987-88 NFCS (Popkin et al., 1992; Stephen and Wald, 1990). However, the total fat intake of the current subjects constituted a lower percentage of their energy intake (32% of kcalories for both exercisers and non-exercisers) and than that of the elderly women surveyed in these national studies (approximately 36% of kcalories in each). The mean saturated fat intakes as percentages of kcalories for both groups (10% for the

exercisers and 11% for the non-exercisers) were also less than those reported by Popkin et al. (1992) for elderly women nationally (about 12%-13%).

Carbohydrate intakes of both groups, accounting for 54% of kcalories for the exercisers and 55% of kcalories for the non-exercisers, although not significantly different from each other, were higher than the 48% of kcalories from carbohydrate for elderly females in the 1987-88 NFCS (Popkin et al., 1992). Thus, the additional daily kcalories consumed by women in the current study, approximately 300 kcalories greater than women in national survey data, appeared to be in the form of carbohydrate not fat.

Dietary fiber consumption for this sample of women was substantially greater than intakes reported for women over 65 in national surveys. Exercisers' and non-exercisers' intake of dietary fiber (20 g/day and 19 g/day, respectively) was almost 10 g/day higher than the intake of US elderly females in the 1977-78 and 1987-88 NFCS described by Popkin et al. (1992). Thus, choosing foods higher in dietary fiber seemed to be a component of the lower fat, higher carbohydrate diets of this sample in relation to US population surveys.

The proportion of each group who met the Dietary Guidelines' (USDA/DHHS, 1990) recommendations for fat and cholesterol consumption is displayed in Table 8. Table 7 provided only group data, whereas Table 8 addresses individuals. Differences among the sample groups concerning these guidelines are more visible in Table 8. Somewhat more of the elderly women exercisers (36%)

Table 8. The proportion of elderly women exercisers and non-exercisers who met current dietary recommendations for intakes of total fat, saturated fat, and cholesterol.

DIETARY RECOMMENDATIONS	EXERCISERS (n=33)		NON-EXERCISERS (n=30)		SIGNIFICANCE[b]
	no.	%[a]	no.	%	
Total fat ≤ 30% kcal/day	12	36	8	27	.41
Saturated fat ≤ 10% kcal/day	13	39	9	30	.43
Cholesterol ≤ 300 mg/day	28	85	28	93	.28

[a] Percents were compared between groups using chi-square tests.
[b] Significance level $p \leq .05$. No significant differences found.

than non-exercisers (27%) met the recommendation that total fat contribute no more than 30% of total energy intake, and somewhat more exercisers (39%) than non-exercisers (30%) were within the saturated fat recommendation of 10% or less of total kcalorie intake, although no significant differences were found between groups. Non-exercisers (93%) were somewhat more likely than the exercising women (85%) to meet the recommendation for consuming no more than 300 mg/day of cholesterol. In a larger sample of exercising and non-exercising elderly women, these differences may have been statistically significant. As a whole, this elderly sample came closer than average American seniors to meeting the Dietary Guidelines (USDA/DHHS, 1990) for fat and cholesterol consumption (Murphy et al., 1992; Patterson and Block, 1988). Only 18.7% of women aged 51+ years participating in the 1987-88 NFCS (Murphy et al., 1992) had diets providing less than or equal to 30% of energy from fat.

The postulated outcome that exercisers would consume less total dietary fat in grams and/or as a percentage of total energy intake than non-exercisers to was not supported by the data. Both groups indicated through questionnaire responses (Appendix K, question #15) that their greatest nutritional concern was fat intake (Bell et al., 1991, unpublished raw data). This concern about fat intake may have been one reason why no significant differences were found in fat consumption between the exercisers and non-exercisers. It appeared that these women, both those who reportedly exercised and those who did not, were following dietary habits in the

direction advocated by health experts, including the reduction of total fat and cholesterol intakes and increased complex carbohydrate and dietary fiber intakes. In our sample, consuming more kcalories as carbohydrate seemed to be an important behavior for keeping total fat intake relatively low for both groups.

Nine-day Mean Micronutrient Intake

Macronutrient intake is only part of overall diet quality. Indications from other studies (Armstrong et al., 1990; Contento and Murphy, 1990; Mensink and Arab, 1989; Munro, 1989; Voorrips et al., 1991) that meat, cheese, and vegetable consumption may differ between active and less active women, led to the decision to compare micronutrient intake between the elderly women exercisers and non-exercisers.

The 9-day mean intakes of micronutrients among the elderly women exercisers and non-exercisers are shown in Table 9. These results are based only on reported food intake, not supplementation. None of the subjects in either group reported being vegetarian. Compared to the 1989 RDA for women age 51+, both the exerciser and non-exerciser groups had 9-day mean intakes which met those recommended for all nutrients except calcium and zinc.

The only significant differences in 9-day mean micronutrient consumption between the two groups were carotene and total vitamin A intakes. Exercisers

Table 9. Nine-day mean, median, and range for intakes of micronutrients among elderly women exercisers and non-exercisers and a listing of the 1989 RDA.

MICRONUTRIENTS	RDA[c]	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			SIGNIFICANCE[d]
		Mean±SD	Median	Range	Mean±SD	Median	Range	
Total Vitamin A (RE)[a,b]	800	1468±615	1256	726-3453	1186±376	1137	605-2267	.03*
Retinol (RE)[a,b]	-	533±449	462	31-2709	538±257	467	166-1352	.49
Carotene (RE)[a]	-	926±387	847	379-1762	631±634	531	210-1637	.00**
Vitamin C (mg)	60	121±52	108	41-236	111±38	103	41-179	.39
Thiamin (mg)	1.0	1.4±0.3	1.3	0.8-2.2	1.4±0.3	1.3	0.9-2.2	.91
Riboflavin (mg)	1.2	1.7±0.5	1.7	0.8-2.7	1.7±0.4	1.8	1.1-2.3	.96
Niacin (mg)	13	18±4	18	10-26	19±5	19	7-30	.80
Vitamin B6 (mg)	1.6	1.7±0.4	1.7	0.9-2.6	1.6±3.5	1.8	1.1-2.3	.64
Vitamin B12 (ug)[b]	2.0	5.3±4.9	4.3	0.5-27.9	3.9±1.6	3.5	1.8-9.2	.28
Folate (ug)	180	276±74	278	138-434	251±65	250	125-377	.17
Calcium (mg)	800	796±299	748	254-1373	750±266	708	311-1636	.52
Iron (mg)	10	13±4	13	9-24	14±4	13	6-23	.39
Zinc (mg)	12	9±3	9	4-18	9±2	9	5-13	.19

[a] Retinol is vitamin A of animal origin, and carotene is the sum of provitamin A of plant origin. Both together give total vitamin A intake.

[b] Nutrients compared between groups using Mann-Whitney U tests. All other nutrients compared using t-tests.

[c] 1989 Recommended Dietary Allowances (RDA) for women 51+ years old.

[d] Significance level $p \leq .05$.

* $p < .05$, ** $p < .01$

consumed significantly more total vitamin A ($p=.03$) and carotene ($p=.00$) than the non-exercisers, although intakes of retinol were not different between the two groups. Mensink and Arab (1989) found similar results in the Heidelberg-Michelstadt-Berlin, Germany study evaluating the nutrient intakes of a sample of active and sedentary older women aged 65-75. Active older women reported higher carotene intake than their sedentary counterparts due to higher fruit and vegetable consumption, with few other observed differences in nutrient intake between groups.

Nutrient intakes meeting 75% of the RDA or above are generally considered adequate (Ahmed, 1992; Garry et al., 1982). The proportion of elderly exercisers and non-exercisers meeting or exceeding 75% of the 1989 RDA for women aged 51+, for 11 micronutrients is given in Table 10. No significant differences in proportion of each group meeting these standards were observed. Table 9 shows group data concerning micronutrient intakes, whereas Table 10 supplies information about individuals. All of the exercisers met at least 75% RDA for 5 of the 11 nutrients, (thiamin, niacin, vitamin A, folate, iron) while all of the non-exercisers achieved 75% adequacy for 4 of the 11 nutrients (thiamin, riboflavin, vitamin B12, and vitamin A).

The nutrients least adequate in the diets of both groups were calcium and zinc. Only 55% of the exercisers and 37% of the non-exercising elderly women met the 75% cut-off value for the zinc RDA. In a larger sample, this difference may have been statistically significant.

Table 10. The proportion of elderly women exercisers and non-exercisers meeting or exceeding 75% of the 1989 RDA for 11 selected micronutrients.

NUTRIENTS	EXERCISERS (n=33) ≥ 75% RDA[a]		NON-EXERCISERS (n=30) ≥ 75% RDA		SIGNIFICANCE[c]
	no.	%[b]	no.	%	
Thiamin	33	100	30	100	-
Riboflavin	32	98	30	100	.34
Niacin	33	100	28	93	.13
Vitamin A	33	100	30	100	-
Vitamin C	32	97	29	97	.94
Vitamin B6	29	88	25	83	.61
Vitamin B12	31	94	30	100	.17
Folate	33	100	29	97	.29
Calcium	23	70	22	73	.75
Iron	33	100	29	97	.29
Zinc	18	54	11	37	.16

[a] 1989 Recommended Dietary Allowances (RDA) for women aged 51+ years.
[b] Percents were compared between groups using chi-square tests.
[c] Significance level $p \leq .05$. No significant differences found.

According to national intake data (Ahmed, 1992; Murphy et al., 1990; Murphy et al., 1992), many elderly consume less than the RDA for calcium and zinc. One study among elderly women showed consumption of only about 500 mg/day of calcium per day instead of the recommended 800 mg (Ahmed, 1992). Goodwin et al. (1989) suggested that the elderly tend to avoid dairy products rich in calcium because they believe them to have a high fat and cholesterol content. National surveys show that low zinc intakes among senior women may be due to efforts to reduce red meat consumption (Ahmed, 1992; Block et al., 1988). The elderly women in this study were very concerned about dietary fat which might have influenced their intake of foods high in calcium and zinc.

Although energy requirements decrease with age, the elderly person's need for micronutrients appears to be at least as great as that of a younger adult (Ahmed, 1992; NRC, 1989b). Thus, the diets of older persons must provide foods of greater nutrient density relative to kcalories. Overall, the nutrient intake for the elderly women in this study indicate the apparent ability of these seniors to make food choices which satisfied most of their nutrient requirements, in spite of energy needs lower than those of younger individuals.

Food Group Consumption

One of the main intents of this study was to identify food groups that make a substantial contribution to dietary fat and fiber intake among elderly women to determine whether elderly women having different physical activity behaviors would demonstrate different food consumption behaviors. It has been suggested that elderly women who have adopted a more active lifestyle are more likely to display other health seeking behaviors, especially with respect to food choices concerning fat and dietary fiber content (Voorrips et al., 1991; Armstrong et al., 1990). It was expected that elderly women exercisers in this study would generally choose more lower fat and higher fiber foods than non-exercisers. With respect to food sources of dietary fat specifically, it was proposed, that exercisers would consume less total fat from the following fat-dense food groups: fats (butter and margarine), higher fat sweets, and the higher fat meat food categories.

The 30 food categories used for this study were adapted from the groupings developed by Popkin et al. (1989), based on total fat and dietary fiber content per 100 grams of each food item. Descriptions of these 30 food categories are given in Appendix J and are the same food categories used for comparisons between groups in Tables 11-15.

Food Group Use

The proportion of elderly women exercisers and non-exercisers who reported consuming foods in each of 30 food categories over the 9 days of analyzed dietary intake is listed in Table 11. Chi-square analysis showed a significant difference in lower fat cheese use, with 67% of the exercisers compared with only 40% of non-exercisers reporting having consumed foods in this category ($p=.03$). A significantly greater proportion of the exercisers (100%) reported consuming green and yellow vegetables than the non-exercisers (87%, $p=.03$). These differences in reported lower fat cheese and green and yellow vegetables use partially explained the exercisers' greater total vitamin A and carotene intakes (Table 9), and may reflect a greater health-consciousness among the exercisers than non-exercisers concerning the sources of dietary fat and fiber.

These results were similar to those reported by other researchers. Armstrong et al. (1990) mentioned that switching to lower fat dairy products was one method to reduce dietary fat reported by their recreational exercisers. Mensink and Arab (1989) found that senior German women, who were active, consumed significantly more fruits and vegetables per day than their sedentary peers. Also, a comparison of daily use of food groups among active and sedentary elderly women from data presented by Voorrips et al. (1991) showed a trend for active women to eat more vegetables and fruits than their sedentary peers.

Table 11. The percent of elderly women exercisers and non-exercisers who reported using foods in each of 30 food categories.

FOOD CATEGORIES	EXERCISERS (n=33) % USERS	NON-EXERCISERS (n=30) % USERS	SIGNIFICANCE[a]
1. Lower fat milk	97	93	.50
2. Higher fat milk	45	47	.92
3. Lower fat cheese	67	40	.03*
4. Higher fat cheese	88	87	.88
5. Lower fat beef, pork, mixed dishes	55	53	.92
6. Medium fat beef, pork, mixed dishes	58	73	.19
7. Higher fat beef, pork, mixed dishes	61	70	.43
8. Lower fat lunch meats, sausages	88	87	.88
9. Higher fat lunch meats, sausages	55	40	.25
10. Lower fat fish, seafood, mixed dishes	36	43	.57
11. Higher fat fish, seafood, mixed dishes	46	47	.92
12. Lower fat poultry, mixed dishes	64	67	.80
13. Higher fat poultry, mixed dishes	67	60	.58
14. All egg products	73	73	.96
15. All legume products	85	80	.61
16. Lower fat/higher fiber breads	94	97	.61
17. Higher fat/lower fiber breads	97	93	.50
18. Higher fat desserts	97	100	.29
19. Higher fat salty snacks	91	90	.90
20. Pasta, rice, cooked cereals	100	100	-
21. Lower fiber cereals	42	37	.64
22. Higher fiber cereals	85	83	.87
23. Higher fat grain mixtures	70	50	.11
24. Higher fat potatoes	48	53	.70
25. Green/yellow vegetables	100	87	.03*
26. Lower fiber other vegetables	100	100	-
27. Higher fiber other vegetables	97	97	.94
28. Butter/margarine	88	97	.20
29. Lower fat salad dressings	42	37	.64
30. Higher fat salad dressings	91	97	.35

[a] Significance level $p \leq .05$.

* $p < .05$ using chi-square tests.

Compared to American women aged 65 and over in the 1987-88 NFCS (Popkin et al., 1992), a greater proportion of both groups in the current sample used foods from a greater number of categories. Although a substantially higher proportion of women in the present study, compared with the percentage of 1987-88 NFCS participants, reported consuming foods from several lower fat food categories (lower fat milk, lower fat cheese, lower fat lunch meats, lower fat poultry, lower fat salad dressing) and higher fiber food categories (legume products, higher fiber cereals, lower fat/higher fiber breads, and all vegetable food groups), a larger fraction of women in this study also reported having consumed foods in many higher fat food categories (higher fat cheese, higher fat beef and pork, higher fat poultry, higher fat desserts, higher fat salty snacks).

There are several plausible rationales for use of a greater number of food categories among this sample of women compared with national surveys. First, food intakes were based on 9 days of food intake, 3 days taken from each phase covering a 14 week period, whereas the 1987-88 NFCS was based on only 3 days of diet records. The larger number of days analyzed might have increased the chance for a greater variety of foods to be consumed, and thus, partly explained the higher proportion of food group use in this sample as compared with national data. In addition, this study spanned 3 months which would favor increased food variability due to seasonality. A wide variety of foods are also available year round in the Northwest region. In addition, both groups in this sample seemed to be aware of

recommendations for dietary fat and fiber consumption, which they appeared to be achieving through selecting a wide variety of foods.

Furthermore, the elderly women in the present sample may have been more active as a whole, than those surveyed in national studies, which could have affected food selections. Krondl and coworkers (1982) found, in studying food use and factors affecting food behavior among a group of 400 men and women over 65, that individuals who were active used a greater variety of foods.

Food Sources of Dietary Fat and Fiber

Nine-day mean intake of total fat from each of the 30 food categories for elderly women exercisers and non-exercisers is displayed in Table 12. The exercisers in this sample consumed significantly fewer grams of total fat from lower fat milk (which included skim, 1%, and 2% milk) than non-exercisers ($p=.02$). The exercising women more frequently reported skim milk instead of 2% or even 1% milk than did non-exercisers. Since exercisers as a group had a somewhat higher calcium intake (Table 9) than the non-exercisers and at least as high a percentage of them reported drinking lower fat milk (Table 11), the exercisers were probably not drinking less milk, but rather choosing milk products with less fat than the non-exercisers.

The exercisers also obtained significantly more total fat from lower fat lunch meats and sausages than the non-exercisers ($p=.04$) (Table 12). This may be

Table 12. Nine-day mean, median, and range for intakes of grams of total fat from each of 30 food categories among elderly women exercisers and non-exercisers.

FOOD CATEGORIES	GRAMS OF TOTAL FAT						SIGNIFICANCE[a]
	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			
	Mean	Median	Range	Mean	Median	Range	
1. Lower fat milk	1.9	1.5	0.0-8.5	2.9	2.1	0.2-6.9	.02*
2. Higher fat milk	0.9	0.7	0.1-2.5	5.7	0.7	0.2-68.8	.68
3. Lower fat cheese	1.0	0.8	0.2-5.1	1.1	0.1	0.2-2.9	.55
4. Higher fat cheese	4.6	3.2	0.1-17.0	3.0	2.0	0.5-12.0	.06
5. Lower fat beef, pork, mixed dishes	1.9	1.4	0.3-7.4	1.9	1.2	0.4-9.9	.72
6. Medium fat beef, pork, mixed dishes	4.1	3.6	0.5-13.6	2.8	2.1	0.5-9.5	.10
7. Higher fat beef, pork, mixed dishes	3.7	3.6	0.1-8.2	2.6	2.0	0.1-5.4	.14
8. Lower fat lunch meats, sausages	1.9	1.5	0.2-6.4	1.4	1.0	0.0-7.8	.04*
9. Higher fat lunch meats, sausages	2.9	1.7	0.7-13.5	3.7	3.7	0.7-6.8	.13
10. Lower fat fish, seafood, mixed dishes	0.8	0.7	0.2-2.1	1.2	0.6	0.2-4.2	.98
11. Higher fat fish, seafood, mixed dishes	3.0	1.4	0.4-10.7	2.8	2.1	0.7-8.2	.60
12. Lower fat poultry, mixed dishes	0.8	0.3	0.1-2.1	0.8	0.5	0.0-3.2	.69
13. Higher fat poultry, mixed dishes	1.5	1.5	0.2-4.2	2.9	1.5	0.2-4.2	.38

[a] Significance level $p \leq .05$.

* $p < .05$ using Mann-Whitney U tests.

Table 12 (continued)

FOOD CATEGORIES	GRAMS OF TOTAL FAT						SIGNIFICANCE[a]
	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			
	Mean	Median	Range	Mean	Median	Range	
14. All egg products	1.7	1.7	0.1-4.1	1.6	1.6	0.0-3.8	.88
15. All legume products	3.3	2.3	0.1-13.9	2.5	1.7	0.0-9.0	.34
16. Lower fat/higher fiber breads	1.6	1.5	0.2-4.5	1.2	1.2	0.0-12.3	.10
17. Higher fat/lower fiber breads	2.6	2.1	0.4-8.9	2.8	2.1	0.2-12.3	.91
18. Higher fat desserts	8.5	8.5	0.7-26.8	8.5	9.0	0.3-14.7	.47
19. Higher fat salty snacks	3.7	3.1	0.2-13.5	3.7	2.0	0.3-15.2	.70
20. Pasta, rice, cooked cereals	1.1	0.9	0.0-3.0	0.8	0.7	0.0-2.6	.16
21. Lower fiber cereals	0.1	0.0	0.0-0.3	0.1	0.0	0.0-0.1	.72
22. Higher fiber cereals	1.4	0.3	0.0-15.2	1.5	0.6	0.0-7.0	.16
23. Higher fat grain mixtures	4.2	3.1	0.2-13.8	3.4	2.1	0.1-10.7	.37
24. Higher fat potatoes	2.5	1.6	0.3-8.9	1.7	1.2	0.6-3.8	.61
25. Green/yellow vegetables	0.1	0.1	0.0-0.7	0.1	0.1	0.0-1.2	.31
26. Lower fiber other vegetables	1.0	0.9	0.2-2.8	0.7	0.5	0.1-1.7	.11
27. Higher fiber other vegetables	0.2	0.2	0.0-2.1	0.2	0.1	0.0-0.5	.87
28. Butter/margarine products	5.2	4.2	0.4-13.9	6.0	5.2	0.4-14.6	.36
29. Lower fat salad dressings	0.4	0.3	0.1-0.9	0.5	0.3	0.0-2.1	.27
30. Higher fat salad dressings	4.4	4.6	0.3-12.6	4.4	4.2	0.9-16.4	.96

[a] Significance level $p \leq .05$.

* $p < .05$ using Mann-Whitney U tests.

indicative of an effort, among those who are more active, to consume lower fat varieties of meat products, even though their total fat consumption of the higher fat kinds of lunch meats and sausages and other meat food groups was not found to be significantly lower than that of the non-exercisers.

Nine-day mean dietary fiber intake from the 13 food categories contributing the most dietary fiber for both groups is shown in Table 13. Exercisers consumed significantly more dietary fiber than non-exercisers from two main food categories, legume products ($p=.02$) and lower fiber other vegetables ($p=.05$), which also supports the exercisers' higher total vitamin A and carotene intakes (Table 9). Voorrips et al. (1991) found that active elderly women tended to eat more vegetables and legumes compared to their sedentary peers. Other researchers have found that active people seem to exhibit a high degree of awareness about the importance of dietary fiber intake and that most vegetables and legumes are good sources (Armstrong et al., 1990; Contento and Murphy, 1990; Harris et al, 1989). Findings in a study of recreational exercisers aged 19 to 80 by Armstrong et al. (1990) showed that the more frequent exercisers and the older subjects were more likely to report eating more legumes, possibly as a low fat alternative to meat protein, although actual food consumption was not measured.

Table 13. Nine-day mean, median, and range for intakes of grams of dietary fiber from each of the highest 13 contributing food categories among elderly women exercisers and non-exercisers.

FOOD CATEGORIES	GRAMS OF DIETARY FIBER						SIGNIFICANCE[a]
	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			
	Mean	Median	Range	Mean	Median	Range	
1. All legume products	1.8	1.7	0.1-4.5	1.1	0.9	0.1-3.9	.02*
2. Lower fat/higher fiber breads	2.3	2.0	0.4-5.4	2.0	1.8	0.2-5.8	.33
3. Higher fat/lower fiber breads	0.7	0.7	0.2-2.0	0.8	0.5	0.1-5.8	.66
4. Higher fat desserts	1.0	0.8	0.2-2.7	0.6	0.5	0.0-1.6	.07
5. Higher fat salty snacks	0.7	0.6	0.0-3.9	0.9	0.4	0.0-3.9	.74
6. Pasta, rice, cooked cereal	1.6	1.2	0.0-4.3	1.7	1.1	0.2-5.4	.71
7. Lower fiber cereals	0.1	0.1	0.0-2.0	0.1	0.1	0.1-0.4	.49
8. Higher fiber cereals	2.1	1.4	0.1-9.2	2.3	2.3	0.2-12.8	.12
9. Higher fat grain mixtures	0.4	0.4	0.0-1.4	0.4	0.3	0.0-1.4	.50
10. Higher fat potatoes	0.5	0.3	0.1-1.7	0.3	0.2	0.1-1.0	.52
11. Green/yellow vegetables	1.2	1.1	0.1-2.6	1.5	0.9	0.2-2.7	.28
12. Lower fiber other vegetables	2.7	2.8	0.9-5.5	2.1	1.9	0.2-4.6	.05*
13. Higher fiber other vegetables	1.2	0.8	0.1-6.1	1.3	1.3	0.4-2.7	.18

[a] Significance level $p \leq .05$

* $p \leq .05$ using Mann-Whitney U tests.

Percent Contribution of Food Groups to Total Fat and Fiber Intake

The 9-day mean percent contributions, from highest to lowest, of the ten food categories contributing most to total fat intake among elderly exercisers and non-exercisers are presented in Table 14. These ten categories accounted for 64% and 63% of the total fat in the diets of exercisers and non-exercisers, respectively. In both groups, higher fat desserts were the prime contributors to total fat intake, (approximately 14% for exercisers and non-exercisers). The butter and margarine category contributed the second highest, and higher fat salad dressings the third highest proportion of fat in both groups. Higher fat salty snacks and lower fat milk ranked fourth and fifth, respectively, in percent contribution to total fat of the non-exercisers, compared with higher fat cheese ranking fourth and higher fat salty snacks coming in fifth as contributors to the exercisers' total fat intake.

Popkin and coworkers' (1992) analysis of the diets of persons aged $\geq$ 65, surveyed in the 1987-88 NFCS, found that, like the current sample, butter and margarine and high fat desserts were the two greatest contributors to total fat intakes. Among both the exercisers and non-exercisers, meats ranked much lower as a source of fat than rankings from the 1987-88 NFCS for elderly women (Popkin et al., 1992). The category for medium fat beef and pork products was the third major contributor of total fat for elderly women nationally (Popkin et al., 1992); but among these elderly non-exercisers and exercisers, this category ranked much lower, 8th and 9th, respectively. Four of the top ten food groups contributing to total fat

Table 14. Percent contribution of the top ten food categories to 9-day mean total fat intake and cumulative percent of total fat intake for elderly women exercisers and non-exercisers.

TOTAL FAT INTAKE					
EXERCISERS (n=33)			NON-EXERCISERS (n=30)		
FOOD CATEGORIES	% Contribution	Cumulative %	FOOD CATEGORIES	% Contribution	Cumulative %
1. Higher fat desserts	14.3	14.4	1. Higher fat desserts	14.3	14.3
2. All butter/margarine prroducts	7.5	21.9	2. All butter/margarine products	10.3	24.6
3. Higher fat salad dressings	7.0	28.9	3. Higher fat salad dressings	7.9	32.5
4. Higher fat cheese	6.5	35.4	4. Higher fat salty snacks	5.7	38.5
5. Higher fat salty snacks	6.0	41.4	5. Lower fat milk	5.4	43.6
6. Higher fat grain mixtures	5.1	46.5	6. Higher fat cheese	4.6	48.2
7. All legume products	4.9	51.4	7. Higher fat/lower fiber breads	4.5	52.7
8. Higher fat/lower fiber breads	4.5	55.9	8. Medium fat beef, pork, mixed dishes	3.8	56.5
9. Medium fat beef, pork, mixed dishes	4.3	60.2	9. All legume products	3.5	60.0
10. Higher fat beef, pork, mixed dishes	4.2	64.4	10. Higher fat beef, pork, mixed dishes	3.4	63.4

among those women in the 1987-88 NFCS were meat categories, while for the current sample only two meat categories, medium fat beef and pork and higher fat beef and pork, were among the top ten food groups contributing to fat intake. Women in the current sample were getting more of their dietary fat from non-meat protein sources, namely higher fat cheese and legume products, and from food groups containing hidden fats, such as higher fat grain mixtures, desserts, and salty snacks, than older Americans nationally. The finding that meat sources were contributing less to the total fat intakes for both groups may reflect that the elderly women in this sample as a whole are eating less meat. Low zinc intake, in comparison to the 1989 RDA, for both exercisers and non-exercisers (Table 9 and 10) also supports this conclusion, since zinc is a nutrient commonly found in meat.

The top ten food group contributors to 9-day mean dietary fiber intake for this sample are shown in Table 15. These ten food categories accounted for 72% and 68% of the fiber in the diets of exercisers and non-exercisers, respectively. The exercising women obtained the greatest amount of their dietary fiber from lower fiber other vegetables (including such foods as lettuce tomatoes, cucumbers, slaw) and lower fat/higher fiber breads, whereas the prime contributor for the non-exercisers was the higher fiber cereals category, followed by lower fiber other vegetables. The legume category ranked higher as a contributor of dietary fiber in the diets of exercisers than in those of non-exercisers. As indicated in Table 13, the exercisers consumed significantly more dietary fiber from legumes than the

Table 15. Percent contribution of the top ten food categories to 9-day mean dietary fiber intake and cumulative percent of dietary fiber intake for elderly women exercisers and non-exercisers.

TOTAL DIETARY FIBER INTAKE					
EXERCISERS (n=33)			NON-EXERCISERS (n=30)		
FOOD CATEGORIES	% Contribution	Cumulative %	FOOD CATEGORIES	% Contribution	Cumulative %
1. Lower fiber other vegetables	13.6	13.6	1. Higher fiber cereal	11.1	11.2
2. Lower fat/higher fiber breads	10.4	24.0	2. Lower fiber other vegetables	10.2	22.0
3. Higher fiber cereals	8.4	32.4	3. Lower fat/higher fiber breads	10.1	32.1
4. Pasta, rice, cooked cereal	7.9	40.3	4. Pasta, rice, cooked cereal	8.8	40.9
5. All legume products	7.5	47.8	5. Higher fiber other vegetables	7.0	47.9
6. Green/yellow vegetables	5.8	53.6	6. Green/yellow vegetables	4.5	52.4
7. Higher fiber other vegetables	5.7	59.3	7. Higher fat salty snacks	4.4	56.8
8. Higher fat desserts	5.0	64.3	8. All legume products	4.3	61.1
9. Higher fat/lower fiber breads	3.9	68.2	9. Higher fat/lower fiber breads	3.9	65.0
10. Higher fat salty snacks	3.3	71.5	10. Higher fat desserts	3.2	68.2

non-exercisers, and when compared with the contributors of total fat (Table 14), it appeared that the exercisers were more likely than the non-exercisers to use legumes as a main ingredient to replace meat in mixed dishes.

As a whole, this sample of elderly women had similar dietary fiber food sources as elderly women participating in the 1987-88 NFCS (Popkin et al, 1992). Higher fiber cereals, whole-grain breads and low-fiber vegetables were also the main contributors to dietary fiber intake among the elderly nationwide. However, for the women exercisers and non-exercisers in this study, the sources of hidden fat (higher fat desserts and salty snacks) were much larger suppliers of dietary fiber than among elderly women nationally.

The exercising elderly women who were studied were not more likely to consume less total fat from the highly fat-dense food categories: fats (butter and margarine), higher fat desserts, and higher fat meats (including the higher fat categories of beef and pork, poultry, lunch meats and sausages, and fish). However, the group of exercising women did make several lower fat and higher fiber food choices compared to the group of non-exercising women. A significantly greater proportion of the exercisers than the non-exercisers reported using lower fat cheeses and green and yellow vegetables (Table 11). Exercisers consumed significantly greater amounts of total fat from the lower fat lunch meats and sausages (Table 12), and significantly greater amounts of dietary fiber from legumes and lower fiber vegetables (Table 13). These differences may indicate a conscious effort

by the exercising elderly women to make lower fat and higher fiber food selections; although, there were no differences in daily dietary fat or fiber intakes between the two groups (Table 7).

Dietary Change Behavior

It is possible that patterns of nutrient intake reflect conscious efforts to select or avoid specific foods for expected health benefits. We examined reported dietary change behavior with respect to food sources of fat/cholesterol and food sources of dietary fiber in an attempt to detect whether conscious food choices helped explain intake differences between elderly women exercisers and non-exercisers. Several studies (Armstrong et al., 1990; Bausell, 1986; Blair et al., 1981; Contento and Murphy, 1990; Elward and Larson, 1992) have indicated that participation in exercise may influence other behaviors such as diet selection; however, none of these studies have supported this with dietary data.

A summary of self-reported changes (Appendix K, question #1) made over the past 10 years in the consumption of five concentrated fat/cholesterol foods and five foods high in dietary fiber is presented in Table 16. Foods were selected from those discussed in the Dietary Guidelines for Americans (USDA/DHHS, 1990) as those whose consumption could be altered to lower fat and increase dietary fiber intake. Exercisers were more likely than non-exercisers to report decreased

Table 16. Proportion of elderly women exercisers and non-exercisers who reported changes in the consumption of ten selected foods over the past 10 years.

REPORTED FOOD BEHAVIOR	EXERCISERS (n=33)		NON-EXERCISERS (n=30)		SIGNIFICANCE[b]
	no.	%[a]	no.	%	
Decreased Intake:					
Red Meat	31	94	23	77	.05*
Eggs	26	79	19	63	.17
Cheese	16	50	11	37	.34
Butter	13	35	15	50	.40
Sweets	17	53	14	47	.70
Increased Intake:					
Cereal	19	58	10	33	.05*
Fresh Fruit/Veg	21	64	12	40	.06
Breads or Pasta	12	36	10	33	.80
Rice or Potatoes	7	21	10	33	.27
Dried Beans/Peas	16	48	4	13	.00**

[a] Percents were compared between groups using chi-square tests.
[b] Significance level $p \leq .05$
* $p \leq .05$, ** $p < .01$.

consumption of red meat (94% vs 77%, p=.05) and increased consumption of both cereals (58% vs 33%, p=.05) and dried beans and peas (legumes) (48% vs 13%, p=.00). Elderly exercisers also reported a significantly greater total number of increases in higher fiber foods than non-exercisers (p=.04), but not more total decreases in higher fat/cholesterol foods (Table 17).

In an attempt to reduce the level of fat in the diets of US adults, the public has been advised to limit high-fat foods or choose lower fat alternatives and increase complex carbohydrate and dietary fiber intake (USDA/DHHS, 1990; DHHS, 1988). According to a study by Connor et al. (1992), in order for a lower fat diet to be attained, complex carbohydrates must be emphasized. Results from this study show that senior women who choose to exercise may be more inclined than those who do not, to make food choice changes which reflect efforts to increase dietary fiber (Table 16 and 17), as well as decrease dietary fat (Table 16).

Actual intake of dietary fiber (Table 13) showed that exercisers got significantly more dietary fiber from legumes and lower fiber other vegetables than non-exercisers. The exercisers were also found to have significantly higher total vitamin A and carotene intakes (Table 9) and were significantly greater reported users of green and yellow vegetables (Table 11) than the non-exercisers. Thus, the reported perceived food choice changes among this sample seem to coincide with and partly explain these actual food and nutrient intake differences between the two groups.

Table 17. The self-reported number of decreases in five selected high fat foods (fat change score) and increases in five selected high fiber foods (fiber change score) made over the past 10 years by elderly women exercisers and non-exercisers.

SCORE	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			SIGNIFICANCE[c]
	Mean±SD	Median	Range	Mean±SD	Media	Range	
Fat Change Score[a]	3.1±0.9	3.0	1.0-5.0	2.7±1.3	3.0	0-5.0	.21
Fiber Change Score[b]	2.3±1.5	2.0	0-5.0	1.5±1.5	1.0	0-5.0	.04*

[a] Fat change score = total number of decreases of the five high fat foods: red meat, cheese, eggs, sweets, and butter. Possible range 0 to 5.

[b] Fiber change score = total number of increases of the five high fiber foods: cereal, fresh fruit and vegetables, breads or pasta, rice or potatoes, and dried beans/peas. Possible range 0 to 5.

[c] Significance level $p \leq .05$.

* $p < .05$ using Mann-Whitney U test.

Other researchers (Armstrong et al., 1990; Bausell, 1986; Contento and Murphy, 1990; Elward and Larson, 1992) have found close relationships between exercise behavior and dietary behavior. Dietary concerns may be more prevalent among seniors due to stronger perceived susceptibility to illness (Bausell, 1986; McIntosh et al., 1990). Bausell (1986) found that the elderly aged 65+ were much more likely than younger respondents to comply with 7 dietary health-seeking behaviors, including restricting salt, fat, cholesterol, and sugar, and consuming more dietary fiber, vitamins/minerals and calcium. Furthermore, of the 177 older subjects, 23% reported regular exercise. Contento and Murphy (1990), studying the influences that are related to favorable dietary change in a group of men and women shoppers ranging in age from 18-75, found that those who reported decreasing intake of red meat and/or butter were also more likely to participate in regular exercise, although actual dietary data were not collected. Armstrong et al. (1990) investigated changes in food consumption based on a survey, and found that frequent exercise was associated with reported decreased consumption of red meat.

The results of the present study indicated that exercise participation appeared to be associated with several reported changes in food consumption behaviors in the direction of current dietary recommendations. These reported changes were, in fact, validated by actual food and nutrient intakes. Additional research is needed to identify more specifically the relationships between exercise and dietary change behavior.

Body Composition

Anthropometric Measurements

The third relationship studied was that exercising elderly women would have a leaner body composition than non-exercisers. Many studies have found that more active seniors tend to have body compositions more conducive to good health, including lower body mass index, waist-to-hip ratio, and percent body fat values, than do less active elderly (Armstrong et al., 1990; Bergman and Boyungs, 1990; Kubena et al., 1982; Thompson et al., 1982; Voorrips et al., 1991).

The anthropometric data for the two groups of elderly women are shown in Table 18. There were no significant differences between the exercisers and non-exercisers for weight, height, body mass index, waist and hip circumferences, waist-to-hip ratio, individual skinfold measurements, or percent body fat derived from the sum of four skinfolds.

Body Mass Index

Body Mass Index (BMI) is the ratio of weight in kg divided by height in m^2. Median weight (kg) by height (cm) for both exercisers and non-exercisers was between the 50th and 75th percentile range for women aged 65 to 75 according to standards given by Frisancho (1990) using data from NHANES I and II. Weight status by age for both groups would be classified as "average" according to these

Table 18. Anthropometric data for elderly women exercisers and non-exercisers based on the average values from three repeat measurement phases.

MEASUREMENTS	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			SIGNIFICANCE[c]
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Weight (lb)[a]	147.7±26.7	140.5	102-210	145.3±23.4	146.7	91-194	
(kg)	67.2±12.2	64.9	46-95	66.0±10.7	66.7	42-88	1.00
Height (in)	63.3±2.4	63.3	58-69	62.7±3.0	63.1	54-67	
(cm)	160.8±6.0	160.9	146-174	159.4±7.6	160.3	137-171	.40
BMI (kg/m^2)[a,b]	26.4±4.6	25.4	19-39	26.5±4.1	25.7	20-35	.85
Waist (in)	32.5±4.0	32.0	25-44	32.7±3.8	40.3	32-50	
(cm)	86.6±10.2	81.9	64-111	83.1±9.7	102.5	82-126	.83
Hip (in)[a]	40.8±3.9	39.5	35-52	40.8±3.5	40.6	32-50	
(cm)	82.6±10.2	100.3	88-133	103.5± 8.9	102.5	82-126	1.00
WHR[c]	0.8±0.1	0.8	0.7-0.9	0.8±0.1	0.8	0.7-1.0	.65

[a] Variables compared between groups using Mann-Whitney U tests. All other body composition variables compared using t-tests.
[b] BMI=Body Mass Index (kg body weight/height m^2).
[c] WHR=Waist-to-Hip Ratio (waist circumference [in]/hip circumference [in]).
[d] PBF=Percent Body Fat derived from the sum of 4 skinfold measurements (triceps, biceps, subscapular, suprailiac) using the age-specific, linear regression equation given by Durnin and Womersley (1974) for women 50+ years old.
[e] Significance level $p \leq .05$. No significant differences found.

Table 18 (continued)

MEASUREMENTS	EXERCISERS (n=33)			NON-EXERCISERS (n=30)			SIGNIFICANCE[e]
	Mean±SD	Median	Range	Mean±SD	Median	Range	
Triceps Skinfold (mm)	23.7±8.7	22.8	8-44	23.1±7.2	23.6	9-40	.77
Biceps Skinfold (mm)[a]	12.0±6.3	10.2	3-27	11.0±5.2	10.6	2-26	.78
Subscapular Skinfold (mm)	17.9±8.2	16.9	6-37	15.1±6.8	13.8	6-28	.15
Suprailiac Skinfold (mm)	22.4±11.0	20.6	7-46	22.0±9.0	22.8	6-44	.86
PBF (%)[d]	31.7±6.8	31.6	16-44	30.8±6.4	31.7	16-41	.62

[a] Variables compared between groups using Mann-Whitney U tests. All other body composition variables compared using t-tests.
[b] BMI=Body Mass Index (kg body weight/height m^2).
[c] WHR=Waist-to-Hip Ratio (waist circumference [in]/hip circumference [in]).
[d] PBF=Percent Body Fat derived from the sum of 4 skinfold measurements (triceps, biceps, subscapular, suprailiac) using the age-specific, linear regression equation given by Durnin and Womersley (1974) for women 50+ years old.
[e] Significance level $p \leq .05$. No significant differences found.

reference values (Frisancho, 1990). Voorrips et al. (1991) found a significant difference between mean body weights for active compared with sedentary older women of similar heights. Other researchers (Kubena, 1991; Yearick, 1980) have found little correlation between lower body weight and greater physical activity among healthy elderly women.

Median BMI values for the exercisers (25.4) and non-exercisers (25.7) were also within the 50th to 75th percentiles for standards of older American women (Frisancho, 1990). According to the National Research Council (NRC, 1989a), the most desirable range of BMI for elderly individuals is 25 to 29. Bray (1989) revealed greater mortality rates among those at both extremes of BMI values in younger and older Americans. However, BMI ratio measurements are complicated by the loss of height with age (Taren and Schler, 1990). Both groups in this study had median values at the low end of the recommendation from the NRC, but because of the wide range of values, some of the participants in each group were far above or below this acceptable range.

Waist-to-hip Ratio

The waist-to-hip ratio (WHR) has become a popular index for describing adipose tissue distribution quantitatively (Chumlea et al., 1992). Women with WHRs of > 0.85 are more at risk for cardiovascular disease, non-insulin dependent diabetes mellitus, and hormone-related cancers (Chumlea et al., 1992). Those who

are physically active tend to have low WHRs (Bergman and Boyungs, 1990; Kubena et al., 1991; Morley, 1986).

The exercisers and the non-exercisers in our sample did not differ with respect to waist or hip circumferences, and both groups had mean WHRs of 0.8. This again demonstrates the similarity between the two groups and their favorable distribution of fat with respect to risk for disease.

Kubena et al. (1991) found that women seniors under 75 years old, who considered themselves to be more active than their peers, had lower values for the anthropometric variables of BMI and waist circumference, but those women over 75 who rated their activity as being higher than their peers had no significant differences in anthropometries. Both groups of women in the present study had a proportion of women over 75, and the lack of differences between the two groups' anthropometric measurements coincides with Kubena and coworkers' findings.

Other researchers have stated that anthropometric parameters in the elderly vary with sex, age, health practices, and presence of certain medical conditions, so that when making comparisons, reference data for the same age range must be used (Frisancho, 1990; Kubena et al., 1991). The third National Health and Nutrition Examination Survey has planned to include 18 anthropometric measurements for elderly individuals which will hopefully provide some needed information about changes in body composition in the later years (Kubena et al., 1991).

Percent Body Fat Estimated from Skinfolds

The median skinfold thicknesses for both triceps and subscapular fatfolds for exercisers and non-exercisers were between the 25th to 50th percentile range of national standards for elderly women aged 65-75 (Frisancho, 1990).

The mean percent body fat (PBF) calculated from the sum of four skinfolds for the exercisers was 32% and was 31% for the non-exercisers. Compared to PBF reference standards (derived from the summed triceps and subscapular fatfolds only) for women age 65 to 69.9 years, values for the two groups fall between the 10th and 15th percentiles. Compared with reference PBF values for 70-74.9 year old women (Frisancho, 1990), the exercisers were between the 15th and 25th percentiles, while the non-exercisers were in the 10th to 15th percentile range. The PBF for elderly women in the present sample was determined using the sum of four skinfolds (triceps, biceps, subscapular, and supriliac), so comparisons with PBF values using only two site fatfold measurements should be made with caution. No standards determining PBF from four skinfolds have been published for American older women for comparison. On average, the subjects in both groups, tended toward leanness, and according to Frisancho's (1990) standards, would be classified as having a "below average" fat status for both of the above age group comparisons.

Percent body fat has been shown to be inversely related to weekly hours of training in aging women (Evans and Meredith, 1989). Bergman and Boyungs (1991) found that older women who engaged in a 10 week walking program

significantly lowered their PBF and total body fat, as well as increasing their lean body mass. Comparisons of elderly controls with those who had increased their activity levels revealed that greater exercise increased lean body mass at the expense of body fat within 4 months. Miller et al. (1985) examined the relationship between body fat, diet composition, energy intake and exercise in adults aged 19-71, and found that exercise frequency was related to leanness. Other researchers, however, have failed to find significant differences in the amount of body fat in comparisons of older adults with differing activity patterns. Parizkova and Eiselt (1966) reported that physically fit seniors in their study had only slightly less body fat than unfit seniors. They concluded that the amount of physical activity their fit seniors were engaging in may not have been sufficient to affect body composition at this age, especially among healthy seniors. Yurkiw et al. (1983) further pointed out that body composition and its changes through the life span are affected by both genetic and other factors such as past and present health, physical activity, and food energy intake.

In this study, elderly women exercisers did not have leaner body compositions than the non-exercisers. There were no significant differences between exercisers and non-exercisers in any of the anthropometric values measured: height, weight, BMI, waist and hip circumference, WHR, individual skinfold thicknesses, or PBF. The elderly women exercisers and non-exercisers did not differ in body fatness nor in body fat distribution, and as a whole were relatively lean according to

Frisancho's (1990) standards. As other researchers have suggested, body composition is complicated by many factors in older women, and therefore, relationships with one variable alone, exercise participation, may not be sufficient to identify variability between two groups (Chumlea et al., 1992; Elward and Larson, 1992; Mensink and Arab, 1989; Voorrips et al., 1991; Yurkiw et al., 1983).

Validation of Percent Body Fat Estimated from Skinfolds

Four-site skinfold testing has been shown to be a valid indirect method for estimation of body fatness in the elderly when age-specific, linear regression equations are used (Chumlea et al., 1992; Chumlea et al., 1991; Deurenberg et al., 1989b; Durnin and Womersley, 1974; Lohman, 1981; Lukaski, 1987). However, the accuracy of skinfold measurements depend on the precision and skill of the measurer (Lukaski, 1987). Furthermore, changes in fat distribution and skin compressibility with age complicates the interpretation of body fat values estimated from calipers.

To assess the accuracy and precision of our four-site skinfold caliper measurements in determining percent body fat for this sample of elderly women, we were able to compare the PBF estimated from our skinfold measurements with the body fat values obtained from dual energy X-ray absorptiometry (DEXA) for five of our subjects who were also enrolled in a separate bone density study. Both bone mineral calcium and percentage of fat of non-bone tissue can be measured with

DEXA (Jensen, 1992). It is considered technologically advanced equipment and possibly provides the best estimate of total body fat of any indirect technique presently available (Jensen, 1992; Wilmore, 1983).

Although not analyzed statistically, an evaluation of PBF of these five subjects is shown in Table 19, and indicates that the percent error for body fat percentage using skinfolds compared to the DEXA values ranged from just over 3% to 7%, the trend showing the smallest errors for the subjects with lower body fat. The mean percent error was approximately 5%, comparable to the 3-6% standard estimated error cited in the literature for the correlation of caliper measurements with hydrostatic weighing and other absorptiometry techniques (Jensen, 1992; Durnin and Womersley, 1974; Lohman, 1981; Lukaski, 1987). Although only five of the subjects' PBF values using skinfolds could be cross-validated with those obtained using DEXA, the relatively close agreement between these methods supports the validity of the body fat measures from skinfolds.

Table 19. Comparisons of percent body fat (PBF) values obtained through dual energy X-ray absorptiometry (DEXA) and four-site skinfolds for five elderly women subjects.

Subjects[a]	DEXA (PBF)	Skinfolds[b] (PBF)	Magnitude and Direction of Difference between Skinfolds and DEXA	Percent Error of Difference (%)
1	29.7	25.6	-2.1	7.0
2	24.5	23.7	-0.8	3.3
3	45.7	43.3	-2.4	5.3
4	27.2	28.1	+1.9	7.0
5	33.8	35.3	+1.5	4.4
			Mean Percent Error (%)	5.4

[a] Subjects 1-4 were elderly women exercisers and subject 5 was a non-exerciser.
[b] The sum of the triceps, biceps, subscapular, and suprailiac skinfolds were used for estimation of PBF using the age-specific, linear regression equation given by Durnin and Womersley (1974) for women 51+ years old.

Implications and Recommendations for Further Research

In this study, elderly women exercisers and non-exercisers were compared with respect to their nutrient intake, food sources of dietary fat and fiber, reported changes in food consumption, and body fatness. Although there were a limited number of significant differences between the exercisers and non-exercisers with respect to food consumption habits and body composition, this sample as a whole had dietary patterns which closely resembled the current dietary recommendations with respect to eating a low fat, high fiber diet, while meeting most micronutrient requirements despite lowered energy intakes relative to younger adults. The elderly women in this sample appeared to be aware of nutritional guidelines and were translating them into food behaviors.

The elderly women regular exercisers in this study appeared to have adopted several more beneficial dietary behaviors compared with the non-exercisers. The food choices made by the exercisers compared with the non-exercisers (greater use of lower fat cheese, green and yellow vegetables; greater fiber intake from legumes and lower fiber vegetables) led to higher intakes of total vitamin A and carotene, and exercisers were more likely to have indicated having made changes in food consumption in the direction of the current recommendations (decreasing intake of red meat, and increasing intake of cereals and legumes).

The findings of this study have nutritional implications for elderly women. Involvement in exercise may be a motivator for positive changes in other health-enhancing behaviors, such as food intake. Thus, the inclusion of an exercise component in health-promotion programs for the elderly, may have added benefits.

This sample as a group, was fairly well-educated and health-conscious with respect to awareness of basic dietary recommendations. In a sample in which the exercisers and non-exercisers were more different from each other, it could be expected that more differences in food and nutrient intakes and body fatness would be found in relation to exercise participation. Additional studies should utilize a larger sample of elderly women with more diverse socioeconomic backgrounds and knowledge of nutrition.

Because of the rapidly increasing proportion of Americans over the age of 65, there is a great demand for research in all areas of health-related issues, especially among elderly women, who out number men substantially by age 85. There is a vital need to more fully understand the aging process and the extent to which dietary intake and physical activity influence the health of women in their later years. More research is needed on the potential interrelationships between food choice, nutrient intake and body composition with exercise participation among older women. The wide array of factors that influence food selection for the elderly population and the lack of data on body composition changes with age among

women complicate the examinations of these factors in relation to physical activity patterns.

Few studies have explored the actual nutrient requirements for those well beyond 51 years of age, for which the current RDA are based. Further investigation into the mode of exercise as well as the intensity, frequency and duration of the activities which will be most beneficial for health and functional capacity is warranted so that appropriate activity programs can be developed and promoted for this group. For sedentary elderly, subsequent research needs to focus on decreasing the barriers for activity and ways of fostering motivation for participating in exercise. Additional research should also focus on how the nutritional needs and distribution of body fat of elderly women are affected by extremes of inactivity and activity. Furthermore, a real need remains for the establishment of adequate standards for anthropometric measurements of the aged and an analysis of the most accurate instruments sensitive to age-related changes for the assessment of body composition among elderly women.

SUMMARY AND CONCLUSIONS

Little data exist on the health-seeking behaviors of older adults. Because of the rapidly increasing proportion of Americans over the age of 65, there is a great demand for research in all areas of health-related issues, especially among elderly women who out number men substantially by age 85. There is a vital need to understand more fully the aging process and the extent to which dietary intake and physical activity influence the health of women in their later years.

It was the intent of this study to investigate whether elderly women with different patterns of physical activity also differed in their dietary patterns and body composition measures. Data were collected to examine the questions of whether elderly women who chose to engage in a regular exercise program would also have higher micronutrient intakes, make lower fat and higher fiber food choices, report having made more dietary changes in the direction of current recommendations, and have leaner body compositions, than those women who reported not participating in a planned exercise regime.

Thirty-three elderly women exercisers and 30 non-exercisers ranging in age from 65 to 98, enrolled in this 14 week study. Each subject kept three, 7-day food records at 5 week intervals. Nutrient intake was estimated from 9 days of food records, 3 predetermined days from each recording period, using the Food Processor

II software. Food sources of dietary fat and fiber were determined using a 30 food category scheme adapted from Popkin and coworkers (1989), in which foods were grouped based on their fat and fiber content per 100 g. Body composition assessment included estimation of percent body fat from four-site skinfolds, and measurements of waist-to-hip ratio and body mass index for evaluation of fat distribution.

Exercisers and non-exercisers had similar energy and macronutrient intakes. Their total fat, saturated fat, and dietary fiber gram intakes were not significantly different. Both groups' mean intakes as a percent of kcalories from total fat (32%), saturated fat (about 10%), and dietary fiber (about 20 grams) were closer to dietary recommendations than national survey intake data for US elderly women. In each group, more than 80% of the subjects consumed less than 300 mg/day of cholesterol. Exercisers consumed significantly more total vitamin A ($p=.03$) and carotene ($p=.00$) based on 9-day mean values. A great portion of both groups did not meet at least 75% of the RDA for calcium and zinc intakes. A significantly larger proportion of the exercisers than non-exercisers reported using lower fat cheese ($p=.03$) and green and yellow vegetables ($p=.03$), which helped to explain their higher total vitamin A and carotene intakes.

Elderly women exercisers did not consume significantly less total fat from concentrated fats (butter and margarine), higher fat desserts, or higher fat meat groups, than non-exercisers, which contradicted what had been postulated.

Exercisers did obtain a significantly greater amount of their total fat from lower fat lunch meats and sausages than the non-exercisers ($p=.04$), which may indicate their intention of eating lower fat meat varieties. However, the exercisers did not consume less total fat than the non-exercisers from any of the other higher fat meat categories. The exercisers in this sample consumed significantly fewer grams of total fat from lower fat milk (which includes skim, 1%, and 2% milk) than non-exercisers ($p=.02$). The exercising women more frequently reported skim milk instead of 2% or even 1% milk than did non-exercisers. Since exercisers as a group had a somewhat higher calcium intake, exercisers were probably not drinking less milk, but rather choosing milk products with less fat than the non-exercisers. The categories of legumes ($p=.02$) and lower fiber other vegetables ($p=.05$) supplied significantly greater amounts of dietary fiber for the exercisers compared with the diets of non-exercisers. Overall, these differences in food choices led to higher total vitamin A and carotene intakes for the exercisers compared to the non-exercisers.

A significantly greater percentage of the exercisers than non-exercisers reported having made dietary changes over the past 10 years suggested by the 1990 Dietary Guidelines, including decreasing red meat intake ($p=.05$) and increasing consumption of cereals ($p=.05$) and legumes ($p=.00$). These reported perceptions for increasing dietary fiber food sources paralleled actual differences found in food intake.

There were no significant differences found between the exercisers and non-exercisers with respect to the body composition parameters of body mass index, waist-to-hip ratio, and percent body fat. These elderly women as a whole were found to be of average weight, height, and below average in body fatness compared to standards for this age range (Frisancho, 1990). Many researchers (Durnin and Womersley, 1974; Evans and Meredith, 1989; Jensen, 1992; Thompson et al., 1982) have identified a large number of factors which influence body composition in the elderly, of which regular exercise is only one. The actual amount, mode, and intensity of exercise necessary to make measurable changes in body fat in elderly women are still unclear. The lack of differences observed between the exercisers and non-exercisers in body composition parameters in the current study may be due in part to the homogeneity and health-consciousness of the sample as a whole. Additional research is needed to distinguish the interactions and influences of age, energy intake, and exercise behavior in body composition assessment among elderly women.

In summary, the elderly women regular exercisers in this study appeared to have adopted several beneficial dietary behaviors compared with the non-exercisers. These findings show that engaging in regular exercise may be a positive motivator for dietary intake. However, overall, there were few significant differences found between the exercising and non-exercising respondents with respect to nutrient intakes, food selection, and anthropometric measurements. The wide array of

factors that influence food selection for the elderly population and the lack of data on body composition changes with age among women complicate the examinations of these factors in relation to physical activity patterns. More research is needed on the potential interrelationships between food choice, nutrient intake, and body composition with exercise participation among older women.

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APPENDICES

APPENDIX A

Screening Form

6/91

Telephone Screening for Diet/Exercise Study

Thank you for calling.

If they want more specifics about the study to start with:

1. Starts early August and ends before Thanksgiving but they don't have to be in town the entire time, just not plan to be gone for more than two weeks at a time during that period.

2. They don't have to eat or do anything different.

3. They have to be willing to keep 3 weekly records of diet and activities and have a student come to their house to review it.

4. They have to be able to get themselves to OSU and live within a 30 minute drive.

5. They have to be willing to come to OSU 3 times for measurements. Weight; height; caliper measurements at upper arm, back and just below the waist; bioelectrical impedance, mobility from sitting and lying prone positions, fill out questionnaires about their opinions. And to follow a few directions about fluids the day of each visit. (Maximum of 3 hours per time).

6. They have to be willing to fill out confidential health history.

Much of this information is included in the following set of questions and it will be faster if you can convince them to let you start taking down information about them and giving them information about the study at the same time.

1. Your Name _____

_____
(and how do you like to be addressed?)

2. Your Address and Phone Number

_____
(street address)

_____
(city and zip code)

_____
(phone number)

3. Will you be able to provide your own transportation to OSU?
yes___ no___
If no, explain that we have no way to get them here and transportation is a condition of participation. They may be able to arrange rides with a friend. If not, "I'm sorry, it's just not possible to participate unless you can get here for appointments. Would you like us to keep your name for future studies? Thank you for your time and interest.

4. Do you live within a 30 minute drive of OSU?
yes___ no___
(This would include Corvallis, Albany, Adair, Philomath)

5. Do you have any condition which would prevent your walking for 30 minutes at a time?
yes___ no___
If yes, try to make sure they understand they will not be asked to actually do it. I would say people who have severe arthritis, emphysema, hip problems, foot problems would fall into the "yes" category.

6. Do you have any condition or expect any situation which would change your usual diet or activity pattern during this period?

If yes, ask to describe_____

Diet -_____.

Activity -_____

7. Do you currently participate in any regular activity (either on your own or in a formal class) designed to maintain or improve your physical fitness?

yes___ no___

If no, a) Have you ever participated in such an activity? If yes,
a) How long ago was the last time you did?_____
b) What activity was it?_____
c) Why did you stop?_____

If yes, a) What activity is that? _____
b) How often do you do this?_____
c) For how long do you do it each time?_____
d) For how long (months, years) have you been doing this activity?_____

8. Do you expect to be out of town for more than 2 weeks at one time from early August up to Thanksgiving.
yes_____ no_____

If yes, when and for how long? If they are gone for a longer period it will probably alter their eating and activity patterns. If yes, get the description and say you will review it with the Project Leader and get back to them promptly.

9. If you didn't explain the protocol at the beginning of the conversation do so at this point. Or you may need to review some of the points.

10. Would you like to participate in the study?

yes___ no___.

If yes,

11. Would you be willing to agree not to start a weight reduction or weight gaining diet or change your exercise pattern between now and Thanksgiving?
yes__ no___

If no, "Thank you for your interest."

12. If they are a viable prospect tell them you will send them a confidential health questionnaire form and Informed Consent form for them to complete and mail back in the envelope provided by _____.

Let's set up an appointment now for your first measurement lab in August. _____.

Thank you very much. We will be counting on you to be one of the study participants and are looking forward to working with you for the next few months. If you have any questions about the forms please don't hesitate to call me at_____.

APPENDIX B

Informed Consent Document

Informed Consent Document

Thank you for volunteering to participate in a 14-week nutrition research study (August 4 - November 22) to provide information about the diet, activity patterns and body composition of older women. Please read the following agreement carefully and sign it indicating your informed consent to participate in the study:

AGREEMENT:

During the 14 weeks of the study I will continue to follow my usual eating and activity patterns. I will keep a record of everything I eat and drink and my activities during the first, seventh and fourteenth week of the study. At the end of each of these weeks I will meet with a researcher at my home to review my recorded information. I will also come, by appointment, to the OSU Dept. of Nutrition and Food Management, Milam Hall, for height, weight, body fat and physical mobility measurement, during the first, seventh and fourteenth week of the study. At these sessions I will also complete some short questionnaires regarding my opinions about foods, physical activity and health. Each session will take no more than three hours.

All of the personal, diet, activity and health information I provide, and all data from the physical measurements taken will be held in strictest confidence. I understand that I will be treated with respect for my privacy during the study and that there is no reason to expect any side effects from participating. I agree to answer the questions about my personal health requested on my Confidential Information Form and I am aware that some people find this stressful. Physical mobility measurement involves stretching from the waist in a sitting position and there is always a remote possibility of minor injury or soreness to joints or muscles. At the end of the study I will receive a summary and explanation of the nutrient content of my usual diet, my body composition and physical mobility measurements. I understand that I can withdraw from the study at any time, but my signature indicates my intention, at this time, to complete the entire fourteen week study.

If you have any questions about this research or your participation please contact the Project Leader, Connie Georgiou at 737-0965.

_____ ____ _____ ____

Participant's signature Date Project Leader's signature Date

APPENDIX C

Confidential Information Form

TEAR SHEET

This cover sheet is the only reference to your name and will be discarded upon receipt and your Participant Identification Number only will be used on all research materials.

Confidential Information Form

Nutrition Study

Your Name

_____

Participant Identification #_____

Confidential Information Form
Nutrition Project

1. Date of Birth:_____
Month/Day/Year

2. Place of residence: Check one.
Individual house, duplex, or mobile home __
Apartment (no meals or home services provided) ___
Apartment (meals or home services provided) ___
Describe which meals and services you receive:
_____
_____
Other (Please specify)_____

3. Racial/Ethnic Identity
Asian __ Hispanic __
Black __ Native American __
Caucasian __ Other (specify) __

4. Marital Status: Please specify: _____

5. Do you live: Alone? ___
With other family member(s) ?___
If so, who?_____
With one or more non-family members? ___

6. Present Height: _____ft.____in. Present Weight_____lbs.
(without shoes) (without shoes)

7. What was your tallest lifetime height?_____

8. Has your weight increased or decreased more than 10 pounds over the past two years? ____Yes ___No
If yes, please describe the time and circumstances
_____
_____
_____

9. What was your highest lifetime weight? (non-pregnant)_____lbs.

10. Do you smoke? ____Yes ___No

11. Do you take any vitamin, mineral or other nutritional supplements? ___Yes ___No

If yes, please list them by brand name and specify how often you take each one.
_____
_____

12. Do you currently take any prescription medications on a regular basis? ___Yes ___No
If yes, please list and specify how often taken

_____

_____

_____

13. Have you been hospitalized during the past two years for any reason? ___Yes ___No
If yes, for how many total days? _____

14. Do you follow any kind of special diet? ___Yes ___No
If yes, please specify:

_____

_____

If yes, who recommended this diet? _____

15. In general, would you say the healthfulness of your diet is:
Excellent __ Very Good __ Good __ Fair __ or Poor? __

16. Do you have trouble biting or cheving food? Yes __ No __
If yes, do you think you have this trouble because of:
Poor fitting dentures? ___
Loss of teeth or dentures? __
Other reasons (please specify) _____

17. Would you describe your appetite as:
Excellent __ Good __ Fair __ or Poor? __

18. Do you currently have any condition or limitation which prevents you from your usual physical activities? ___Yes ___No
If yes, please explain:

_____

_____

_____

19. Has a doctor ever told you that you have:

diabetes ___	allergies ___
high blood pressure ___	cancer ___
osteoporosis ___	ulcers ___
bone fracture ___	angina ___
arthritis ___	

heart problems (specify)_____
spastic colon/diverticulitis ___
mental depression requiring medication ___
cirrhosis ___

For those you checked, please give year of diagnosis and your current status with respect to the condition:

_____

_____

20. Do you take estrogens? ___Yes ___No

21. Are you a vegetarian? ___Yes___No
If yes, circle the type of vetgetarian diet you follow:
Lacto-ovo Vegan Other _____

22. Do you have any regularly planned physical exercise activity?
___Yes ___No

If no, go on to question #24.

23. If yes, what is the type of activity? (i.e., walking, swimming, aerobics, etc._____

How many times each week or month do you do this activity?
_____times per week or _____times per month

About how many minutes, on the average, do you spend at this activity each time? _____minutes

For how long would you say you've been doing this type of physical activity, or another type, on a regular basis?
Started during the past 6 months _____
Six months to one year _____
More than one year but less than two years ____
More than two years_____. If so, how many?____

24. If no, have you previously engaged in regularly planned physical activity on a regular basis? ___Yes ___No
If yes, how long ago? ____

25. Are you currently employed? ___Yes ___No
If yes, what is your occupation?_____
Do you work full time __ or part-time __?

If no, have you ever been employed? ___Yes ___No
If yes, what was your occupation? _____
Did you work full time ___or part time___?

26. Would you describe your current household income as:
Less than $10,000 per year ___
Between $10,000 and $20,000 per year ___
Between $20,00 and $30,000 per year ___
Between $30,000 and $40,000 per year ___
Greater than $40,000 per year ___
I prefer to keep this information private ___.

27. What is the highest level of education you have completed ?

____ Less than high school diploma
____ High school diploma
____ Some college but not a degree
____ Bachelor's degree
____ Master's Degree
____ Doctorate
____ Professional training or certification

APPENDIX D

Activity Questionnaire

Subject #: _____

WEIGHT HISTORY / ACTIVITY QUESTIONNAIRE

1. At the present time, how would you describe your health ?

___ Excellent ___ Fair

___ Good ___ Poor

2. At the present time, do you consider yourself to be:

_____ Very underweight _____ Somewhat overweight

_____ Somewhat underweight _____ Very overweight

_____ About the right weight

3. Have you ever been on a diet to reduce your body weight? YES or NO

If YES:

a. Please indicate during which periods of your life you have dieted? (place a check in front each appropriate age range)

___ 10-20 years old ___ 60-70 years old

___ 20-30 years old ___ 70-80 years old

___ 30-40 years old ___ 80-90 years old

___ 40-50 years old ___ 90-100 years old

___ 50-60 years old

b. Which of the following sources of weight reduction diets have you used during the past 10 years ? (check all that apply)

___ Commercial diet program (e.g. Weight Watchers, Nutri-Systems)

___ Doctor/dietitian recommended diet

___ Over-the-counter liquid diet (e.g. Slim Fast)

___ Over-the-counter diet pills (e.g. Dexatrim)

___ Popular diet book weight reduction plan

___ Self-designed diet

___ Other _____

4. Do you weigh MORE, LESS, or ABOUT THE SAME now, compared to 20 years ago ?

   a. If you weigh MORE now, to what do you attribute your weight gain ? (check all that apply)

   _____ Increased calorie intake
   _____ Decreasing energy needs
   _____ Decreased physical activity
   _____ A weight gain diet
   _____ Poorer food choices
   _____ Other_____

   b. If you weigh LESS now, to what do you attribute your weight loss ? (check all that apply)

   _____ Decreased calorie intake
   _____ Decreased interest in food
   _____ Increased physical activity
   _____ Specific illness_____
   _____ Better food choices
   _____ Other_____
   _____ A weight loss diet

5. As a teenager or younger adult, did you participate in sports ? YES or NO

   If YES, what type ?_____

6. During which of the following periods of your life, if any, did you engage in what you would call a regular program of vigorous exercise? (please check all that apply)

   ____ less than 20 years old
   ____ 60-70 years old
   ____ 20-30 years old
   ____ 70-80 years old
   ____ 30-40 years old
   ____ 80-90 years old
   ____ 40-50 years old
   ____ 90-100 years old
   ____ 50-60 years old
   ____ None of the above

7. During the past 10 years, how would you describe changes in your ability to perform physical activities that INCREASE YOUR HEART RATE, such as going up stairs, walking fast, or bicycling ? (please check one)

   ____ It has increased
   ____ It has remained the same
   ____ It has decreased

8. During the past 10 years, how would you describe changes in your ability to perform physical activities that require STRENGTH, such as lifting or carrying a load, getting up from a seated or lying down position ? (please check one)

___ It has increased ___ It has remained the same

___ It has decreased

9. During the past 10 years, how would you describe changes in your ability to perform physical activities requiring FLEXIBILITY, such as bending from the waist, or turning to look or reach behind you? (please check one)

___ It has increased ___ It has remained the same

___ It has decreased

10. Do you do any type of stretching on a regular basis to maintain or improve your mobility ? YES or NO

11. Have you ever, during the past 10 years, experienced persistent low back pain ? YES or NO

12. How would you describe your usual activity pattern NOW ? (check only one)

___ I am sedentary pretty much all the time. (Go to question #14)

___ I am quite sedentary on most days, but occasionally exercise vigorously. (Go to question #14)

___ I am quite sedentary during the day, except for my regularly scheduled vigorous exercise. (Go to question #13)

___ I am energetic in my usual chores, hobbies and leisure time activities, although I do not participate in any regularly scheduled vigorous exercise. (Go to question #14)

___ I am energetic in my usual chores, hobbies and leisure time activities, and I also participate in regularly scheduled vigorous exercise. (Go to question #13)

___ Other _____

13. From the following choices, please choose the most important reason(s) WHY you exercise: (check all that apply, and if more than one, please rank your reasons)

___ To cope with stress ___ To improve your flexibility

___ To feel more energetic ___ To control/reduce your weight

___ To strengthen your heart ___ To enhance your sense of well-being

___ To strengthen your muscles ___ Other _____

Do you usually exercise: (check all that apply)

___Alone ___With relatives ___ With friends ___ In large group

14. From the following choices, please choose the most important reason(s) you DO NOT participate in regularly scheduled vigorous exercise: (check all that apply, and if more than one, please rank your reasons)

_____ You are already healthy enough
_____ You lack the time
_____ Doctor advised you not to
_____ Disability limits your activity
_____ You are not motivated to exercise
_____ You want to avoid the risk of injury
_____ You do not enjoy exercise
_____ Other _____

15. From the following sources of fitness information, please check the THREE you would say have influenced you the most over the past 10 years:

_____ Magazines _____
_____ Books on exercise _____
_____ Professional journals _____
_____ Newspaper _____
_____ Television Program _____
_____ Doctor / Dietitian
_____ Family and/or friends
_____ Exercise Instructor / Physical therapist
_____ Other _____

APPENDIX E

Seven-Day Food Record Instructions and Recording Form

Instructions for

7-DAY FOOD RECORD

Record everything you swallow, including water and any nutrient or food supplements you take. You do not need to record medications you take.

Record, for each day, only the amount of each food you ACTUALLY EAT - not necessarily the amount that was on your plate.

Keep each day's food record by clock time of day, starting with the first thing you eat or drink after 5:00 AM and continuing until 5:00 AM the next day. If you get up and eat or drink during the night, record this on the previous day's record, not on the next day's. Group the items you eat and/or drink together next to a single clock time.

Begin each day's record on a new "24 Hour Food Record" form. If you run out of lines go on to the back of the page marked "continued". A sample day's record follows the instruction pages.

*Time - This means clock time, for example 7:00 AM or 3:30 PM.

**Type, Preparation and Amount of foods - On the following pages are examples of descriptors for different categories of foods, their amounts and preparation methods.

***Where Eaten - For example: at home, a restaurant, Burger Chef, a friend's house, camping out, a relative's house

	Type	Preparation	Amount
Bread	white, whole wheat, rye Brand name	Toasted French toast	Slice
Cereals	Brand name	Cold or cooked	Estimate volume in cups or parts of cups of cereal. Estimate milk and sugar separately.
Rice	white, brown, other type	Cooking method	Estimate volume in cups of cooked rice.
Pasta	dry, fresh, whole wheat, spinach, other type	Boiled only, boiled and baked, boiled and sauted, other.	Estimate volume in cups of cooked pasta alone. Estimate sauce separately possible. If necessary, estimate cups of mixture.
Beans	navy, kidney, etc.	Boiled only, boiled and sauteed, etc.	Estimate volume in cups of cooked beans.
Fruits, Vegetables	canned, frozen, fresh	Cooked or raw	Estimate volume of cut-up fruit/veggies in cups or parts of cups or by the Each, i.e., one small plum.
Juices	canned, frozen, fresh		Estimate volume in cups or part cups.
Salads	tossed, Waldorf, etc.	Cooked or raw	Estimate volume of each ingredient, i.e, 1 cup shredded iceberg lettuce, 2 Tbls. chopped green pepper. List dressing

			separately.
Milk	whole, 1%, 2%, skim, buttermilk, other	Usually none	Estimate volume in cups or parts or cups.
Yogurt	Brand name, container description, plain or flavored, with fruit, low-fat, frozen yogurt (Brand).	Usually none	Estimate volume in cups or parts of cups.
Cheese	swiss, sharp cheddar, spread, cheese food, process cheese, string cheese, part-skim, etc.	Usually none or as part of a recipe.	Estimate weight in ounces from total package weight or volume in cups, Tbls.or tsp. if shredded, or number of slices if presliced.
Cream, Creamers	sour cream, half and half, cream cheese, powdered coffee creamer, frozen coffee creamer, Brand name.	Usually none	Estimate volume in cups or Tbls. or tsp.
Meats	chicken, pork, etc., loin chop, shoulder roast, thigh with or without skin, % fat in ground meat, etc.	Broiled, boiled, fried, baked, etc. With or without added fat.	Estimate cooked weight in ounces. Cooking loss is usually about 1/4 of raw weight.
Mixed meat dishes	Name type and list ingredients (tuna casserole with noddles, mushroom soup, peas and breadcrumbs.	Baked, fried, boiled, etc. With or without added fat.	Estimate volume of the finished product you ate in cups or part cups.

Beverages:			
Coffee/tea	brewed, instant, decaf.		Estimate volume in cups or part cups. List sugar, cream, etc. separately.
Beer/wine Spirits	rose wine, lite beer, brandy, bourbon, etc. or whiskey sour.		Estimate volume in cups, part cups, or jiggers (1.5 fl. oz/jigger) of ingredients or whole drink volume.
Pop/other sweet drinks	Brand and type, diet or regular		Estimate volume in cups or part cups.
Snacks:			
Crackers	Brand name		Number
Chips	Type - Brand name		Estimate volume in cups or part cups.
Nuts	Type		Estimate volume in cups or part cups or number of nuts.
Candy	Brand name or type		Weight from package, number of pieces, or each if whole candy bar.
Desserts:			
Cookies	Brand name or type	Homemade or Bought	Number and size
Cake	Type, with/without icing.	Homemade or Bought	Measurments of piece, i.e., 2"X2"X4" with icing, or 1/6 pie.

Ice Cream	Brand, name, flavor		Estimate volume in cups or part cups or Tbls.
Pudding	Brand name, type	Homemade or bought, Specify kind of milk used if any.	Estimate volume in cups or part cups or Tbls.
Other:			
Solid fats, oils	Brand and type, liquid or solid		Estimate volume in Tbls., tsp., cups or parts of any of these.
Salad dressings, mayo.	Brand and type, specify lite, lo-cal, or other description on label.	Ingredients if homemade.	Estimate volume in Tbls., tsp., cups or parts of any of these.
Jam, relish, mustard.	Brand and type, flavor	Ingredients if homemade.	Estimate volume in Tbls., tsp., cups or parts of any of these.

24 HOUR FOOD RECORD

Subject Number 134
Day of Week Tuesday
Date August 6

Time*	Food Item	Type and Preparation**	Amount**	Where Eaten***
5:30 AM	Coffee	Brewed - regular	2½ cups	Home
	Rice Krispies		½ cup	"
	Milk	whole	½ cup	"
	Sugar	on cereal	1 tsp.	"
	Juice	apple - canned	1 cup	"
	Toast	Orowheat - white	1 slice	"
	Jelly	Strawberry - homemade	2 tsp.	"
	Butter	Land-O-Lakes	2 tsp	"
10:00 AM	Crackers	Pepperidge Farm - Sesame	6 each	Friend's home
	Cheese	swiss	1 or 6 tiny slices	"
	tea	Herbal - orange	1 cup	"
	sugar	in tea	1 tsp	"
12:20 PM	Sandwich:			Restaurant
	Ham	Boiled	1 slice	"
	Cheddar Cheese		1 slice	"
	Bread	whole wheat	2 slices	"
	lettuce	iceberg	1 small leaf	"
	mayonnaise	regular	1 Tbls.	"
	Milk	2%	¾ cup	
	Pie	blueberry - homemade	⅛ pie	"
5:00 PM	Vegetable soup	Home made with		Home
		peas, carrots, potatoes	1½ cups	"
	Chicken	thigh, baked	1 thigh	"
	Peach	Fresh	1 medium	"
	tea	Lipton - regular	1 cup	"
8:30 PM	Frozen yogurt	Yogurt Hill Raspberry	¾ cup	Yogurt Hill

Was your intake unusual in any way? Yes ✓ No ___
If yes, how and why was it unusual?
I hardly ever eat out twice in one day.

Did you take any vitamin or mineral supplements today? Yes ✓ No ___
If yes, how many? 1 Name and Brand Fred Meyer. One-A-Day plus Iron

24 HOUR FOOD RECORD

Day ___ of 7

Subject Number ___
Day of Week ____
Date _____

Time*	Food Item	Type and Preparation**	Amount**	Where Eaten***

Was your intake unusual in any way? Yes___ No___
If yes, how and why was it unusual?

Did you take any vitamin or mineral supplements today? Yes___ No___
If yes, how many? ___ Name and Brand _____

APPENDIX F

Food Model Kits

FOOD MODEL KITS

Food Model	Measure
Generic Bean Models	
Dry beans on paper plate	1 cup
	1/2 cup
	1 tablespoon
	1 teaspoon
Artifical Models	
Variety of meats (pork chop,	1 ounce
turkey slice, beef patty)	2 ounces
	3 ounces
Tuna	1/4 cup
Cheese slice	1 ounce
Butter pat	1 teaspoon
Mashed potatoes scoop	1/2 cup
Real Foods - dry cereals in bowls covered with plastic	
Cheerios cereal	1 cup
All-bran ceral	1/2 cup
Houshold Measures	
Measuring cups	1 cup
	1/2 cup
	1/3 cup
	1/4 cup
Measuring spoons	1 tablespoon
	1 teaspoon
	1/2 teaspoon
	1/4 teaspoon
Glasses	
Plastic glasses of various sizes	4-6 ounces
	8-10 ounces
	12-16 ounces
Cardboard Cut-out shapes	
Cirlces	2, 3, 4, 6 inch
Squares	2, 4 inch
Wedge	1/6, 1/9 pie wedge

APPENDIX G

1989 Recommended Dietary Allowances

FOOD AND NUTRITION BOARD, NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL
RECOMMENDED DIETARY ALLOWANCES.[a] Revised 1989

Designed for the maintenance of good nutrition of practically all healthy people in the United States

Category	Age (years) or Condition	Weight[b] (kg)	Weight[b] (lbs)	Height[b] (cm)	Height[b] (in)	Protein (g)	Fat-Soluble Vitamins: Vitamin A (μg RE)[c]	Vitamin D (μg)[d]	Vitamin E (mg α-TE)[e]	Vitamin K (μg)	Water-Soluble Vitamins: Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg NE)[f]	Vitamin B_6 (mg)	Folate (μg)	Vitamin B_{12} (μg)	Minerals: Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Iodine (μg)	Selenium (μg)
Infants	0.0–0.5	6	13	60	24	13	375	7.5	3	3	30	0.3	0.4	5	0.3	25	0.3	400	300	40	6	3	40	10
	0.5–1.0	9	20	71	28	14	375	10	4	10	35	0.4	0.5	6	0.6	35	0.5	600	500	60	10	5	50	15
Children	1–3	13	29	90	35	16	400	10	6	15	40	0.7	0.8	9	1.0	50	0.7	800	800	80	10	10	70	20
	4–6	20	44	112	44	24	500	10	7	20	45	0.9	1.1	12	1.1	75	1.0	800	800	120	10	10	90	20
	7–10	28	62	132	52	28	700	10	7	30	45	1.0	1.2	13	1.4	100	1.4	800	800	170	10	10	120	30
Males	11–14	45	99	157	62	45	1,000	10	10	45	50	1.5	1.5	17	1.7	150	2.0	1,200	1,200	270	12	15	150	40
	15–18	66	145	176	69	59	1,000	10	10	65	60	1.5	1.8	20	2.0	200	2.0	1,200	1,200	400	12	15	150	50
	19–24	72	160	177	70	58	1,000	10	10	70	60	1.5	1.7	19	2.0	200	2.0	1,200	1,200	350	10	15	150	70
	25–50	79	174	176	70	63	1,000	5	10	80	60	1.5	1.7	19	2.0	200	2.0	800	800	350	10	15	150	70
	51+	77	170	173	68	63	1,000	5	10	80	60	1.2	1.4	15	2.0	200	2.0	800	800	350	10	15	150	70
Females	11–14	46	101	157	62	46	800	10	8	45	50	1.1	1.3	15	1.4	150	2.0	1,200	1,200	280	15	12	150	55
	15–18	55	120	163	64	44	800	10	8	55	60	1.1	1.3	15	1.5	180	2.0	1,200	1,200	300	15	12	150	50
	19–24	58	128	164	65	46	800	10	8	60	60	1.1	1.3	15	1.6	180	2.0	1,200	1,200	280	15	12	150	55
	25–50	63	138	163	64	50	800	5	8	65	60	1.1	1.3	15	1.6	180	2.0	800	800	280	15	12	150	55
	51+	65	143	160	63	50	800	5	8	65	60	1.0	1.2	13	1.6	180	2.0	800	800	280	10	12	150	55
Pregnant						60	800	10	10	65	70	1.5	1.6	17	2.2	400	2.2	1,200	1,200	320	30	15	175	65
Lactating	1st 6 months					65	1,300	10	12	65	95	1.6	1.8	20	2.1	280	2.6	1,200	1,200	355	15	19	200	75
	2nd 6 months					62	1,200	10	11	65	90	1.6	1.7	20	2.1	260	2.6	1,200	1,200	340	15	16	200	75

[a] The allowances, expressed as average daily intakes over time, are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined. See text for detailed discussion of allowances and of nutrients not tabulated.

[b] Weights and heights of Reference Adults are actual medians for the U.S. population of the designated age, as reported by NHANES II. The median weights and heights of those under 19 years of age were taken from Hamill et al. (1979) (see pages 16–17). The use of these figures does not imply that the height-to-weight ratios are ideal.

[c] Retinol equivalents. 1 retinol equivalent = 1 μg retinol or 6 μg β-carotene. See text for calculation of vitamin A activity of diets as retinol equivalents.

[d] As cholecalciferol. 10 μg cholecalciferol = 400 IU of vitamin D.

[e] α-Tocopherol equivalents. 1 mg d-α tocopherol = 1 α-TE. See text for variation in allowances and calculation of vitamin E activity of the diet as α-tocopherol equivalents.

[f] 1 NE (niacin equivalent) is equal to 1 mg of niacin or 60 mg of dietary tryptophan.

APPENDIX H

Percent Missing Entries in Data Base

PERCENT MISSING ENTRIES IN DATA BASE

NUTRIENTS	PERCENT MISSING ENTRIES
Kcalories	0.0%
Protein	0.0%
Carbohydrate	0.0%
Total Fat	0.0%
Saturated Fat	1.9%
Monounsaturated Fat	2.1%
Polyunsaturated Fat	2.2%
Cholesterol	1.5%
Dietary Fiber	2.1%
Total Vitamin A	1.0%
Retinol	2.8%
Carotene	2.7%
Vitamin C	1.9%
Thiamin	0.6%
Riboflavin	0.3%
Niacin	0.6%
Vitamin B6	3.0%
Vitamin B12	2.4%
Folate	2.9%
Calcium	0.2%
Iron	0.5%
Zinc	2.1%

APPENDIX I

Default List

DEFAULT LIST

Recorded As	Default Item
Fruits & Vegetables	
apple	2.75 inch, with peel
apple -large	3.75 inch, with peel
banana - small	0.75 each
banana - large	1.25 each
raisins	seedless, unpacked
blueberries	fresh
applesauce (homemade)	sweetened
pear	Bartlett, 161 grams
pinneapple	canned, light syrup
orange juice	Orange juice prepared from frozen
baked potato	without skin
broccoli, cooked	from frozen
mixed vegetables	frozen, cooked
lettuce	iceberg lettuce (1 c)
squash	acorn
Breads & Cereal	
white bread	white bread, 28 gram/slice
wheat bread	part whole wheat, 28 gram/slice
whole wheat bread	whole wheat bread, 28 gram/slice
dinner roll	dinner roll, comm.
muffin (homemade)	plain muffin, recipe
apple/raisin muffin	plain muffin + 1 tsp raisins
cornbread	2x2 inch square
bran flakes cereal	40% Kellogg's
corn flakes	Kelllogg's
Oroweat Hazelnut/Health nut bread	mixed grain, 33 gram/slice
pizza	regular crust
spaghetti	cooked without salt

Top Ramen noodles	chicken flavor, 2 c pkg.
rice	white rice regular
casserole	tuna casserole

Meats & Nuts

chicken - on sandwich	chicken roll, light meat
chicken - for dinner	chicken meat, all roasted
steak	sirloin, lean & fat
ham	roasted, lean & fat
ham lunchmeat	lunchmeat, regular
beef	beef round
lamb	loin chop
fish	cod, broiled
burrito	meat + beans
tuna	canned, oil packed
meat loaf	beef only
liver	beef liver, fried
peanuts	dry roasted, salted
almonds	dry roasted, salted

Dairy Products

milk	2% milk
sour cream	cultured
yogurt	lowfat, plain
cheese	cheddar
mozzarella cheese	part skim
cottage cheese, low fat	low fat, 2%
cottage cheese	4% milkfat

Fats

margarine - stick	80% fat, hard (1 T)
margarine - tub	60% fat, softspread (1 T)
oil	corn oil (1 T)
salad dressing	Ranch salad dressing (2 T)
Miracle Whip	mayo-type salad dressing

Desserts

chocolate candy	chocolate candy kiss
doughnut	cake type, plain 3.25 inch
brownie	with nuts, homemade
chocolate cookie	homemade
chocolate sauce	chocolate syrup, thin
sugar wafer	sugar cookie, 1/2 cookie
berry pie	blueberry, 1/6 piece
cake	yellow cake, chocolate icing, pce=1/16th, from mix
whipped topping	dessert topping, non-dairy frozen

Snacks

popcorn	cooked in oil and salted
chips	tortilla chips
pretzels	thin sticks, 2.25 inches
french fries	frozen, prepared cooked in vegetable oil

Condiments

Mustard/mayonnaise	1 tsp/slice bread
gravy	from dry mix
taco sauce	salsa

Beverages

gin/rum/vodka	80 proof
wine	white, medium
tea	brewed
coffee	brewed
diet cola	with aspartame

APPENDIX J

Food Categories

FOOD CATEGORIES

[adapted from Popkin et al. (1989)]

FOOD CATEGORIES*	CHARACTERISTIC FOODS
1. Lower fat milk [1]	2%, 1% or skim
2. Higher fat milk [2]	Whole milk
3. Lower fat cheese [1-4]	Cottage cheese, mozzarella, cheese sauce
4. Higher fat cheese [5]	processed and other cheeses
5. Lower fat beef, pork, and mixed dishes [3]	lean, trimmed, broiled beef and pork, chili, hamburger with ketchup on bun
6. Medium fat beef, pork, and mixed dishes [4]	Cooked ground beef or patty, cheeseburgers, lean roast beef, lean or trimmed roast beef and pork chops, meat loaf
7. Higher fat beef, pork, and mixed dishes [5]	Untrimmed roasts, steaks, short ribs, pork chops
8. Lower fat poultry and mixed dishes [2-3]	Broiled and chopped ham, chicken and turkey loaf, poultry franks and bologna
9. Higher fat poultry and mixed dishes [4]	Chicken with skin; fried, breaded, or processed chicken
10. Lower fat lunch meats, sausages [2-4]	Boiled and chopped, ham, chicken and turkey loaf, poultry franks and bologna
11. Higher fat lunch meats, sausages [5]	Frankfurters, bologna, pork sausage, salami, pepperoni
12. Lower fat fish, seafood, mixed dishes [1-2]	Tuna canned in water; boiled, steamed, baked shrimp, scallops, flounder, haddock; seafood stews
13. Higher fat fish, seafood, mixed dishes [3-4]	Tuna canned in oil, fish sandwich or fish cakes, tuna salad and casseroles, fried seafood and fish, oilier fish (catfish, mackerel)

14. All egg products	Eggs boiled or fried, omelets, egg salad
15. All legume products	Chili with beans, pork and beans, refired beans, split pea soup
16. Lower fat [1,2], higher fiber breads [3,6]	Whole wheat and multi-grain bread, corn tortillas
17. Higher fat [3-5], lower fiber breads [1-2]	White soft rolls, biscuits, cornbread, pancakes, waffles, french toast, sweet rolls, croissants
18. Higher fat desserts [3-5]	Ice cream, cakes, cookies, pies, doughnuts, granola bars
19. Higher fat salty snacks [3-5]	Potato chips, saltine and snack crackers, corn and tortilla chips, popcorn with butter
20. Pasta, rice, cooked cereals	Pasta, rice, grits, oatmeal
21. Lower fiber ready to eat cereals [1-3]	Corn flakes, rice cereal
22. Higher fiber ready to eat cereals [4-6]	Oat cereal, wheat or bran flakes, and cereal with bran in name
23. Higher fat grain mixtures [3-5]	Pizza, macaroni and cheese, spaghetti and meat balls, pasta salad, tacos, egg rolls
24. Higher fat potatoes [3-5]	French fries, potato salad, hash browns
25. Dark green, yellow vegetables	Broccoli, spinach, other greens, carrots, winter squash
26. Lower fiber other vegetables [1-2]	Lettuce, tomatoes, onions, cucumbers, slaw
27. Higher fiber other vegetables [3-4]	Corn, green beans, peas, lima beans, cooked cabbage
28. Fats - butter and margarine	All butter and margarine products
29. Lower fat salad dressings [1-3]	Low-calorie dressings, sauces, sour cream
30. Higher fat salad dressings [4-5]	Mayonnaise, regular dressings

* Numbers in brackets indicate fat and/or dietary fiber subgroups

Dietary Fat Groups (fat g/100g food)

[1] < or = 2.5g

[2] > 2.5g but < or = 5g

[3] > 5g but < or = 10g

[4] > 10g but < or = 20g

[5] > 20g

Dietary Fiber Groups (fiber g/100g food)

[1] > 1g

[2] > 1g but < or = 2.5g

[3] > 2.5g but < or = 5g

[4] > 5g but < or = 7.5g

[5] > 7.5g but < or = 10g

[6] > 10g

APPENDIX K

Eating Behavior Questionnaire

Subject #: _____

EATING BEHAVIOR QUESTIONNAIRE

1. Thinking about the past 10 years, please indicate if you have made changes in your food choices from any of the following categories. (Use these indicators: I = Increased use, D = Decreased use, R = Remained the same, or X = Don't eat or don't use)

____ Fresh fruits or vegetables	____ Dried beans & peas
____ Canned fruits or vegetables	____ Milk or yogurt
____ Cereals	____ Cheese
____ Breads or pasta	____ Butter
____ Rice or potatoes	____ Margarine
____ Poultry	____ Eggs
____ Fish	____ Vitamin or mineral supplements
____ Red meat	____ Sugar or sweets

What do your feel were your MAIN reasons for making these changes?

_____

_____

2. Which of the following do you eat on a regular basis? (check all that apply)

____ Breakfast	____ Dinner
____ Mid-morning snack	____ Evening snack
____ Lunch	____ Mid-night snack
____ Mid-afternoon snack	____ Rather than eat meals, I usually graze throughout the day

3. Do you usually eat: (check one)

____ Alone

____ With family

____ With friends

____ Other (please specify)_____

4. During the past week have you: (check all that apply)

____ Prepared meals for yourself at home

____ Prepared meals for you & others at your home

____ Eaten at another's home

____ Eaten at a restaurant

____ Eaten at a senior center

____ Other (please specify)_____

5. Who does the majority of the grocery shopping in your household? (check only one)

____ You by yourself

____ You with assistance

____ Your spouse

____ Another relative

____ A neighbor/friend

____ other (please specify)_____

6. Who does the majority of the food preparation in your household? (check only one)

____ You

____ Your spouse

____ Another relative

____ A neighbor/friend

____ Other (please specify) _____

7. Which type(s) of fat(s) or oil(s) do you use on a regular basis? (check all that apply)

____ Olive oil

____ Vegetable oil

____ Solid vegetable shortening

____ Animal shortening (meat/bacon drippings)

____ Non-stick cooking spray

____ Regular tub or liquid margarine

____ Regular stick margarine

____ Diet margarine

____ Butter

____ Other (please specify)_____

8. If there is a "low-fat" or "lite" version of a regular food item you are going to purchase, do you:

___ Always choose that over the regular kind
___ Frequently choose that over the regular kind
___ Occasionally choose that over the regular kind
___ Never choose that over the regular kind

9. The last time you cooked or ate red meat, did you trim the visible fat?

___ Yes
___ Partially
___ No
___ I don't eat red meat

10. The last time you cooked or ate poultry or fish, did you remove the skin?

___ Yes
___ Partially
___ No
___ I don't eat poultry or fish

11. Do you think that older people can get adequate nutrition from foods alone without taking supplements? ___ Yes ___ No

12. Based on your knowledge of nutrition, which of the following dietary practices has been shown to be MOST successful in lowering blood cholesterol levels? (check only one)

___ Decreasing cholesterol intake
___ Decreasing sugar intake
___ Decreasing saturated fat intake
___ Decreasing calorie intake
___ Decreasing protein intake
___ unsure

13. From the following sources of nutrition information, rank which TWO have been most important in influencing your food habits in the past 10 years: (1 = most important, 2 = next most important)

___ Television _____
___ Newspaper _____
___ Magazines _____
___ Food labels
___ Friends/Relatives
___ Doctor/Dietitian
___ Other (please specify)_____

14. From the following list, rank the TWO factors that are most important to you when choosing food: (1 = most important, 2 = next most important)

____ Taste ____ Convenience

____ Cost ____ Appearance

____ Healthfulness ____ Other (please specify) _____

15. At the present time, which one of the following food components would you say is your GREATEST nutritional concern? (choose only one):

____ Protein ____ Fiber

____ Fat ____ Vitamins and minerals

____ Cholesterol ____ Calories

____ Complex carbohydrates ____ Salt or Sodium

____ Sugar ____ They are all about the same

16. During the past month, have you used any information from a food label to make a food purchasing decision?

____ Yes ____ No

If yes, which of the following types of information did you use? (check all that apply)

____ Ingredient list

____ Calorie content

____ Amount of fat

____ Amount of sodium

____ Amount of carbohydrate

____ Amount of protein

____ Cholesterol content

____ Food additives listed in the product

____ Advertising statements, such as "Provides 10 essential vitamins and minerals" or "Sugar-free"

APPENDIX L

Excerpt for Estimation of Percent Body Fat

EXCERPT FOR ESTIMATION OF PERCENT BODY FAT FROM SKINFOLDS

The estimated percent body fat (PBF) for elderly women subjects in this study was determined from the regression equation of the logarithm of skinfolds on body density, obtained from hydrostatic weighing, given by Durnin and Womersley (1974) for women aged 50 and over, and the use of Siri's (1956) equation. The estimation of PBF for the elderly women in the current study was made in the following steps using SPSS computer software.

First, every subject had four skinfold sites measured during each of the three phases of the study. The four skinfolds used were: triceps (TS), biceps (BS), subscapular (Sub), suprailiac (Sup). The three measurements taken at each skinfold site were averaged to get a mean value for each skinfold. These four individual mean skinfold values for each subject were then added together to get the sum:

$$\begin{aligned}\text{Sum of four} \\ \text{Skinfolds (mm)} =\end{aligned} \quad \begin{aligned}&\text{mean TS + mean BS +} \\ &\text{mean Sub + mean Sup}\end{aligned} \qquad (1)$$

Second, body density (BD) was predicted using the age-regression equation for women aged 50 years and over, relating the $\log_{10}$ of the sum of the four skinfolds (Durnin and Womersley, 1974):

$$\text{BD (g/mL)} = 1.1715 - (0.0779 \times \log_{10} \text{sum of four skinfolds}) \qquad (2)$$

Third, the estimated (PBF) associated with the predicted body density was then calculated using Siri's (1956) equation:

$$PBF = [(4.95/BD)-4.50] \times 100 \quad (3)$$

An example of PBF estimation from skinfolds is given below:

	TS	BS	Sub	Sup
Phase I	18	12	19	26
Phase II	18	14	17	28
Phase III	18	10	18	27
Mean Values (mm)	18	12	18	27

Sum of Four Skinfolds (mm) $= 18 + 12 + 18 + 27 = 75$ mm (1)

$BD\ (g/mL) = 1.175 - (0.0779 \times \log_{10} 75) = 1.029\ g/mL$ (2)

$PBF = [(4.95/1.029) - 4.50] \times 100 = 31.0\%$ (3)

APPENDIX M

EXCERPT FOR USE OF THE MANN-WHITNEY U STATISTICAL TEST

EXCERPT FOR USE OF THE MANN-WHITNEY U STATISTICAL TEST

All statistical analyzes for this study were performed using Statistical Package for the Social Sciences (SPSS) program. To determine whether a t-test or nonparametric test was required for comparisons between groups, a Kolmogorov-Smirnov (K-S) statistic with a Lilliefors significance level of $\leq .05$ was used to test normality for all variables. The K-S test compares the cumulative distribution function for a variable with a normal distribution and tests whether the distributions are homogeneous. It is sensitive to any difference in median, dispersion, and skewness between the two distributions (SPSS Reference Guide, 1990).

When distributions of variables in both groups were normally distributed, t-tests were used for comparisons between the exercising and non-exercising elderly women. When the distribution of a variable from either group differed significantly from the normal distribution, the nonparametric Mann-Whitney U test was chosen to compare variables, since these evaluations could not be based on parametric statistics which compare means. The Mann-Whitney U test is considered to be an excellent substitute for the t-test for uncorrelated data (Siegel, 1956; Downie and Heath, 1970).

The Mann-Whitney U test compares two independent samples defined by a grouping variable on a single test variable. It is a nonparametric or distribution-free test and makes minimal assumptions about the underlying distribution of the data;

only that the shape and spread of the two populations are the similar, but not normally distributed (Downie and Heath, 1970). The test statistic uses the rank of each case to determine whether the groups are drawn from the same population (Siegel, 1956). Cases are ranked in order of increasing size, and the test statistic U (the number of times a score from Group 1 precedes a score form Group 2) is compared (SPSS Reference Guide, 1990).

The following formulas given by Downie and Heath (1970) express these computations , where N_1 and N_2 are the two sample sizes, ER_x and ER_y are the sum of the ranks for each sample. To Obtain U:

$$U_1 = N_1N_2 + \frac{N_1(N_2 + 1)}{2} - ER_x \qquad (1)$$

$$U_2 = N_1N_2 + \frac{N_1(N_2 + 1)}{2} - ER_y \qquad (2)$$

If $U_1 < U_2$, then $U_1 = U$. The z ratio can then be computed using the smaller of the two U values, where the numerator is U minus the second term, which is the mean of U, and the denominator is the standard deviation of the U:

$$z = \frac{U - (N_1N_2/2)}{\sqrt{[N_1N_2 (N_1 + N_2 + 1)]/12}} \qquad (3)$$

The SPSS program display shows the mean rank of the variable within each group, the valid count of each group, the Mann-Whitney U, the W statistic (the rank sum of the smaller group), and the two-tailed probability of Z corrected for ties. For fewer than 30 cases using the SPSS program, an exact significance level is computed. For more than 30 cases, U is transformed into a normally distributed Z statistic. The following is an example of the SPSS printout for comparison between elderly women exercisers and non-exercisers of the percent contribution of lower fat milk food category to total fat intake:

PERCENT CONTRIBUTION OF LOWER FAT MILK TO TOTAL FAT

Mean rank	Cases	
27.76	33	Exercisers
36.67	30	Non-Exercisers
	63	Total

Corrected for ties

U	W	Z	2-Tailed P
355.0	1100.0	-1.9268	0.0540

Since the Mann-Whitney U test compares the rank order of the variable of interest for each group and not the mean or median, it becomes difficult to report statistically meaningful results. Therefore, for all sample variables in this study, the mean $\pm$ standard deviation, the median, and the range were all presented to describe as completely as possible the comparisons between groups.