

GARDENING AS A PHYSICAL ACTIVITY FOR HEALTH IN OLDER ADULTS

by

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B.S., Sangmyung University, Republic of Korea, 2001
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AN ABSTRACT OF A DISSERTATION

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requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Horticulture, Forestry and Recreation Resources
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

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ABSTRACT

The objectives of this study were to determine exercise intensity of common gardening tasks in older adults and to investigate if older gardeners meet the physical activity (PA) recommendations (intensity and time) through their daily gardening. Kinds of gardening tasks, body postures, and bodily pain while gardening of older gardeners were investigated and the possibility of gardening as a predictor for a physically active lifestyle and life satisfaction in older adults was determined.

Older participants were randomly recruited from the community of Manhattan, KS. To determine the exercise intensity of gardening, the heart rates of older adults were measured by radiotelemetry during gardening or garden tasks, and then oxygen uptake and energy expenditure were measured via indirect calorimetry using a submaximal graded exercise test. Overall health conditions by the Short Form 36 Health Survey (SF-36), hand functions by hydraulic hand dynamometer and pinch gauge, and bone mineral density (BMD) by dual-energy x-ray absorptiometry were measured. An observational study and weekly logs were conducted to study kinds of gardening, postures, and bodily pain of older gardeners. The Community Healthy Activities Model Program for Senior (CHAMPS) questionnaire was used to measure leisure-time PAs (frequency per week of all PAs and calories expended per week in all PAs).

In conclusion, the nine gardening tasks were found to be low to moderate intensity PA in healthy older adults (1.6 ± 3.6 METs). Gardening observed was moderate intensity (3.8 ± 1.4 METs) PA in older adults and the subjects met the PA recommendation, which is at least 30 minutes of moderate intensity PA on most days of the week through their daily gardening

(moderate intensity; average 33 hrs/wk in May and 15 hrs/wk in June and July). The older gardeners showed higher values for hand function and some SF-36 domains (physical function, bodily pain, and physical summary) than older non-gardeners. Gripping, stooping, lifting, stretching, walking, standing, kneeling, sitting, and squatting were observed while older adults gardened and lower back pain was the main bodily pain reported. Furthermore, gardening was found to be a predictor for leading a physically active lifestyle and high life satisfaction in older adults.

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DEDICATION

To my God, always leading my life.

CHAPTER 1 - INTRODUCTION

Approximately 90% of older people have at least one or a number of chronic health problems (Federal Interagency Forum on Aging Related Statistics, 2000; Hoffman, Rice & Sung, 1996). Biological changes, chronic diseases, functional disability and psychological problems are common phenomenon among the elderly (Dustman, Emmerson, & Shearer, 1994; Katz, 1983). A sedentary lifestyle and a low-level of physical activity (PA) of older adults play a role as a cause for these problems (Stuck, Walthert, Nikolaus, Büla, Hohmann, & Beck, 1999; Blair, Kohl, Paffenbarger, Clark, Cooper, & Gibbons, 1989; Saltin, 1992).

Regular PA is a crucial factor for healthy aging (American College of Sports Medicine, 1998; Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995). Regular PA contributes to health through maintenance or improvement of functional capacity, independence and quality of life (American College of Sports Medicine, 1998). Health benefits of PA include reduction in the risk of coronary heart disease, hypertension, type 2 diabetes, osteoporosis, ischemic stroke, selected cancers, anxiety and depression (American College of Sports Medicine, 1993; American College of Sports Medicine, 2004; Hui & Rubenstein, 2006; Lee, Paffenbarger, & Hsieh, 1991; Powell, Thompson, Casperson, & Ford, 1987). Physical activity also provides improvement in fitness level, muscle strength, aerobic capacity, balance and bone mineral density (American College of Sports Medicine, 1998; DiPietro, 2001; U.S. Department of Health & Human Services, 1996). Thus, PA provides numerous health benefits, not only reductions in obesity but also a protective mechanism against physical and mental decline, morbidity, and mortality in older adults. Based on compelling evidence from the research literature for improvement and maintenance of health, at least 30 minutes of moderate intensity PA on most days of the week is recommended (Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995; Nelson, Rejeski, Blair, Duncan, Judge, King et al., 2007).

Gardening is a prevalent type of PA preferred among many older adults (Armstrong, 2000; Walsh, Pressman, Cauley, & Browner, 2001). In the U.S., 45% of men and 35% of women aged 65 years or older reported participation in gardening as a form of leisure-time PA (Yusuf, Croft, Giles, Anda, Casper, Caspersen et al., 1996). A variety of gardening tasks were calculated at moderate intensity PA in adults based on published and unpublished data of energy costs of more than 500 PAs (Ainsworth, Haskell, Whitt, Irwin, Swartz, Strath et al., 2000). Gunn, Brooks, Withers, Gore, Plummer & Cormack (2005) and Withers, Brooks, Gunn, Plummer, Gore, & Cormack (2006) reported that lawn mowing is a moderate intensity PA in female and male adults aged 55-65 years old. Although a few gardening tasks have been reported as forms of moderate intensity PA in the literature (Ainsworth, Haskell, Whitt, Irwin, Swartz, Strath et al., 2000), there is limited research that has directly determined the exercise intensity of various garden tasks in older adults.

Moreover, gardening has the possibility of offering health benefits from PA for older adults. Gardening has been associated with improved physical and psychosocial health outcomes such as lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration (Armstrong, 2000; Walsh, Pressman, Cauley, & Browner, 2001). Reynolds (1999) reported that gardening could improve grip strength of participants through a pilot study of the Green Gym project after 6 months and cardiovascular fitness was expected because gardening activities could elevate heart rate of participants during the Green Gym program, a project to encourage members of a local community to join conservation activities for improving health and the environment. Another study of the Green Gym project showed improvement in mental health and depression after 3 months of gardening (Reynolds, 2002). Moreover, gardening is an activity which is expected to influence whole body bone mineral density because

it includes weight-bearing motions such as pushing a mower, digging holes, pulling weeds, carrying soil, and other gardening items and because it uses the whole body (Turner, Bass, Ting, & Brown, 2002). Turner, Bass, Ting, & Brown (2002) reported from their study that jogging, swimming and calisthenics were weak predictors for high bone density, while bicycling, aerobic, walking, and dancing were moderate predictors, and yard work and weight training were strong and positive predictors. Although there is some evidence of the positive health benefits gardening offers as a form of PA, there is limited research reported that has specifically studied gardening for health in older populations.

Some research has reported on uncomfortable gardening postures and tried to suggest solutions. Stoffert (1989) selected stooping, kneeling, and squatting as the most uncomfortable and dangerous postures during gardening. Stooping overburdens the spine and the brain has more blood than normal. Kneeling pressures knee-caps and knee-joints with the body weight. The high degree of flexion of the knees and the external pressure on the knees in kneeling work are known contributors to knee complaints (Kivimaki, Riihimäki, & Hänninen, 1992; Thun, Tanaka, Smith, Halperin, Lee, Luggen et al., 1987). While squatting, a maximal bending of knee-joints and hip-joints are required. These uncomfortable gardening postures can cause fatigue, physical pain, and injuries to older gardeners. Working in a flexed posture has shown to be a cause of low back pain (Maeda, Okazaki, & Suenaga, 1980; Stubbs, Buckle, & Hudson, 1983). Moreover, digging with a conventional spade was determined to lead to lower back injury (Bridger, Sparto & Marras, 1998).

Predictors for a physically active lifestyle in older adults are high self-efficacy to do PA, age range (65-69 years rather than 60-64 or 70 or older), regular participation of friends and family, finding footpaths safe for walking, and access to local facilities such as a local hall,

recreation center, cycle track, gym, or park (Booth, Owen, Bauman, Clavisi, & Leslie, 2000). Trost, Owen, Bauman, Sallis, & Brown (2002) summarized in a review paper for PA determinants as age, gender, socioeconomic status, occupational status, educational attainment, overweight or obesity, and PA self-efficacy. Moreover, Ruuskanen & Parkatti (1994) reported that the main factor for limited PA was poor health status among nursing home residents. In case of men, PA was considerably related to higher self-rated function capacity, less depression, and higher contentment with life in the nursing home. In women, higher contentment in the nursing home and less depressive symptoms were related to a physically active life.

Life satisfaction is an important factor in aging (Mannell & Dupuis, 1996). The predictors for life satisfaction are age, marital status, education level, and income level (Fernández-Ballesteros, Zamarrón, & Ruíz, 2001; Mannell & Dupuis, 1996; Penning & Strain, 1994). There is a positive relationship between PA and life satisfaction (Elavsky & McAuley, 2005; Elavsky, McAuley, Motl, Konopack, Marquez, Hu et al., 2005; Mihalko & McAuley, 1996; Grant, Todd, Aitchison, Kelly, & Stoddart, 2004).

Objectives

1. To determine the exercise intensity of nine common gardening tasks in older adults
2. To investigate if older gardeners meet the PA recommendation (exercise intensity and time) through their daily gardening and their overall physical and mental health
3. To investigate the physical and psychological health conditions (overall health conditions, hand function, and bone mineral density) of older gardeners versus non-gardeners and the leisure-time activities, particularly PAs of older participants
4. To observe kinds, postures and motions of gardening used in regular gardening of older gardeners, and bodily pain which can be produced from the postures and motions during daily gardening
5. To determine the possibility of gardening as a predictor of an active lifestyle and a contributor to good life satisfaction in older adults

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CHAPTER 2 - LITERATURE REVIEW

Health issues in older adults

Increasing older population

The population over 65 years of age has increased rapidly in the most industrialized nations (Bureau of the Census, 1996; National Institute of Aging, 2002; U. S. Senate Special Committee on Aging, 1989). The older population constitutes approximately 36 million in the United States. It is estimated that this number will increase to 70 million or 22% of the population by the year 2030 (Federal Interagency Forum on Aging-Related Statistics, 2000; Geographic Profile of the Aged, 1993). People over the age of 85 years constitute the most rapidly growing group, increasing from 3.1 million in 1990 to approximately 17.7 million by the year 2050 (Federal Interagency Forum on Aging-Related Statistics, 2000; Geographic Profile of the Aged, 1993; National Center for Health Statistics, 1997).

Changing health conditions of older adults

Although individuals in a modern society may live longer, they may not necessarily live active, happy, and independent lives (McAuley & Rudolph, 1995) because of problems such as biological changes, chronic diseases, functional disability and psychological problems (Dustman, Emmerson, & Shearer, 1994; Katz, 1983). Approximately 90% people of 65 years or more have at least one chronic health problem (Hoffman, Rice, & Sung, 1996).

Physiological changes associated with aging include: aerobic capacity decreases by 10% per decade, pulmonary function decreases, percentage of body fat increases, muscular strength is reduced, bone mass decreases, size and number of muscle fibers decrease, maximal stroke volume decreases, maximal cardiac output decreases, and movement time and reaction time decrease (Patricia & Deborah, 2002). After age 30, the strength of muscles declines steadily. At

first, the decline progresses slowly, however, after middle age, the decline is more rapid (American College of Sports Medicine, 1998a & 1998b; McArdle, Katch, & Katch, 1996). By age 65, strength is decreased by 20% and after age 70, the loss of strength is more dramatic (American College of Sports Medicine, 1998a & 1998b; Harries & Bassey, 1990; Larsson, 1978).

Loss of strength with increasing age results mainly from the substantial loss of muscle mass. Between the ages of 25 and 80 years the decrease of total muscle mass is about 40 to 50% (American College of Sports Medicine, 1998a & 1998b; Booth, Weedem, & Tseng, 1994; Brooks & Faulkner, 1994; Doherty, Vandervoort, Taylor, & Brown, 1993). Moreover, daily energy expenditure decreases with age which is also related to loss of muscle mass. If resistance training can increase muscle mass, there may be a concomitant increase in the metabolic rate. The decrease of muscle mass is due to changes in muscle fibers. Individual muscle fibers have a decrease in number and size (Doherty, Vandervoort, Taylor, & Brown, 1993; Frontera, Meredith, O'Reilly, Knuttgen, & Evans, 1988; Larsson, 1982; Lexell, Taylor, & Sjostrom, 1988). The decline is clearer in Type II fibers, which are used during high-intensity and short-duration movements such as lifting heavy objects or sprinting, although some of this apparent loss is due to motor unit remodeling (shift to type I fibers) and changes in the innervation of muscle fibers (Doherty, Vandervoort, Taylor, & Brown, 1993). Furthermore, neural and hormonal changes in old people can be lead by the some of the strength loss (Patricia & Deborah, 2002).

Decreased bone mass and structural debasement of bone tissue leads to fragility and increased susceptibility to fractures (U.S. Department of Health and Human Services, 1996). It induces osteoporosis which is a common condition afflicting 25 million Americans (Patricia & Deborah, 2002). Elderly having osteoporosis will have hip fractures (90% women and 17% men)

(U.S. Department of Health and Human Services, 1996) and 18 to 33% of those with a hip fracture will die within one year and have deteriorations in the quality of life (Ross, 1996; Wolinsky, Fitzgerald, & Stump, 1997). Osteoporosis is a skeletal disorder which is a condition with severe demineralization of bone tissue resulting in a reduced bone mass and microarchitectural deterioration of bone tissue (Beier, Maricic, & Staats, 1998; Cooper, 2003).

Flexibility is defined as the ability of a joint to move freely through its full range of motion. The most important factor that influences the amount of movement possible at a joint is the length and extensibility of muscles and connective tissue (tendons and ligaments). It is crucial to move each joint through its normal range of motion to keep good joint mobility (Patricia & Deborah, 2002). Roach & Miles (1991) found that the range of motion of the hip and knee was related to age. It showed that as age increased, range of motion decreased.

Balance is the ability to maintain the body's position over its base of support, whether the base is stationary or moving (Spiraduso, 1995). To maintain balance, many biological systems are important such as vision, the vestibular system (inner ear), the musculoskeletal system, and the somatosensory system. These systems have decreases with aging, leading to decreases in balance and postural stability (Era & Heikkinen, 1985; Woollacott & Shumway-Cook, 1990). During standing or locomotion, losing balance and falling is an increasing problem in the elderly. Falls cause over 2 million injuries, 369,000 admissions to the hospital, and 9,000 deaths, at a cost of \$8 billion per year (Rothschild & Leape, 2000). In the United States, one out of every three adults 65 years old or older falls each year (Sattin, 1992; Tinetti, Speechley, & Ginter, 1988).

Finally, adequate strength is necessary to keep basic activities of daily living such as getting in and out of the bathtub, rising from a chair, carrying groceries, and vacuuming. Strength is also important for preserving the ability to join social activities like dancing, travel,

and to continue hobbies such as gardening or woodworking (Spiraduso, 1995). Thus, with increasing age, maintaining strength is vital to health, functional abilities, and independent living.

The body's ability to use oxygen is the key to cardiorespiratory fitness because all of the major body systems are involved. The lungs get oxygen into the body from the atmosphere, the blood carries oxygen, and the heart pumps blood so that oxygen is carried to all parts of the body and the muscles use the oxygen to make energy for movement (Patricia & Deborah, 2002). Cardiorespiratory fitness is almost half of the age-related loss of muscle mass, increase of fat mass, and reduced physical activity (Jackson, Beard, Wier, Ross, Stuteville, & Blair, 1995; Jackson, Wier, Ayers, Beard, Stuteville, & Blair, 1996). The age-related decrease in VO_2max , which represents the greatest amount of oxygen that can be used by the body per minute of physical activity and can be accurately measured in a lab, is due to changes in the cardiovascular system from decreases in maximal cardiac output, heart disease, and stroke volume (Fleg, Connor, Gerstenblith, Becker, Clulow, Schulman et al., 1995; Ogawa, Spina, Martin III, Kohrt, Schecgtman, Holloszy et al., 1992; Stratton, Levy, Cerqueira, Schwartz, & Abrass, 1994; Wiebe, Gledhill, Jamnki, & Ferguson, 1999). Cardiovascular disease is the main cause of death in elderly adults (Patricia & Deborah, 2002).

Psychological changes associated with aging include: depression, anxiety, quality of sleep and other stress related emotions. Elderly with symptoms of severe depression are 15% of those age 65 to 79% of those age 80 to 84, and 23% of those 85 and older (Federal Interagency Forum on Aging-Related Statistics, 2000). Depression rates of old people who live in long-term care institutions are as high as 50% (Hogstel, 1995).

Effects of sedentary lifestyle and low-levels of physical activity on health

These changing health conditions due to aging induce a sedentary lifestyle, and a low-level of physical activity from this sedentary lifestyle plays a role in causing or exacerbating these health problems. McGinnis and Foege (1993) reported that 14% of all deaths in the United States was attributed to insufficient activity. Moreover, a low-level of physical activity (Stuck, Walthert, Nikolaus, Büla, Hohmann, & Beck, 1999) and a sedentary lifestyle (Blair, Kohl, Paffenbarger, Clark, Cooper, & Gibbons, 1989; Saltin, 1992) increased the risk in decline of functional status of muscular strength and endurance, flexibility, balance, cardiopulmonary, etc. (Frederiksen & Christensen, 2003). Therefore, these deteriorations can cause premature aging and declines in the ability to perform activities of daily living so that they have difficulty in completing their routine activities such as dressing, grooming, housekeeping (Blair, Kohl, Paffenbarger, Clark, Cooper, & Gibbons, 1989), and keeping social activities for their economy, travel, and hobbies.

Physical activity and health in older adults

Health benefits from physical activity in older adults

A key factor for healthy aging is regular physical activity (U.S. Department of Health and Human Services, 1996; Institute of Medicine, Division of Health Promotion and Disease Prevention, 1990). Regular physical activity contributes to the prevention and reduction of chronic diseases associated with aging, and helps maintain independent living (American College of Sports Medicine, 1998a; Galloway & Jokl, 2000).

Health benefits from regular physical activity include reduction in the risk of coronary heart disease, hypertension, type 2 diabetes, osteoporosis, ischemic stroke, selected cancers,

anxiety and depression (American College of Sports Medicine, 1993 & 2004; Hui & Rubenstein, 2006; Lee, Paffenbarger, & Hsieh, 1991; Powell, Thompson, Casperson, & Ford, 1987). Physical activity also increases fitness level, muscle strength, aerobic capacity, balance and bone mineral density (American College of Sports Medicine, 1998a; DiPietro, 2001; U.S. Department of Health and Human Services, 1996). In order to maintain or improve health, the American College of Sports Medicine and the Centers for Disease Control and prevention recommend at least 30 minutes of moderate intensity physical activity on most days of the week (Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995).

There are many studies related to exercise and physical functional ability of the elderly. Kalapotharakos, Michalopoulos, Tokmakidis, Godolias, & Gourgoulis (2005) demonstrated that older adults improved their functional performance with heavy and moderate resistance training, and task-specific resistance training improved the abilities of older adults to rise from a bed and from a chair (Alexander, Galecki, Grenier, Nyquist, Hofmeyer, Grunawalt et al., 2001). Three studies demonstrated that various exercise program such as strength training, rhythm, aerobic, flexibility, reaction, and balance exercises gave positive effects to elderly in the improvement of physical function and strength (Hessert, Gugliucci, & Pierce, 2005; Mihalko & McAuley, 1996; Puggaard, 2003). Exercise programs such as walking, swimming, and functional exercise circuit training showed the improvements of flexibility, grip strength, mobility, balance, range of motion, and gait characteristics for elderly (Alexander, Nickle, Boreskie, & Searie, 2000; Hubley-Kozey, Wall, & Hogan, 1995; Whitehurst, Johnson, Parker, Brown, & Ford, 2005). Frontera, Meredith, O'Reilly, Knuttgen, & Evans (1988) reported on twelve healthy untrained volunteers, men age 60 to 72, that participated 12 weeks in a strength training program (8 repetition/set; 3 sets/day; 3 days/week) at 80% of the one repetition maximum for extensors and

flexors of both knee joints. By 12 weeks, the strength of extensor increased 107.4% and flexor strength had increased 226.7%. Midthigh composition from computed tomographic scans showed an increase in total thigh area, total muscle area, and quadriceps area. Accordingly, strength gains were associated with significant muscle hypertrophy and an increase in myofibrillar protein turnover. Fiatarone & Carol (1990) studied ten frail elderly aged 90 ± 1 years that participated three times per week during 8 weeks of high-intensity resistance training. After 8 weeks, the 9 subjects who completed the training showed muscle strength of the knee gain averaged $174\% \pm 31\%$ (mean \pm SEM), midthigh muscle area increased $9.0\% \pm 4.5\%$, and mean tandem gait speed improved 48%. Thus, high resistance weight training leads to significant gains in muscle strength, size, and functional mobility among frail residents of nursing homes up to 96 years of age. Stephanie, Campbell, & Evans (2003) reported on 8 men and women aged 63-88 years with a diagnosis of dementia (Mini Mental Status Exam scores that ranged from 13-20) that participated and completed successfully a group resistive training program held twice a week for 12 weeks in order to assess muscle strength, power and physical functional abilities. In the comparison of pre-training versus post-training, muscle strength and power were increased for the hip abductor/adductor, shoulder press, leg extension/curl and chest/back exercise although there were no measurable improvements of functional abilities, including balance, the timed chair stand, gait speed or the timed stair climb.

Kemmler, Wildt, Engelke, Pintag, Pavel, Bracher et al. (2003) reported that during exercise, growth hormone levels increased by 80% over baseline, at the same time, cortisol levels decreased. Hormonal changes through exercise can give significant effects on bone mineral density that protect against loss and stimulate new bone formation. Bone cells are very susceptible to exterior stress such as high intensity exercises that are required to provide enough

mechanical load as the stimulus for new bone formation, although the stress produces transient deformation of the bone (Turner & Robling, 2003). For the optimum increase in bone mineral density from exercise, the intensity of the exercise program must be much greater than that of normal activities of daily living (Beck & Snow, 2003). The bone reacts better to high loads with low frequency than to high frequency with low loads (Hazzard, Blass, Ettinger, Halter, & Ouslander, 1998). Resistance and weight-bearing exercises are more effective for bone mineral density than endurance exercise (Bonajuti, Shea, Jovine, Negrinj, Robinson, Kemper et al., 2002; Marcus, Drinkwater, Dalsky, Dufek, Raab, Slemenda et al., 1992; Turner, Bass, Ting, & Brown, 2002; Taafee, Robinson, Snow, & Marcus, 1997). Resistance exercise can stimulate whole-body bone mineral density (Nelson, Fiatarone, Morganti, Trice, Greenberg, & Evans, 1994), while endurance exercises tend to be focused only on lower extremity bone mineral density stimulation, excluding spine and upper extremity bones (Benton & White, 2006).

During exercise, muscles can get more than 85% of cardiac output because circulatory control mechanisms carefully keep the balance for maintaining blood pressure with the increased metabolic demands of exercising muscle. At the same time, peripheral resistance decreases during exercise because of the great increase of blood flow to working skeletal muscles.

Average systolic blood pressure increases throughout the life span, while diastolic blood pressure increases until age 55 to 60 years and then decreases or levels off. Therefore, prevalence of high blood pressure is increased in older adults because of an increase in isolated systolic hypertension (Brooks, Fahey, & White, 1995). For the treatment or prevention of high blood pressure, weight loss, decreased sodium intake, increased physical activity and medication are recommended (Hazzard, Blass, Ettinger, Halter, & Ouslander, 1998). Physical activity or fitness lower blood pressure and meta-analysis of randomized controlled trials have determined that

chronic dynamic aerobic endurance training can decrease blood pressure (Fagard, 2002; Fagard & Cornelissen, 2005). Fagard (2005) showed that a higher level of physical activity or fitness led to a lower incidence of hypertension. Moreover, physical activity may reduce body weight which is a risk factor of high blood pressure by increasing the energy expenditure during exercise (Long, 1985; Horton, 1988; Barrett-Connor, 1989).

It is well known that for managing diabetes, doing regular physical activity, maintaining a healthy weight, and consuming fresh fruit and vegetables are recommended (American Diabetes Association, 1994; Roman & Harris, 1997).

Norris, Carroll, & Cochrane (1990) examined 77 men age 20 to 50 who did aerobic and anaerobic training three times a week for 10 weeks. After training, subjects had reduced job stress, and improved life satisfaction and health. Blumenthal, Emery, Madden, George, Coleman, Riddle et al. (1989) studied 50 men and 51 women with the mean age of 67 who did a 4 month exercise program three times a week for 45 minutes. Depression in the men was reduced but women had no change and the program didn't affect life satisfaction. A study of 8 men and 40 women with the mean age of 72 who did one hour fitness class three times a week for 16 weeks did not see change in any psychological variables (Emery & Gatz, 1990). Toshima, Kaplan, & Ries (1990) studied 87 men and 32 women with a mean age of 62.6 who participated in individually prescribed progressive walking 2 times a week for 8 weeks. The walking program did not improve well-being or depression.

Issues of physical activity in older adults

Although regular physical activities lead to promotion of health and function (Buchner & Wagner, 1992), persons over 50 years old represent the greatest sedentary segment of the

population (U. S. Department of Health and Human Services, 1996) and the number of adults over 60 years old engaging in exercise is very low (Blair, Kohl, Paffenbarger, Clark, Cooper, & Gibbons, 1989; Seeman, Charpentier, Berkman, Tinetti, Guralnik, Albert et al, 1994). Only 30% of people over 65 years old participate in exercise regularly (National Center for Health Statistics, 1997) and less than 10% engage in vigorous physical activity (Heath, Hagberg, Ehsani, & Holloszy, 1981).

There are several reasons given for avoiding physical activity. Many exercise programs do not maintain motivation because they become inconvenient, boring and monotonous, resulting in the participants returning to their sedentary lifestyle after finishing the program (Patricia & Deborah, 2002). Exercise programs may not be accessible to all ability levels and exercise equipment or fees can be relatively expensive (Restuccio, 1992). Also, injuries from physical activity may reduce participation in beneficial activities (Powell, Heath, Kresnow, Sacks, & Branche, 1998). Moreover, many forms of exercise do not involve all members of the family (Restuccio, 1992). Therefore, older adults can easily lose interest to exercise and cannot find the motivation to maintain regular physical activity.

Predictors of physically active lifestyle in older adults

The predictors for a physically active lifestyle in older adults were determined to be a high self-efficacy, regular engagement with friends and family, finding footpaths safe for walking, and access to local facilities (Booth, Owen, Bauman, Clavisi, & Leslie, 2000). Social support such as childhood encouragement in physical activities, current exercise level, larger family size, and younger age were also predictors for an active later life (Cousins, 1995). Elderly in a nursing home in Finland reported that good health status, self-rated functioning, depressive symptoms,

and contentment with life in the nursing home were predictors of a physically active lifestyle (Ruuskanen & Parkatti, 1994). Trost, Owen, Bauman, Sallis, & Brown (2002) summarized in a review paper on physical activity determinants that age, gender, socioeconomic status, occupational status, educational attainment, overweight or obesity, and physical activity self-efficacy reported consistent determinants of physical activity behavior.

Changing sedentary lifestyle of older adults to active is not an easy task because of many reasons and barriers to physical activity such as insufficient time, too tiring, too weak, fear of falling, bad weather, no facilities, and lack of exercise partners (Lian, Gan, Pin, Wee, & Ye, 1999). Accordingly, many approaches have been tried to change the lifestyle of older adults. Märki, Georg, Nigg, Conca-Zeller, & Gehring (2006) reported that an exercise promotion program based on the trans-theoretical model increased exercise behavior of older adults during the one year observation. As another approach, motivational interviewing, which is derived from client-centered counseling, cognitive-behavioral therapy and social-cognitive theory (Brodie & Inoue, 2005) has been recommended by many researchers (Hillsdon, Thorogood, & Anstis, 1995; Loughlan & Mutrie, 1995). When older adults with heart failure participated in a traditional exercise program, an exercise program with motivational interviewing, or both treatments, motivational interviewing group and receiving both treatments showed increasing level and type of activities (Brodie & Inoue, 2005). Telephone based counseling for encouraging physical activity of older adults strongly increased their physical activity (Kolt, Oliver, Schofield, Kerse, Garrett, & Latham, 2006).

Gardening for health in older adults

Gardening as a physical activity for health in older adults

Gardening is a popular leisure-time activity of people aged 65 years or older (Yusuf, Croft, Giles, Anda, Casper, Caspersen et al., 1996). Gardening has strong potential for influencing the health of older adults. Gardening has been associated with improved physical and psychosocial health outcomes such as lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration (Armstrong, 2000; Walsh, Pressman, Cauley & Browner, 2001).

Gardening is a physical activity for health benefits because gardening tasks are a moderate intensity physical activity (Ainsworth, Haskell, Whitt, Irwin, Swartz, Strath et al., 2000). Gunn, Brooks, Withers, Gore, Plummer, & Cormack (2005) and Withers, Brooks, Gunn, Plummer, Gore, & Cormack (2006) reported that lawn mowing is a moderate intensity physical activity in females and males aged 55-65 years old. Moreover, gardening activity incorporates many important elements of accepted exercise regimes such as stretching and stance, repetition and movement and even resistance principles similar to weight training while expending calories. Relf (1973) stated that specific activities in gardening have the possibility to improve muscle coordination and train unused muscles. For example, transplanting of seedlings can be used to practice grasp and release and flexion of the thumb and forefinger. Restuccio (1992) examined the relationships between the parts of muscles and gardening activities in his book, *Fitness the Dynamic Gardening Way*.

Gardening provides an adequate and challenging workout, but not as stressful to the body as other exercise such as jogging and aerobics (Restuccio, 1992). Gardening activity is suitable for older adults because it can be adapted to various levels of physical ability (Giancone, 1979;

Langford, 1984; Relf, 1981; Riordan, 1983; Shoemaker & Lauer, 1979). Gardening in a community or home environment has benefits for management and prevention of diabetes (Diabetes Health Connection, 2005).

Regular physical activity is very effective for the improvement of insulin sensitivity and glycemic control by changing muscle metabolism in Type II diabetes (Boule, Haddad, Kenny, Wells, & Sigal, 2001; Tuomilehto, Lindstrom, Eriksson, Valle, Hamalainen, Ilanne-Parikka et al., 2001; Van Dam, Schuit, Feskens, Seidell, & Kromhout, 2002; Quandt, Stafford, Bell, Smith, Snively, & Arcury, 2006; Helmrich, Ragland, Leung, & Paffenbarger, 1991; The Diabetes Prevention Program Research Group, 2006). Physical activity increases peripheral sensitivity to insulin, especially in skeletal muscle and adipose tissue (Horton, 1991; Pescatello & DiPietro, 1993; Feskens, Loeber, & Kromhout, 1994), and it increases the number and activity of GLUT-4, which is a type of glucose transporter protein in muscle, so that glucose transport metabolic system is activated (Brooks, Fahey, & White, 1995). In addition, physical activity can reduce the side effects of the disease such as cardiovascular disease (Gregg, Gerzoff, & Caspersen, 2003). Accordingly, individuals who joined in more than one physical activity including gardening for at least 30 minutes on most days of the week got improvement for insulin sensitivity and glycemic control and decreased need for oral medications or insulin (Will, Strauss, Mendicino, Ballew, White, & Peter, 1997; Wood, 2002 & 2003). Moreover, physical activity may reduce body weight which is a risk factor of diabetes mellitus by increasing the energy expenditure during exercise (Long, 1985; Horton, 1988; Barrett-Connor, 1989).

Turner, Bass, Ting, & Brown (2002) reported that gardening is an activity which is expected to influence whole body bone mineral density because it includes weight-bearing motions such as pushing a mower, digging holes, pulling weeds, carrying soil, etc. and because it

uses the whole body. In study, yard work and weight training were strong and positive predictors for bone mineral density rather than other physical activities such as jogging, swimming, calisthenics, bicycling, aerobic, walking and dancing.

Reynolds (1999) reported that gardening could improve grip strength of participants after 6 months and cardiovascular fitness was expected because gardening activities could elevate heart rate of participants. Moreover, older gardeners reported from the Short Form 36 health survey that they had positive health conditions such as physical function, bodily pain, vitality, social functioning, and mental health. It can be assumed that gardening may improve or manage physical function, pain, vitality, social activities and psychological well-being. In another study, Reynolds (2002) reported improvement of participants to mental health and depression through gardening after 3 months. Moreover, home and community gardeners reported psychological well-being (Kaplan, 1973; Ulrich, 1981) and social well-being (McBey, 1985; Sommer, Learey, Summitt, & Tirrell, 1994) from gardening.

Additional benefits of gardening for older adults

Gardening is a long-term focus activity (Restuccio, 1992), because it can lead to a responsibility for taking care of a garden continuously (Relf, 1981). Accordingly, gardening helps maintain motivation continuously and as a result they can maintain their health through an active lifestyle.

Powell, Heath, Kresnow, Sacks, & Branche (1998) reported that gardening is an activity with less injury than other activities such as weightlifting, outdoor bicycling, and aerobics in older adults. Another advantage of gardening is that brain activity of the right hemisphere from gardening can contribute to emotional origins of psychosocial dysfunction (Kaplan, 1973 &

1976). Kaplan (1973) suggested a hypothesis that humans have a basic psychological need for plants in the environment. Home and community gardeners reported psychological well-being (Kaplan, 1973; Ulrich, 1981) and social well-being (Sommer, Learey, Summitt, & Tirrell, 1994) from gardening. Milligan, Gatrell, & Bingley (2004) reported that older adults had a sense of achievement, satisfaction, and aesthetic pleasure through their gardening.

Gardening is already one of the most popular leisure-time activities in America (Charles, 1990). Gardening supplies fun, excitement and curiosity through observing or enjoying nature. Sharing the harvest or working with family members, friends, and neighbors can promote social cohesion (Restuccio, 1992) and provide economic benefits from garden produce.

Gardening outdoors can help vitamin D formation which is decreased by aging. Vitamin D is composed in the skin after exposure to sunlight or ultraviolet light and released into the bloodstream so that it can be bound to a carrier protein and transported to the critical metabolism sites such as liver and kidney (Hazzard, Blass, Ettinger, Halter, & Ouslander, 1998; Lips, 2006).

Summary

The population of older adults has increased rapidly. The older adults may live longer, but they may not live active, happy, and independent lives because of biological changes, chronic diseases, functional disability and psychological problems. A sedentary lifestyle and low-level of physical activity plays a role in causing or exacerbating these health problems. For healthy aging, regular physical activity contributes to the prevention and reduction of chronic disease associated with aging, and helps maintain independent living. However, the numbers of older adults participants in physical activity is low and motivation to maintain regular physical activity can be difficult to maintain because of inconvenient, boring, or monotonous. Meanwhile, gardening is a popular leisure-time activity in older populations and is a physical activity for health benefits because gardening tasks are moderate intensity physical activity, which can contribute to health maintenance and improvement. Gardening is associated with health benefits such as increased hand function ability, bone mineral density, lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration. Gardening activity incorporates many important elements of accepted exercise regimes such as stretching and stance, repetition and movement and even resistance principles similar to weight training while expending calories. Gardening activity is suitable for older adults because it can be adapted to various levels of physical ability.

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**CHAPTER 3 - EXERCISE INTENSITIES OF GARDENING
TASKS IN OLDER ADULTS**

Abstract

To determine exercise intensity of common gardening tasks, heart rate (HR) was measured continuously via radiotelemetry while men and women aged 71-85 years old completed nine garden tasks. Oxygen uptake (VO_2) and energy expenditure (EE) were measured via indirect calorimetry using a submaximal graded exercise test (GXT). The HR and VO_2 values from the GXT were used to estimate gardening VO_2 ($\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$), EE ($\text{kJ} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$), percent of HR reserve (% HRmax) and metabolic equivalents (METs). The gardening tasks tested were determined to offer low to moderate intensity physical activity (PA) (1.6-3.6 METs). Garden tasks (digging, turning compost, raking, transplanting plants, and mulching), which work the upper and lower body, elicit moderate intensity PA (2.5 ± 0.5 to 3.6 ± 0.8 METs) and the tasks (hand weeding, mixing soil, filling containers with soil, and transplanting seedlings) that work primarily the upper body offer low intensity PA (1.6 ± 0.5 to 2.3 ± 0.9 METs).

Key Words: energy expenditure, heart rate, oxygen uptake, physical activity, metabolic equivalents, indirect calorimetry

Introduction

Regular physical activity (PA) is a crucial factor for healthy aging (American College of Sports Medicine, 1998; Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995). Regular PA contributes to health through maintenance or improvement of functional capacity, independence and quality of life (American College of Sports Medicine, 1998). Health benefits of PA include reduction in the risk of coronary heart disease, hypertension, type 2 diabetes, osteoporosis, ischemic stroke, selected cancers, anxiety and depression (American College of Sports Medicine, 1993; American College of Sports Medicine, 2004; Hui & Rubenstein, 2006; Lee, Paffenbarger, & Hsieh, 1991; Powell, Thompson, Casperson, & Ford, 1987). Physical activity also provides improvement in fitness level, muscle strength, aerobic capacity, balance and bone mineral density (American College of Sports Medicine, 1998; DiPietro, 2001; U.S. Department of Health & Human Services, 1996). Thus, PA provides numerous health benefits, not only reductions in obesity but also a protective mechanism against physical and mental decline, morbidity, and mortality in older adults. Based on compelling evidence from the research literature, the American College of Sports Medicine and the Centers for Disease Control and Prevention recommend PA for improved health, which is at least 30 minutes of moderate intensity PA on most days of the week (Nelson, Rejeski, Blair, Duncan, Judge, King et al., 2007; Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995).

Gardening is a prevalent type of PA preferred among many older adults (Armstrong, 2000; Walsh, Pressman, Cauley, & Browner, 2001). In the U.S., 69% of men and 75% of women aged 65 years or older reported participation in gardening as a form of leisure-time PA (Yusuf, Croft, Giles, Anda, Casper, Caspersen et al., 1996). A variety of gardening tasks were calculated at moderate intensity PA in adults based on published and unpublished data of energy costs of more

than 500 PAs (Ainsworth, Haskell, Whitt, Irwin, Swartz, Strath et al., 2000). Gunn, Brooks, Withers, Gore, Plummer & Cormack (2005) and Withers, Brooks, Gunn, Plummer, Gore, & Cormack (2006) reported that lawn mowing is a moderate intensity PA in female and male adults aged 55-65 years old. Moreover, gardening has been associated with improved physical and psychosocial health outcomes such as lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration (Armstrong, 2000; Walsh, Pressman, Cauley, & Browner, 2001). Accordingly, can gardening be used as a form of PA to meet the current PA recommendations in adults over 65 years of age?

Although a few gardening tasks have been reported as forms of moderate intensity PA in the literature (Ainsworth, Haskell, Whitt, Irwin, Swartz, Strath et al., 2000), there is limited research that has directly determined the exercise intensity of various garden tasks in older adults. Therefore, the purpose of this study was to determine the exercise intensity of nine common gardening tasks in older adults.

Methods

Subjects

6 males and 2 females (age ranged 71-85 years old) were selected among approximately 40 recruited older adults from the community of Manhattan, KS based on subject criteria and the volunteers' availability. Criteria for participation included no uncontrolled chronic diseases, no heart and lung diseases, no pace maker, ability to kneel, non-smoker, and physician's consent. Subjects were asked to not consume caffeine and to eat breakfast at least 3 hours before arrival to reduce the thermal effect of food. Subjects were also asked to wear comfortable clothes and

shoes for gardening. Written informed consent was obtained at an orientation that explained the experimental procedures, possible risks (physical fatigue), and how their participation would contribute to a health issue of older adults. All volunteers provided written consent from their primary healthcare provider prior to beginning the investigation. The Kansas State University Committee for Research Involving human subjects (IRB) approved this study.

Demographic information

A demographic questionnaire was developed and included questions on age, gender, race, education, marital status, employment status, current chronic diseases (CDs), limited activity from CDs, confidence to garden, and patterns of moderate PA in their daily life. The questionnaire also included the Short Form 36 Health Survey (SF-36), which assesses eight health concepts: physical functioning, usual role activities (physical), bodily pain, general health, vitality, social functioning, usual role activities (emotional), and mental health (Ware, Snow, Kosinski, & Gandek, 1993). The SF-36 was scored using SF Health Outcomes Scoring Software (QualityMetric, Lincoln, RI, USA).

Procedures

This study was conducted in the fall of 2005, from September 26 to October 10. Sixteen 8' × 4' garden plots were created for this study in the K-State Gardens on the campus of Kansas State University (K-State). Located next to the garden plots were 4 compost bins (1.2 m × 1.1 m × 0.9 m for one bin) with compost and a grassy area with weeds. Nine gardening tasks were performed by the subjects in the morning (Table 3.1).

Our criteria for choosing the nine gardening tasks were to have a mix of tasks performed in the ground and at a work bench with various motions such as kneeling, squatting, bending or standing. The subjects did each task for 10 minutes followed by a 5-minute resting time while sitting on a chair. In preliminary work, a 10-minute task time determined to be sufficient time for reaching maximum heart rate (HR) of older adults for each garden task and a 5-minute resting time was sufficient time for their HR to return to their resting HR. Each set of tasks was replicated twice on different days in the same week. The subjects could freely take a rest during the garden tasks because of fatigue, although no one did this. The average weather conditions were: temperature = 19.7 ± 2.1 °C and relative humidity = 66.9 ± 2.2 %.

Descriptions of gardening tasks

The testing session began with a warm up in the indoor Visitors Center where the subjects stretched for 4 minutes along with a video (Exercise: A Video from the National Institute on Aging, USA, 2004) for persons over 50 years old. Subjects then walked outdoors for 6 minutes ending at the garden plots. In week one, the testing session included hand weeding, raking, digging, and turning compost. The second week tasks were transplanting plants, mulching, mixing soil, filling containers with soil, and transplanting seedlings. The order of gardening tasks was based on preliminary work and to reflect regular home gardening. Simplified average HR patterns of the nine gardening tasks and resting periods from the eight subjects are shown in Figure 3.1.

Dependent variables

The subject's HR was continuously measured and recorded via radiotelemetry (Polar S 610i, Finland) during gardening. For data analysis, the initial minute of HR measured during each gardening task and during the rest period was not used in order to reduce noise between the end and beginning of a task.

Based on the gardening HR measurements, oxygen uptake (VO_2) was measured by using a submaximal graded exercise test (GXT). The subjects wore a mask over their mouth with their nose plugged and a HR monitor (Polar S 610i, Finland) under their breast while they walked on the treadmill (Precor, 964i, USA, 1997) with different speeds and elevations until reaching their gardening maximum HR (HR max). Expired gases were directed to a ParvoMedics metabolic cart (Provo, UT) through a Hans-Rudolph (Kansas City, MO) non-rebreathing mouthpiece. The flow meter and gas analyzers were calibrated prior to testing. While portable indirect calorimeters or the Douglas bag method are the standard for this type of measurement, the high cost of these methods and the invasiveness of wearing the mask while gardening deemed them inappropriate for this study.

The VO_2 and MET values for each gardening task were derived from the laboratory VO_2 treadmill test. The energy expenditure (EE) of each gardening task was calculated ($\text{kJ/kg/hour} = \text{kal/m} \cdot (4.186 \cdot 60) / \text{kg}$ of body weight). Percent HRmax was also calculated ($\% \text{HRmax} = (\text{Average gardening HR} - \text{Average resting HR}) / (\text{HRmax} - \text{Average resting HR}) \cdot 100$). Descriptive information on the subjects included height, weight, body mass index (BMI), resting HR, and age-predicted HRmax. Height and weight were measured with a wall stadiometer (Seca 216 Stadiometers, USA) and electronic balance (Ohaus, ES200L, USA). Body mass index ($\text{BMI} = \text{mass (kg)} / \text{height (m)}^2$) and age-predicted HRmax ($\text{Age-predicted HRmax} = 220 - \text{age}$) were calculated. METs are expressed in terms of oxygen consumption per unit body mass: $1 \text{ MET} = 3.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$.

Moderate PA is activity performed at an intensity of 3-6 METs (Pate, Pratt, Blair, Haskell, Macera, Bouchard et al., 1995). Physical activity measured below 3 METs is considered low intensity and above 6 METs is considered high intensity.

Data analysis

Duncan's multiple range test and t-test were used to compare means at $p=0.05$ by the Statistical Analysis System (SAS version 9 for Windows, SAS Institute Inc, Cary, NC, USA).

Results

Demographic information

Descriptive characteristics and self-reported overall physical and mental health conditions of the subjects are presented in Tables 3.2 and 3.3, respectively. All subjects reported no limited activity due to CDs (Table 3.2). Self-reported SF-12 health survey scores (Table 3.3) were compared to standard values of adults over 75 years old (Ware, Kosinski, Turner-Bowker, & Gandek, 2002). The physical and mental health summary score of the subjects were 49.14 and 54.89, respectively and the standard values were 39.75 and 48.89 (Ware, Kosinski, Turner-Bowker, & Gandek, 2002). Based on these results, the older adult subjects were determined to be healthy.

The definition of moderate intensity PA given to the subjects was 'Moderate PA or exercise includes activities such as gardening, yardwork, brisk walking, swimming, cycling, and dancing. Moderate activities cause a small increase in breathing or heart rate. You should be able

to carry on a conversation when doing moderate activities' (Marcus & Forsyth, 2003). Subjects reported participating in moderate intensity PA four times in a typical week. Average time spent doing moderate intensity PA was two hours per day. Moderate intensity PAs reported most frequently were gardening, yard work, mowing the lawn, walking, using exercise machines, and swimming. When asked about their confidence to garden, 75% reported they were completely sure they could garden for 30 minutes or more on five or more days in a week; and 12.5% were certain they could garden 30 minutes or more on two days in a week (doesn't total 100% due to one missing data).

Exercise intensities of gardening tasks

Gardening tasks were low to moderate intensity PA in healthy older adults (1.6-3.6 METs) (Table 3.4). Energy expenditure and METs were significantly different ($p < 0.0001$) between the low intensity and moderate intensity gardening tasks (Table 3.5). Digging, turning compost, raking, transplanting plants, and mulching were found to be moderate intensity PA (2.5 ± 0.5 to 3.6 ± 0.8 METs) and hand weeding, mixing soil, filling containers with soil and transplanting seedlings were shown to be low intensity PA (1.6 ± 0.5 to 2.3 ± 0.9 METs). Digging and turning compost were significantly ($p < 0.0001$) more intense than hand weeding, mixing soil, filling containers with soil, and transplanting seedlings (Table 3.4).

Discussion

Nine common gardening tasks were determined to provide low to moderate intensity PA (1.6-3.6 METs) for healthy older adults (Table 3.4). This suggests that gardening may provide

the same health benefits received from nongardening forms of PA such as decreased risk for coronary heart disease, hypertension, type 2 diabetes, osteoporosis, ischemic stroke, musculoskeletal function, selected cancers, obesity, and anxiety and depression (American College of Sports Medicine, 1993; Helmrich, Ragland, Leung, & Paffenbarger, 1991), and increased functional capacity, muscle strength, aerobic capacity, balance, bone mineral density and overall quality of life (American College of Sports Medicine, 1998; King, Taylor, Haskell, & DeBusk, 1989). Reynolds (2002) reported that gardening activities were expected to improve cardiovascular fitness due to elevated HR during gardening. This study also showed increased HR patterns of older gardeners through garden tasks (Table 3.4 and Figure 3.1).

Garden tasks that used both the upper and lower body such as digging, turning compost, raking, transplanting plants, and mulching were shown to be moderate intensity PA. The tasks that used primarily the upper body such as hand weeding, mixing soil, filling containers with soil, and transplanting seedlings were low intensity PA (Table 3.4). Knowing the exercise intensity of various gardening tasks could be valuable information when gardening activities are applied to older adults for therapeutic purpose according to their health conditions or various levels of physical ability.

Participation in regular PA can improve health and reduce the risks for most chronic diseases (Pate, Pratt, Steven, Blair, William, Haskell et al., 1995). Physical inactivity was associated with 35% of U.S. deaths in 2000 (Mokdad, Marks, Stroup, & Gerberding, 2004). A low-level of PA results in increased risk in decline of functional status of muscular strength and endurance, flexibility, balance, cardiopulmonary function, etc. (Stuck, Walthert, Nikolaus, Büla, Hohmann, & Beck, 1999). In spite of the health benefits from PA, many older adults still remain sedentary (Hui & Rubenstein, 2006). Only 30% of adults 65-74 years old and 15% of adults over

75 years old participated in regular leisure-time PA in 1999-2001 (Schoenborn, Adams, Barnes, Vickerie, & Schiller, 2004).

There are several reasons given for avoiding PA. Many exercise programs do not maintain motivation because they become inconvenient, boring and monotonous, resulting in the participants returning to their sedentary lifestyle after finishing the program (Garber & Blissmer, 2002). Exercise programs may not be accessible to all ability levels and exercise equipment or fees can be prohibitive (Restuccio, 1992). Injuries from PA may reduce participation in beneficial activities (Powell, Heath, Kresnow, Sacks, & Branche, 1998). Activity-related musculoskeletal injury is one of the most common barriers to exercise for the elderly. Older adults take more time before returning to activity after injury when compared to younger age groups and may even avoid PA thereafter (Galloway & Jokl, 2000). Moreover, many forms of exercise do not encourage involvement of or allow other members of the family to participate, which may decrease one's desire to partake in that form of PA (Restuccio, 1992). Therefore, interest in exercising and motivation to maintain regular PA is difficult to uphold.

Gardening can address many of the reasons given for avoiding PA. Gardening is one of the most popular leisure-time activities in the U.S. (Yusuf, Croft, Giles, Anda, Casper, Caspersen et al., 1996), and it supplies fun, excitement and curiosity through observing or enjoying nature. Also, sharing an abundant harvest or working with family members, friends, and neighbors promotes social cohesion (Restuccio, 1992). Economic benefits can be experienced by selling extra produce or having a reduced grocery bill. Gardening is a long-term focused activity (Restuccio, 1992) because a garden requires regular and continuous care (Relf, 1981). Moreover, gardening is an activity which includes weight-bearing motions such as pushing a mower, digging holes, pulling weeds, carrying soil, and can work most muscle groups of the whole body

(Turner, Bass, Ting, & Brown, 2002), but is not as stressful to the body as other exercise such as jogging and aerobics (Powell, Heath, Kresnow, Sacks, & Branche, 1998). Gardening activities are suitable for older adults because they can be adapted to various levels of physical ability (Restuccio, 1992; Riordan, 1983) and its benefits can delay the onset of disease. Home and community gardeners reported psychological well-being (Kaplan, 1973; Ulrich, 1981) and social well-being (Sommer, Learey, Summitt, & Tirrell, 1994) from gardening.

In summary, gardening provides many psychological and social benefits to older adults, involves caring for living plants, is currently a popular leisure-time activity, and the present data demonstrate gardening is a form of moderate intensity PA. Furthermore, these results suggest future research should consider if gardening can be an effective method to maintain motivation.

A limitation of this study was the small subject number. The study is still of value though since there is no known preliminary research that has determined exercise intensity of gardening tasks in an actual garden. Future research is needed to determine the exercise intensities of more gardening tasks and the gardening intensity of older gardeners in a practical garden setting.

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Tables and Figure

Table 3.1. Descriptions of gardening tasks performed by the subjects

Gardening tasks ^a	Descriptions
Hand weeding	With a hand fork (0.1 kg), squatting or sitting in a grassy area with weeds, some moving as they completed an area
Raking	With a rake (1.0 kg), raking up small stones, bark and weeds in an 8' × 4' garden plot
Digging	With a shovel (1.7 kg), digging a raked 8' × 4' garden plot (did not make a big hole)
Turning compost	With pitch fork (1.5kg), turning compost in previously prepared compost bins (1.2 m × 1.1 m × 0.9 m)
Transplanting plants	With hand trowel (0.2 kg), transplanting tomato plants (average 15 plants per each person) in an 8' × 4' garden plot
Mulching	With straw, applied mulch around the transplanted plants in an 8' × 4' garden plot
Mixing soil	With a bucket, mixing soil in the bucket with their hands, adding water from water can and mixing with soil
Filling containers with soil	With 4 cm pots, filling pots with soil by hands or small container (average 65 pots per each person)
Transplanting seedlings	With tomato seedlings, transplanting seedlings from the tray by making a hole with finger in the center of the pots (average 25 transplants per each person)

Note. ^aSubjects were standing for all gardening tasks except hand weeding.

Table 3.2. Descriptive characteristics of 8 participants

	Mean	SD
Age (years)	77.4	4.1
Height (cm)	169	7.6
Body weight (kg)	82.9	13.3
Body mass index (kg · m ⁻²)	29.2	5.4
Resting HR ^a (bpm)	71.0	9.0
Age-predicted HR _{max} (beats min ⁻¹)	142.6	4.1
		Percentage (%)
Race	White	100
Current CDs ^b	None	12.5
	High blood pressure	25
	Diabetes	25
	Cancer	25
	Arthritis	37.5
	Asthma	25
	Blood clots	12.5
	Memory loss	12.5
Limited activity from CDs	Yes	0
	No	100

Education	Undergraduate	37.5
	Graduate	62.5
Marital status	Married	87.5
	Divorced	12.5
Employment status	Retired	75
	Homemaker	12.5
	Part-time	12.5

Note. ^aHR: Heart rate. ^bCDs: Chronic diseases.

Table 3.3. Average SF-36 Health Survey scores for 8 older adult subjects

SF-36 ^a	Standard ^b	Average
Physical Functioning	39.26	48.73
Usual Role Activities - Physical	40.38	49.17
Bodily Pain	45.01	51.24
General Health	43.46	51.65
Vitality	46.92	57.93
Social Functioning	46.85	51.71
Usual Role Activities - Emotional	43.36	50.07
Mental Health	50.57	54.70
Physical Health Summary	39.75	49.14
Mental Health Summary	48.89	54.89

Note. ^aThe Short Form 36 Health Survey. ^bStandard values for males and females over 75 years old from the SF-12 manual.

Table 3.4. Metabolic measurements for 9 different gardening tasks as performed by older adults

Gardening Activities	HR ^a (beats min ⁻¹)	HR _{max} (%)	VO ₂ (ml· kg ⁻¹ · min ⁻¹)	EE ^d (Kj · kg ⁻¹ · h ⁻¹)	METs ^e
Digging	100 ^b ±16 ^c A	66.8±18 A	12.6±3.0 A	15.7±3.8 A	3.6±0.8 A
Turning Compost	99±15 A	66.4±16 A	12.1±2.7 A	15.2±3.6 A	3.5±0.8 A
Raking	93±15 AB	31.6±17 B	9.4±3.5 AB	13.3±3.1 AB	2.7±1.0 AB
Transplanting Plants	88±13 AB	21.0±12 B	8.9±2.0 AB	11.1±2.4 ABC	2.6±0.6 AB
Mulching	88±14 AB	24.5±12 B	8.8±1.6 AB	10.3±2.6 BC	2.5±0.5 AB
Hand Weeding	85±14 AB	20.9±15 B	7.9±3.0 B	9.5±4.0 BCD	2.3±0.9 B
Mixing Soil	86±11 AB	24.6±13 B	7.6±2.2 B	9.8±2.2 BCD	2.2±0.6 B
Filling containers with Soil	83±13 AB	20.9±8 B	7.1±1.8 BC	8.8±2.2 BCD	2.0±0.5 BC
Transplanting Seedlings	81±11 AB	17.9±8 B	5.7±1.9 BC	7.4±2.2 CD	1.6±0.5 BC
Resting (5 min.)	71±9 B	14.6±8 B	3.4±0.6 C	5.0±0.7 D	0.9±0.2 C

Note. A, B, C, and D means sharing at least one common letter are not significantly different by Duncan's multiple range test at $p=0.05$.

^aHR: Heart rate.

^b and ^c indicate means and standard deviations of 8 subjects, respectively.

^dEE: Energy expenditure.

^eMETs: Metabolic equivalents.

Table 3.5. Classifying nine gardening tasks as low or moderate intensity physical activity based on the standard value of 3 METs

Exercise Intensity	EE ^c (Kj · kg ⁻¹ · h ⁻¹)	METs ^d
Gardening tasks low intensity ^a	8.9 ^e ±2.8 ^f	2.0±0.7
Gardening tasks moderate intensity ^b	13.1±3.7	3.0±0.9
<i>P</i> value	<.0001 ^{***}	<.0001 ^{***}

Note. Means are significantly different at $p < .0001$ by t-test.

^aGardening tasks with low intensity: The gardening tasks which had below 3 METs including standard deviation such as hand weeding, mixing soil, filling containers with soil, and transplanting seedlings.

^bGardening tasks with moderate intensity: The gardening tasks which had above 3 METs including standard deviation such as digging, turning compost, raking, transplanting plants, and mulching.

^c EE: Energy expenditure.

^d METs: Metabolic equivalents.

^e and ^f indicate means and standard deviation of the tasks selected based on the standard value of 3 METs.

^{***} $P < .0001$.

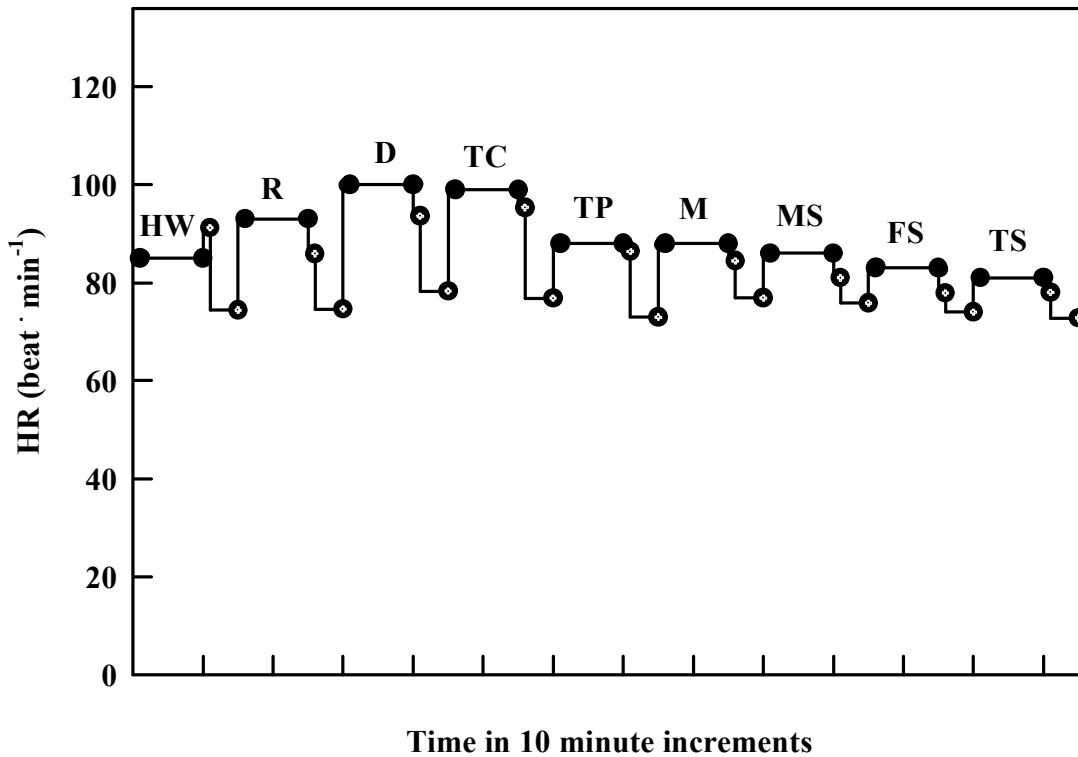


Figure 3.1. The average heart rate (HR) of 8 subjects for nine different gardening tasks

HW, R, D, TC, TP, M, MS, FS, and TS indicate hand weeding, raking, digging, turning compost, transplanting plants, mulching, mixing soil, filling containers with soil, and transplanting seedlings, respectively. The lines between ● and ● indicate the average value of performing a gardening task, and the lines between ○ and ○ indicate the average value of resting. The intervals between ● and ○ or ○ and ● represents the time walking between the garden test plot and the resting chair.

**CHAPTER 4 - CAN OLDER GARDENERS MEET THE
PHYSICAL ACTIVITY RECOMMENDATION THROUGH
GARDENING?**

Abstract

The objectives of this study were to investigate if older gardeners meet the physical activity (PA) recommendation of at least 30 minutes of moderate intensity PA on most days of the week through gardening and to examine their health conditions. Heart rate of 14 older gardeners (5 females, 9 males) was continuously measured during gardening through radiotelemetry. Oxygen uptake and energy expenditure were measured through indirect calorimetry using a graded exercise test. To know how long the subjects gardened and the kinds of gardening tasks performed, an observational study was conducted and weekly logs were completed by the subjects. To investigate their physical and mental health conditions, the Short-Form 36 Health Survey (SF-36) and questions on the weekly logs were used. Gardening was determined to be moderate intensity (3.8 ± 1.4 METs) PA. The subjects' average gardening time during the observational study was 53 minutes. The subjects reported gardening an average of 33 hrs in a typical week in May and almost 15 hrs in a typical week in June and July. Results from the SF-36 and health questions from the weekly logs indicated that the subjects were physically and mentally healthy. In conclusion, older gardeners can meet the PA recommendation from their daily gardening and it may be a factor in their good physical and mental health conditions.

Additional index words. metabolic equivalents (METs), moderate intensity PA, the Short-Form 36 Health Survey (SF-36), indirect calorimetry

Introduction

Approximately 90% of older people have at least one chronic health problem (Federal Interagency Forum on Aging Related Statistics, 2000; Hoffman, Rice & Sung, 1996). Biological changes, chronic diseases, functional disability and psychological problems are common phenomenon among the elderly (Dustman, Emmerson, & Shearer, 1994; Katz, 1983). Participation in regular physical activity (PA) may reduce and prevent many chronic diseases associated with aging, and help maintain independent living (American College of Sports Medicine, 1998; Galloway & Jokl, 2000). At least 30 minutes of moderate PA on most days of the week is recommended to maintain or improve health (Pate et al., 1995; Nelson et al., 2007).

Gardening is a popular leisure-time activity (men, 45%; women, 35%) of adults aged 65 years or older (Yusuf et al., 1996). Gardening has the possibility of offering the health benefits from PA for older adults. Reynolds (1999) reported that gardening improved grip strength of participants after 6 months in a pilot study of the Green Gym project and cardiovascular fitness was expected because gardening activities elevated the heart rate of participants during the Green Gym program, a project to encourage members of a local community to join conservation activities for improving health and the environment. Another study of the Green Gym project showed improvement in mental health and depression after 3 months of gardening (Reynolds, 2002). Moreover, gardening is an activity which is expected to influence whole body bone mineral density because it includes weight-bearing motions such as pushing a mower, digging holes, pulling weeds, carrying soil, and other gardening items and because it uses the whole body (Turner, Bass, Ting, & Brown, 2002). Turner, Bass, Ting, & Brown (2002) reported from their study that jogging, swimming and calisthenics were weak predictors for high bone density, while bicycling, aerobic, walking, and dancing were moderate predictors, and yard work and weight training were strong and positive predictors. Although there is some evidence of the positive

health benefits gardening offers as a form of PA, there is limited research reported that has specifically studied gardening for health in older populations.

In order to know the health benefits through gardening, we need to determine if gardening can be a PA for older adults. Accordingly, our preliminary research determined that nine common gardening tasks were low to moderate intensity PA in older adults (unpublished). Garden tasks which use both upper and lower body (digging, turning compost, raking, transplanting plants, and mulching) offered moderate intensity PA and tasks which use primarily upper body with standing or squatting postures (hand weeding, mixing soil, filling containers with soil, and transplanting seedlings) were low intensity PA. Therefore, our hypotheses for this study were that older gardeners meet the PA recommendation (exercise intensity, time spent gardening) through their daily gardening and their overall physical and mental health is healthy.

Methods

Subjects

Fourteen older gardeners (5 females, 9 males) 63-86 years old were recruited by phone or in person from the community of Manhattan, KS. Inclusion criteria were participants with no uncontrolled chronic diseases, no heart and lung diseases, no pace maker, and non-smokers. Participants were required to obtain their physician's consent prior to beginning the investigation. In an orientation, informed written consent was obtained after subjects were briefed on the experimental procedures and schedules. The Kansas State University Committee for Research Involving Human Subjects (IRB) approved this study.

Observational study

This study was conducted in Manhattan, KS at each subject's garden in June and July of 2006 in the morning or evening to avoid the hottest part of the day. Pretesting of the observational data sheet and training of the observers were done in the spring of 2006.

Two observers (a graduate student and an undergraduate student in the Department of Horticulture, Forestry and Recreation Resources at Kansas State University) visited the subject's garden twice for the observational study. The observational data sheet allowed the observers to easily mark the gardening tasks observed (kinds of gardening tasks and time amount). Using a stop watch, the observers recorded the time spent on each gardening task. The total amount of time spent gardening each time was also recorded and there was no limitation by the observers on how long the subjects gardened. Each subject did various gardening tasks which were planned by themselves. The subjects could do their garden tasks freely without any limitation or interference from the observers. All subjects gardened no more than 2 hours during the observations. The average temperature was 24.1 ± 3.3 °C and the relative humidity was 67.1 ± 21.8 % during gardening.

Metabolic measurements

During the observational study, each subject's heart rate (HR) was continuously measured by radiotelemetry (Polar S 610i, Finland). Each subject wore a HR monitor under their breast on the skin and had a wireless HR storage device on their wrist. The HR data were continuously recorded in the wireless storage from the start to the end of their gardening. After the two observational periods, subject's oxygen uptake (VO_2) was measured using a graded exercise test (GXT) in a lab. The subjects wore a mask over their mouth with their nose plugged and HR monitor (Polar S 610i, Finland) under their breast and then walked on a treadmill

(Precor, 964i, USA, 1997) at different speeds and elevations until reaching the maximum HR that had been measured while they were gardening. Expired gases were directed to a ParvoMedics metabolic cart (Provo, UT) through a Hans-Rudolph (Kansas City, MO) non-rebreathing mouthpiece. The flow meter and gas analyzers were calibrated prior to testing.

The HR and VO_2 measurements were used to calculate metabolic equivalents (METs) to determine the exercise intensity of gardening. One MET is a resting metabolic rate of $3.5 \text{ ml of } \text{O}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. Moderate intensity PA is considered to be in the range of 3-6 METs (Pate et al., 1995). The energy expenditure (EE) of gardening was calculated ($\text{kJ/kg/hour} = \text{kal/m} \cdot (4.186 \cdot 60) / \text{kg of body weight}$). Percent HRmax ($\% \text{ HRmax} = (\text{Gardening HR} - \text{Resting HR}) / (\text{HRmax} - \text{Resting HR}) \cdot 100$) was also calculated.

Descriptive information on the subjects included height, weight, body mass index (BMI), resting HR, and age-predicted HRmax. Height and weight were measured with a wall stadiometer (Seca 216 Stadiometers, USA) and electronic balance (Ohaus, ES200L, USA). Body Mass Index ($\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$) and age-predicted HRmax ($\text{Age-predicted HRmax} = 220 - \text{age}$) were calculated. Subjects sat on a chair before starting the GXT test and their resting HR data for 10 minutes was recorded.

Survey instruments

The self-reported health method is widely used for self-rated health determinants such as disabilities, chronic diseases, and symptoms like lack of energy and pain (Manderbacka, Lundberg, & Martikainen, 1999; Molarius & Janson, 2002; Noro & Aro, 1996; Shadbolt, 1997). We used the Short-Form 36 Health Survey (SF-36), which is a self-rated health survey for measuring perceived health status and assessed eight health concepts: the physical component

consists of physical functioning, role limitations due to physical health, bodily pain, and general health; the mental component consists of vitality, social functioning, role limitations due to emotional health, and mental health (Ware, Snow, Kosinski, & Gandek, 1993).

At an orientation meeting, subjects completed the SF-36 survey and a questionnaire written by the researchers with demographic questions and questions on time spent and frequency of gardening of each garden task, and kinds of gardening performed in May. Subjects were also given weekly logs to complete two times, one typical week in June and one typical week in July. The subjects were asked to record their gardening activities, time spent gardening, and frequency of gardening of each task on the weekly logs. The logs also included questions on their physical and mental health level after they gardened. Time and frequency were used to calculate average gardening time.

The SF-36 was scored by using SF Health Outcomes Scoring Software (QualityMetric, Lincoln, RI, USA).

Data analysis

For SF-36 data analysis to compare females and males, analysis of variance (ANOVA) was performed by the Statistical Analysis System (SAS version 9 for Windows, SAS Institute Inc, Cary, NC, USA). Fisher's Least Significant Difference (LSD) test was used to compare means at $\alpha=0.05$. To compare the self-reported health conditions of females and males, Pearson Chi-square tests were used at $\alpha=0.05$.

Results

Characteristics of subjects

The mean age of the female subjects (65 ± 3) was younger than males (76 ± 6) (Table 4.1). Fifty-seven percent of the subjects had home gardens, twenty-nine percent had a plot in a community garden, seven percent had a garden at a space remote from their home, and seven percent had a community garden and other space remote from their home.

Observational study

Older adults, when gardening in their own gardens, were performing moderate intensity (3.8 ± 1.4 METs) PA and gardened on average 60 ± 25 minutes during a gardening observation (Table 4.2).

The average exercise intensity of gardening in females (3.0 ± 0.9 METs) was less than male's (4.3 ± 1.5 METs), but both METs values were in the range of moderate intensity (3-6 METs). The gardening tasks performed by more than 50% of the subjects during the observational study are shown in Figure 4.1.

Self-reported time spent and tasks performed while gardening

The older gardeners reported that they spent an average of 15 hrs a week gardening in June and July. The garden tasks that were performed by more than 50% of the subjects during June and July are presented in Figure 4.2. The average time gardening in May was 33 hrs in a week. The garden tasks performed by more than 50% of older gardeners in May are shown in Figure 4.3.

Physical and mental health status

The older gardeners in this study were healthy. Comparing the SF-36 health determinates of the subjects with standard norms (Ware, Kosinski, Turner-Bowker, & Gandek, 2002) indicated that the health conditions of the older gardeners in this study were much healthier than their age cohort from the general population (Table 4.3).

When SF-36 scores of males and females were compared, males reported less bodily pain ($p < 0.025$) and higher physical health summary ($p < 0.027$) than females (data not shown). Most of the subjects ranked their physical and mental health after gardening as good, very good or excellent in their weekly logs (Table 4.4). There were no significant gender differences in self-reported physical and mental health.

Discussion

Older gardeners showed that they met the PA recommendation of at least 30 minutes of moderate intensity ($MET > 3.0$) PA on most days of the week through their daily gardening in May, June, and July (spring and summer). Moreover, the self-reported health conditions for physical and mental health were good. Therefore, gardening is a proper intervention for preventing or improving health conditions in older adults because it can offer moderate intensity PA and activities requiring a time commitment consistent with the recommendation of at least 30 minutes most days of the week.

The updated PA recommendation for older adults by the American College of Sports Medicine and the American Heart Association (2007) reported that older adults have to have an activity plan for achieving the recommended PA. In older adults with low fitness and currently not meeting the PA recommendation, PA should be increased gradually to the recommended

level with a plan, and gardeners can make their PA plan through gardening, considering their health condition and physical ability. Based on the progress of their health condition and ability, the gardeners can gradually increase the amounts of gardening tasks or garden size through self-monitoring and re-evaluating of their plan. Moreover, therapeutic garden designs and adapted tools can make gardening tasks for people with low fitness or abilities more assessable.

In this study, the garden tasks performed by more than 50% of the older gardeners while being observed gardening and from their gardening logs overlapped considerably. Even though the subjects HR was measured while gardening only on two days, this considerable overlap in observed and self-reported garden tasks suggests that the exercise intensity of their daily gardening can be considered as a moderate intensity PA.

Gardening tasks in May included two different tasks, trimming and planting seedlings or shrubs, compared to gardening tasks in June and July. This indicates that gardening is a dynamic activity because the garden tasks change according to the seasons and the plants growth cycles. Boredom is often a reason given for not exercising. However, gardening provides interest and change through the seasons so may foster an active lifestyle. With older adults a sedentary lifestyle is one of the factors for increased risk in decline of functional status of muscular strength and endurance, flexibility, balance, cardiopulmonary, etc. (Burbank & Riebe, 2002). Accordingly, gardeners are healthy from avoiding a sedentary lifestyle. On the other hand, the seasonality of gardening can be a limitation factor for regular PA. Mobily et al. (1995) reported that gardening and yardwork activities were restricted to seasonal variations. For example, older adults in two medium sized midwest communities spent only about 57 minutes in gardening and 506 minutes in yardwork in the winter season. Accordingly, this issue of seasonal variation should be considered.

Contributions of gardening for physical and mental health benefits in older adults were reported in this study. Gardening has been associated with improved physical and psychosocial health outcomes such as lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration (Armstrong, 2000; Walsh, Pressman, Cauley & Browner, 2001). Reynolds (2002) reported that gardening activities were expected to improve cardiovascular fitness due to elevated HR during gardening. This study showed similar results to Reynolds (2002) in that the HR of our subjects increased while gardening and additionally, we showed that gardening is performed at a intensity adequate for it to be considered PA. Older gardeners reported from the SF-36 that they had positive health conditions. It can be assumed that gardening may improve or manage physical function, pain, vitality, social activities and psychological well-being (the SF-36 health domains). In another study, Reynolds (2002) reported improvement of participants to mental health and depression after gardening. Furthermore, home and community gardeners reported psychological well-being (Kaplan, 1973; Ulrich, 1981) and social well-being (McBey, 1985; Sommer, Learey, Summitt, & Tirrell, 1994) from gardening.

Results from this study support the need for a larger similar study that would encompass all the regions of the U.S. Continued research in this area should also investigate the specific effects of gardening on health issues in older adults.

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Tables and Figures

Table 4.1. Descriptive characteristics of the older gardener study participants

	Female (n=5)		Male (n=9)		Combined (n=14)	
	Mean	SD ^z	Mean	SD	Mean	SD
Age (years)	65	3	76	6	72	8
Race	White		White		White	
Height (cm)	164.1	8.0	171.6	4.5	168.9	7.0
Body weight (kg)	80.4	17.0	79.9	12.6	80.1	14.0
Body Mass Index (kg · m ²)	29.9	6.5	27	3.3	28.1	5
Resting HR ^y (bpm)	80	4	74	7	77	6
Resting METs ^x	1	0.2	1	0.1	1	0.1
Age-related HRmax (beats · min ⁻¹)	155	3	144	6	148	8

^zSD: Standard Deviation. ^yHR: Heart Rate. ^xMETs: Metabolic Equivalentents.

Table 4.2. Metabolic measurements from observed gardening activities

	Female (n=5)		Male (n=9)		Combined (n=14)	
	Mean	SD ^z	Mean	SD	Mean	SD
HR ^y	101	14	98	21	98	8
VO ₂ (ml · kg ⁻¹ · min ⁻¹)	10.6	3.0	15.0	5.2	13.5	5.0
% HRmax	39.9	27.8	41.4	43.0	40.8	37.7
HRmax	126	16	117	22	119	20
METs ^x	3.0	0.9	4.3	1.5	3.8	1.4
Kj/kg/hour	11.5	5.1	20.2	9.8	17.1	9.3
Gardening time (minute)	71	27	53	22	60	25

^zSD: Standard Deviation. ^yHR: Heart Rate. ^xMETs: Metabolic Equivalentents.

Table 4.3. Average SF-36 Health Survey scores for older adult subjects

SF-36 ^z	Standard ^y	Average
Physical Functioning	44.87	51.90
Usual role-Physical	45.28	50.69
Bodily Pain	47.97	53.05
General Health	46.72	54.83
Vitality	50.10	54.41
Social Functioning	50.27	55.59
Usual role-Emotional	48.34	53.84
Mental Health	52.60	56.93
Physical Health Summary	43.93	51.04
Mental Health Summary	51.57	56.68

^zSF-36: The Short Form 36 Health Survey.

^yStandard: These values are norms for the general population aged 65-74 years old from the SF-12 manual.

Table 4.4. Self-reported health conditions from 2 weekly logs

	Female (%)	Male (%)	Significance ^z
Physical health			NS
Excellent	20	16.7	
Very good	50	50	
Good	10	27.8	
Fair	20	0	
Poor	0	0	
Emotional health			NS
Excellent	40	16.7	
Very good	40	55.6	
Good	20	22.2	
Fair	0	0	
Poor	0	0	

^zSignificance: No significant difference by Pearson Chi-square test at $\alpha=0.05$.

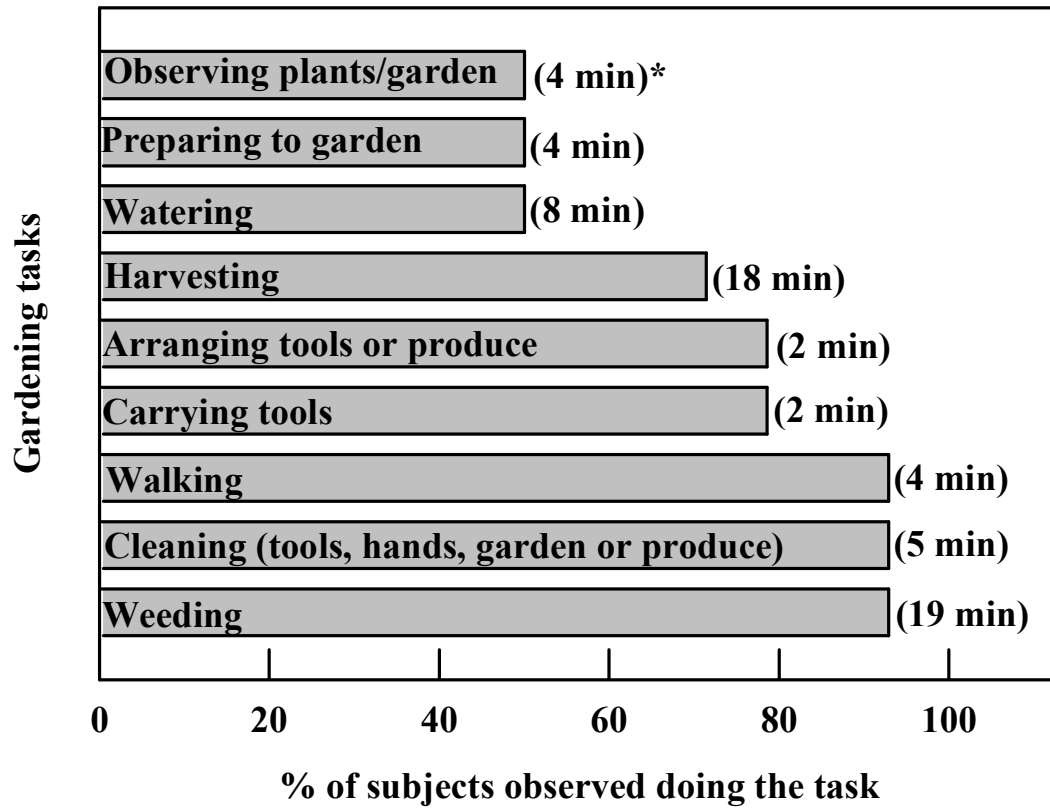


Figure 4.1. Gardening tasks performed by more than 50% of subjects that were observed gardening in June and July

* Average time of the gardening task

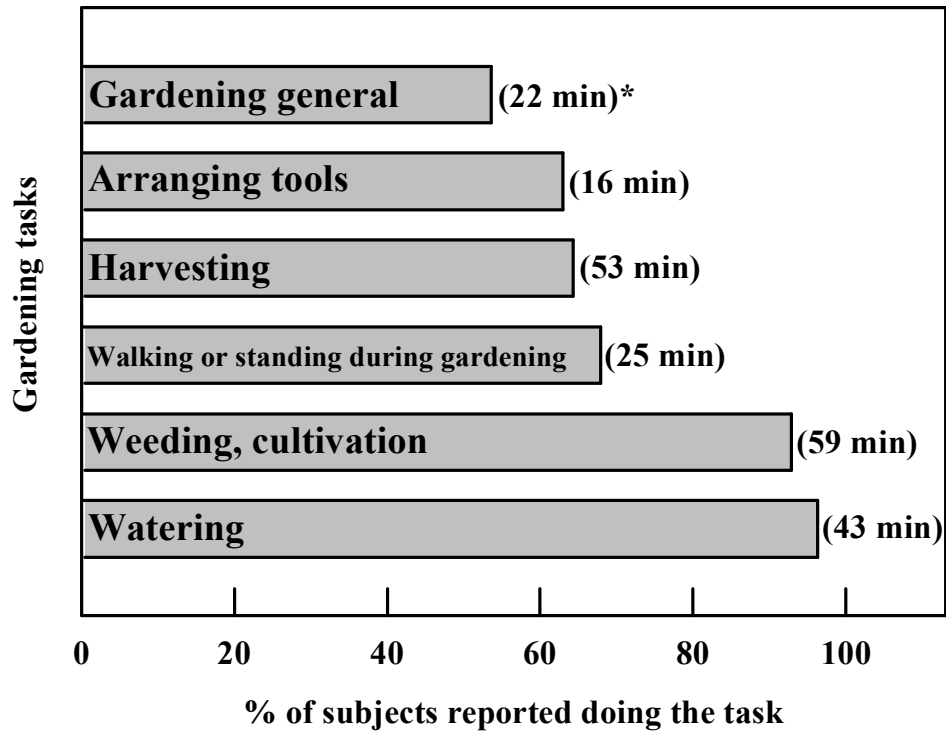


Figure 4.2. Gardening tasks performed by more than 50% of subjects in June and July as reported in their weekly logs

* Average time of the gardening task

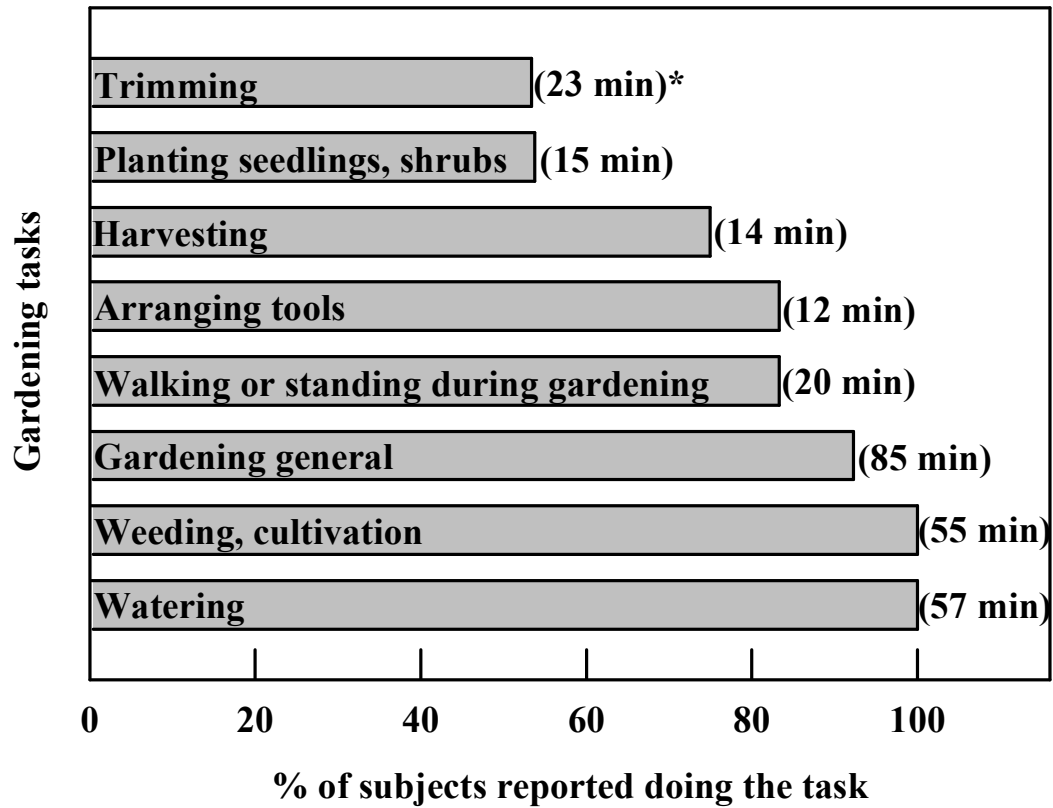


Figure 4.3. Gardening tasks performed by more than 50% of subjects in May from a written questionnaire

* Average time of the gardening task

**CHAPTER 5 - GARDENING AS A PHYSICAL ACTIVITY FOR
HEALTH IN OLDER ADULTS**

Abstract

Objectives: To compare the physical and psychological health conditions and leisure-time activities, particularly physical activities (PAs) of older gardeners and non gardeners.

Design: Posttest-only nonexperimental design.

Setting: Community of Manhattan, KS.

Participants: Fifty-three older adults were randomly recruited.

Intervention: Three groups were classified based on results from the Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire: Active Gardeners (n=11) classified as gardeners that met the PA recommendation through gardening; Gardeners (n=14) classified as gardeners, did not meet the PA recommendation through gardening; and Non Gardeners (n=28).

Measurements: Overall physical and mental health conditions were determined with the Short Form 36 Health Survey (SF-36), hand function (hand strength and pinch force) was determined by hydraulic hand dynamometer and pinch gauge, and bone mineral density (BMD) was determined by dual-energy x-ray absorptiometry.

Results: Active Gardeners were significantly different than Gardeners and Non Gardeners in physical health, hand strength, and pinch force ($p \leq 0.05$). There were no differences in mental health between the three groups, but all groups had scores higher than the standard norm for older adults over 55 years old. There was no difference in BMD between the groups, but all participants had higher scores than the standard BMD value of their age. The only significant difference of caloric expenditure in leisure-time PAs between the groups was gardening ($p < 0.001$).

Conclusion: Gardening is an effective moderate PA to meet the recommendation for health in older adults.

Keywords: Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire, The Short-Form 36 Health Survey (SF-36), hand function, bone mineral density (BMD)

Introduction

Regular physical activity (PA) contributes to the prevention and reduction of chronic diseases associated with aging, and can help maintain independent living (American College of Sports Medicine, 1998; Galloway and Jokl, 2000). Health benefits from regular PA include reduction in the risk of coronary heart disease, hypertension, type 2 diabetes, osteoporosis, ischemic stroke, selected cancers, anxiety and depression (American College of Sports Medicine, 1993; American College of Sports Medicine, 2004; Hui and Rubenstein, 2006; Lee, Paffenbarger and Hsieh, 1991; Powell, Thompson, Casperson, and Ford, 1987). Physical activity also increases fitness level, muscle strength, aerobic capacity, balance and bone mineral density (BMD) (American College of Sports Medicine, 1998; DiPietro, 2001; U.S. Department of Health and Human Services, 1996).

In order to maintain or improve health, at least 30 minutes of moderate intensity PA on most days of the week (at least 150 minutes of moderate intensity PA) is recommended (Pate et al., 1995; Nelson, Rejeski, Blair, Duncan, Judge, King et al., 2007).

Gardening is a popular leisure-time activity of people aged 65 years or older (Yusuf et al., 1996). In our previous research, gardening was determined to offer moderate intensity PA thus has the possibility of offering the health benefits from PA for older adults (not published). Gardening has been associated with improved physical and psychosocial health outcomes such as lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration (Armstrong, 2000; Walsh, Pressman, Cauley, and Browner, 2001). Turner et al. (2002) reported that gardening is an activity which is expected to influence whole body BMD because it includes weight-bearing motions such as pushing a mower, digging holes, pulling weeds, carrying soil, etc. and because it uses the whole body. In his study, yard work and weight training were strong and positive predictors for BMD rather than other PAs such as jogging,

swimming, calisthenics, bicycling, aerobic, walking and dancing. Reynolds (1999) reported that gardening improved grip strength of participants after 6 months and cardiovascular fitness was expected because gardening activities elevated heart rate. In another study, Reynolds (2002) reported improvement of participants to mental health and depression through gardening after 3 months.

Although there is some evidence of the positive health benefits from gardening as a form of PA, there is limited research reported that has specifically studied gardening for health in older populations. Therefore, the purpose of this study was to investigate the physical and psychological health conditions (overall health conditions, hand function, and BMD) of older gardeners verse non-gardeners and the leisure-time activities, particularly PAs of older participants.

Methods

Subjects

Fifty-three older adults (age ranged 58-86 years old) were randomly recruited from the community of Manhattan, KS. In an orientation, the experimental procedures were explained, and written informed consent and a demographic information questionnaire were completed by the participants. The Kansas State University Committee for Research Involving Human Subjects (IRB) approved this study.

Demographic information

A demographic questionnaire was developed and included questions on age, gender, race, education, marital status, employment status, and annual income. The questionnaire also

included the Short Form 36 Health Survey (SF-36), which assesses eight health concepts associated with both physical and mental health: physical functioning, usual role activities (physical), bodily pain, general health, vitality, social functioning, usual role activities (emotional), and mental health (Ware, Snow, Kosinski et al., 1993). The SF-36 was scored using SF Health Outcomes Scoring Software (QualityMetric, Lincoln, RI, USA).

Health assessments

The health assessments were conducted in October of 2006. A specialist and a trained graduate research assistant conducted the health assessments of the participants. Height and weight were measured with a wall stadiometer (Seca 216 Stadiometers, USA) and electronic balance (Ohaus, ES200L, USA) without shoes. Body mass index ($BMI = \text{mass}(\text{kg})/\text{height}(\text{m})^2$) was calculated.

Hand function (hand strength and pinch force) was determined by a hydraulic hand dynamometer (JAMAR Hydraulic Hand Dynamometer, model 5030J1, USA, 2001) and a pinch gauge (JAMAR Hydraulic Pinch Gauge, model 7498-05, USA, 2001). Subjects were tested 3 times on each hand and were asked to indicate their dominant hand.

To determine the T-score and Z-score of the lumbar spine (L1-L4), femoral neck of both hips and total body, BMD (g/cm^2) was measured by dual-energy x-ray absorptiometry (DXA; Prodigy v6.8, GE Lunar Corp., Milwaukee, WI). For the BMD measurement, participants were asked to wear pants with no metal buckle, to not have a large meal before the test, and to go to the bathroom.

Leisure-time PAs of older adults

The Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire for older adults was used to measure leisure-time PAs. This instrument has been shown to be reliable and valid in estimating frequency per week of all PAs and calories expended per week in all PAs (Stewart et al., 1997; Stewart et al., 2001; Harala et al., 2001). The PAs in this questionnaire were classified as moderate intensity PA (above 3.0 MET) and light intensity PA (below 3.0 MET) based on the values reported by Ainsworth and colleagues (Ainsworth et al., 1993). Those not reported by Ainsworth et al. (1993) were classified by interpolating values of similar activities. Adjustments for some MET values were conducted in this questionnaire because almost of the METs values reported by Ainsworth and colleagues are based on younger persons. Reported values for endurance type activities in Ainsworth et al (1993) exceed the aerobic capacity of older adults. For activities related to strength, adjustments premise that older adults work at a lower level of intensity because of their lower muscle strength (Stewart et al., 2001).

Exercise intensity and time spent gardening were calculated based on the CHAMPS questionnaire responses to questions on gardening and subjects were then classified as Active Gardeners, Gardeners, or Non Gardeners in order to determine the health effects of gardening: Active Gardeners (n=11) met or exceeded the PA recommendation by gardening at moderate intensity for more than 150 minutes per week; Gardeners (n=14) did not meet the PA recommendation by gardening but did garden for 120-150 minutes per week at both low and moderate intensity; and Non Gardeners did no gardening or little gardening only at low intensity (n=28). By separating gardeners that met the PA recommendation through gardening from gardeners that did not, we were able to determine the effects of gardening as a PA.

Data analysis

Analysis of variance (ANOVA) was performed by the Statistical Analysis System (SAS version 9 for Windows, SAS Institute Inc, Cary, NC, USA). Fisher's Least Significant Difference (LSD) test was used to compare means at $\alpha=0.05$.

Results

Demographic information

A higher percentage of the Active gardeners were male than in the other group (Table 5.1) and reported the highest income. A higher percentage of Gardeners and Active gardeners were white and retired than non gardeners.

Caloric expenditure and frequency of leisure-time PAs

All subjects, regardless of gardening group, were very active, exceeding the PA recommendation considerably. This is evident in the weekly caloric expenditure and frequency of PA per week, which were not significantly different between the three groups (Table 5.2). Thus, activity level, when considering all activities, was the same for all three groups. When comparing energy expenditure of each activity, gardening was the only activity that was significantly different between the groups (Table 5.3). Therefore, any difference in health outcomes may be explained through the gardening activity.

Health assessments

Active Gardeners reported higher physical function and overall physical health, and lower bodily pain (Table 5.4). There were no differences in mental health between the 3 groups (Table

5.4), but all groups had scores higher than the standard norm for older adults over 55 years old (Ware et al., 2002).

There was no difference in BMD between the groups, but all participants had higher values than the standard value of their age (Table 5.5) (National Institutes of Health Osteoporosis and Related Bone Disease~ National Resource Center, 2006).

Since hand function abilities are not strongly influenced by exercise intensity, intensity of gardening was not used in classifying the subjects as was done previously. To analyze hand function abilities subjects were classified as gardeners (gardening more than 120 minutes at both low and moderate intensity) or non gardeners (gardening less than 120 minutes at low intensity). Gardeners had significantly higher hand function abilities than non gardeners in their hand strength and pinch force ($p \leq 0.05$) (Table 5.6).

Discussion

Healthy active older adults who participated in gardening enough to meet the PA recommendation of 30 minutes moderate intensity PA on 5 or more days of the week had higher values in 3 of the physical domains of the SF-36 and better hand function ability than those who were also active but did less gardening. Active gardening has a broad impact on physical health (physical summary) and there was no independent effect on the mental summary score. Improved hand strength through gardening was also reported by Reynolds (1999). Gardening tasks can improve muscle coordination and train unused muscles in hands because many of the tasks require grasping, releasing, and flexion of the thumb and fore finger (Relf, 1973). Most gardening tasks work the muscles of the body (Restuccio, 1992) so muscle strength and range of motion can be improved.

Physical function and bodily pain were positively associated with gardening in this study. Basen-Engquist et al. (2006) reported that moderate activity in the daily routines of cancer survivors led to positive effects on bodily pain as reported in the SF-36. All subjects had healthy mental health compared to standard norms of their ages from the SF-36 manual (Ware, Snow, and Kosinski, 1993) and were very PA as indicated by the CHAMPS results. This supports the strong evidence that an active lifestyle gives physical and mental health benefits (Glass et al., 1999; Takano et al., 2002).

Meanwhile, this study did not show the distinct benefits of improved BMD through gardening as reported by Turner et al (2002). The BMD values of all participants in this study were over standard values for their ages. A possible explanation is that all the subjects in this study had healthy BMD because of their very physically active lifestyle based on the CHAMPS. Also, most of the older subjects showed high education attainment in this study (Table 5.1) and education is assumed as a contributor to bone health. Cankurtaran et al. (2005) reported that low educational attainment is a risk factor for osteoporosis.

Future research should determine various health benefits of gardening in older adults by treating gardening as an exercise intervention.

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Tables and Figures

Table 5.1. Demographic information of 53 participants

Variable	Active Gardeners (N=11)	Gardeners (N=14)	Non gardeners (N=28)
		Mean (SD)	
Age	73 (7)	71 (6)	72 (9)
Height (cm)	165.4 (7.2)	164.8 (7.0)	160.1 (8.4)
Body weight (kg)	75 (15.6)	82.7 (12.4)	68.7 (13.2)
Body Mass Index	27.0 (4.8)	29.4 (4.6)	26.5 (4.5)
		Percentage (%)	
Gender			
Male	54.5	35.7	28.6
Female	45.5	64.3	71.4
Race			
White	90.9	100	75
Asian	9.1	0	25
Education			
High school graduate	90.9	100	85.7
2-year secondary education or less	18.2	35.7	28.6
4-year secondary education or less	100	64.3	67.9
No response	0	0	3.6
Marital status			
Single*	36.4	26.8	35.7
With partner†	63.6	71.4	64.3
Retired	72.7	78.6	50

Annual income			
Less than \$40,000	18.2	50	32.1
\$40,000-59,999	27.3	7.1	25
\$60,000-80,000	9.1	14.3	21.4
More than \$80,000	45.5	14.3	7.1
No answer	0	14.3	14.4

*Single = never married, divorced, separated or widowed.

†With partner = married or having a partner.

The sum of percentage for education in Active Gardeners group is over 100% because some people completed two education courses.

Table 5.2. Physical activity measures from CHAMPS questionnaire by 53 older subjects

Measure	Active Gardeners (N=11)	Gardeners (N=14)	Non Gardeners (N=28)	<i>p</i> -value
Moderate and greater intensity measures				
Caloric expenditure per week in at least moderate intensity physical activities (MET ≥ 3.0)	4000 [†] (795) [*]	2385 (705)	2632 (498)	0.27 ^{NS}
Frequency per week in at least moderate intensity physical activities (MET ≥ 3.0)	11 (3)	10 (2)	9 (2)	0.82 ^{NS}
All activities measures				
Caloric expenditure per week in all listed physical activities	5834 (1032)	4152 (915)	4441 (647)	0.43 ^{NS}
Frequency per week in all listed physical activities	22 (4)	26 (4)	22 (3)	0.70 ^{NS}

*: mean (standard error).

†: Kcal/week.

^{NS}: No significant difference by Least Significant Difference (LSD) test at *p*=0.05.

Table 5.3. Kinds and energy expenditure of leisure-time physical activities in CHAMPS questionnaire performed by the subjects

Leisure-time physical activities	Active Gardeners (N=11)	Gardeners (N=14)	Non Gardeners (N=28)	<i>p</i> -value
Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)	0	207.6*	0	0.26 ^{NS}
Play golf, carrying or pulling your equipment (count walking time only)	83.8	21	22.4	0.34 ^{NS}
Play golf, riding a cart (count walking time only)	100.2	4	80.3	0.67 ^{NS}
Play tennis (single+double)	0	296.1	87.4	0.33 ^{NS}
Do work around the house (light+heavy)	1363	819.6	847.8	0.31 ^{NS}
Do gardening (light+heavy)	1811.6 a	907.7 b	385.7 c	0.0001***
Work on your car, truck, lawn mower, or other machinery	55.9	154.8	102.9	0.75 ^{NS}
Jog or run	649.1	432.4	101.6	0.18 ^{NS}
Walk (uphill, hike uphill, fast, briskly for exercise)	750.7	650.1	598.1	0.90 ^{NS}
Walk (errands, leisurely) (count walking time only)	909.5	541.1	530.4	0.24 ^{NS}
Ride a bicycle or stationary cycle	145.6	146.7	184.8	0.96 ^{NS}
Do other aerobic machines such as rowing, or step machines (do not count treadmill or stationary cycle)	276.5	11.9	81.5	0.11 ^{NS}
Do water exercises (do not count other swimming)	0	0	144.18	0.16 ^{NS}
Swim (moderately, fast, gently)	0	0	76.2	0.26 ^{NS}

Do stretching or flexibility exercises (do not count yoga or Tai-chi)	269.6	119.1	89.6	0.08 ^{NS}
Do yoga or Tai-chi	123.5	0	69.1	0.35 ^{NS}
Do aerobics or aerobic dancing	188.3	154.1	52.4	0.41 ^{NS}
Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push ups)	313.7	105.4	76.1	0.18 ^{NS}
Do light strength training (such as hand-held weights of 5 lbs. or less or elastic bands)	72.3	67.1	116.5	0.64 ^{NS}
Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)	48.4	26.6	61.9	0.69 ^{NS}

*: Kcal/week.

a,b,c means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) test at $\alpha=0.05$.

*** means $p < 0.001$.

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

Table 5.4. Comparisons of the Short-Form 36 Health survey

	Active Gardeners (N=11)	Gardeners (N=14)	Non Gardeners (N=28)	<i>p</i> -value
Physical function	54.1 a	48.9 b	48.4 b	0.05*
Role physical	53.7	44.3	48.7	0.06 ^{NS}
Bodily pain	56.1 a	44.1 b	49.0 b	0.01**
General health	54.6	51	50.1	0.26 ^{NS}
Vitality	58.3	50.6	54.9	0.08 ^{NS}
Social function	55.7	53.3	53.8	0.69 ^{NS}
Role emotional	50.6	48.6	52.0	0.50 ^{NS}
Mental health	57.3	52.6	53.3	0.16 ^{NS}
Physical summary	54.6 a	45.6 b	47.6 b	0.01**
Mental summary	55.2	53.2	55.3	0.65 ^{NS}

a,b means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) test at $\alpha=0.05$.

* means $p \leq 0.05$ and ** means $p \leq 0.01$.

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

Table 5.5. Comparisons of Bone Mineral Density (BMD)

BMD	Active Gardeners (N=11)		Gardeners (N=14)		Non Gardeners (N=28)		<i>p</i> -value
	Mean (SD)*	Range	Mean (SD)	Range	Mean (SD)	Range	
Hip-BMD	0.96 (0.2)	0.6-1.2	0.96 (0.1)	0.8-1.3	0.92 (0.1)	0.6-1.3	0.63 ^{NS}
Young-adult T-score	-0.71 (1.2)	-3.0-0.8	-0.56 (1.1)	-2.3-1.5	-0.84 (1.1)	-3.5-1.3	0.74 ^{NS}
Age-adjusted Z-score	0.41 (1.1)	-2.1-1.7	0.27 (1.0)	-1.2-2.5	0.42 (0.9)	-1.1-2.2	0.89 ^{NS}
AP spine- BMD	1.11 (0.2)	0.7-1.4	1.24 (0.3)	0.9-1.9	1.13 (0.2)	0.7-1.7	0.23 ^{NS}
Young-adult T-score	-0.8 (1.7)	-3.8-1.7	0.37 (2.1)	-2.5-5.3	-0.51 (1.6)	-3.6-3.8	0.21 ^{NS}
Age-adjusted Z-score	0.21 (1.4)	-2.5-2.3	1.24 (2.1)	-1.4-5.9	0.78 (1.6)	-2.1-4.7	0.34 ^{NS}

*SD: Standard Deviation.

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

Table 5.6. Comparisons of hand function ability

Hand function	Hand	Gardeners (N=25)	Non Gardeners (N=28)	<i>p</i> -value
Strength	Dominant	30.1 a	25.1 b	0.04*
	Left	28.6 a	22.9 b	0.02*
	Right	30.2 a	24.9 b	0.03*
Pinch force	Dominant	6.2 a	4.7 b	0.00**
	Left	5.9 a	4.3 b	0.00**
	Right	6.2 a	4.6 b	0.01**

a,b means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) test at $\alpha=0.05$.

* means $p < 0.05$ and ** means $p \leq 0.01$.

**CHAPTER 6 - OBSERVING GARDENING POSTURE AND
MOTION OF OLDER GARDENERS FOR HEALTH BENEFITS
AND RISKS**

Abstract

Gardening is a moderate intensity physical activity in older adults. Thus, health benefits are possible, however, gardening postures such as stooping, kneeling, and squatting may be uncomfortable. In this study, kinds of gardening tasks and body postures during daily gardening of 14 older gardeners were observed on two separate occasions. Bodily pain during gardening of older gardeners was self-reported. Seventeen different garden tasks were observed. From these garden tasks, six motions were done by 90% of the subjects: gripping, bending, walking, lifting, stretching, and standing. Lower back pain was the highest percentage in the ten kinds of bodily pains reported.

Keywords: physical activity, bodily pain, lower back pain

Introduction

Gardening is a popular leisure-time activity of adults aged 65 years or older (Yusuf, Croft, Giles, Anda, Casper, Caspersen et al., 1996). The health benefits through gardening as a form of physical activity (PA) have been reported in older adults (Armstrong, 2000; Walsh, Pressman, Cauley, & Browner, 2001). In our previous research, gardening of older gardeners was determined to be moderate intensity PA and the older gardeners met the PA recommendation for health (at least 30 minutes of moderate intensity PA on most days of the week) through their daily gardening. Older gardeners also reported better overall health condition and hand function abilities (hand strength and pinch force) than non gardening older adults (not published). Furthermore, Reynolds (1999) reported in his Green Gym project that the grip strength of participants improved by gardening after 6 months and cardiovascular fitness was expected because gardening activities elevated the heart rate of participants during gardening. Another study of the Green Gym project showed improvement in mental health and depression through gardening after 3 months (Reynolds, 2002).

Although gardening may provide many physical and mental health benefits, it may also burden the body or cause injury. Stoffert (1989) reported that stooping, kneeling, and squatting are the most uncomfortable and dangerous postures to the physical body during gardening. Stooping overburdens the spine and causes the brain to have more blood than normal. Kneeling posture pressures knee-caps and knee-joints with body weight. Flexed knees at a high degree and the external pressure on the knees in kneeling work may cause knee complaints (Kivimäki, Riihimäki, & Hänninen, 1992; Thun, Tanaka, Smith, Halperin, Lee, Luggen et al., 1987). Squatting requires a maximal bending of knee-joints and hip-joints. Flexed posture in working had been reported as a cause of low back pain (Maeda, Okazaki, & Suenaga, 1980; Stubbs, Buckle, & Hudson, 1983). Moreover, digging with a conventional spade was determined to be a

probable cause of low back injury (Bridger, Sparto, & Marras, 1998). Therefore, these gardening postures can result in fatigue, physical pain, and injuries to older gardeners.

In this study, the gardening tasks and motions used in regular gardening of older gardeners were observed and bodily pains which can be produced from the motions during daily gardening were investigated.

Methods

Subjects

14 older gardeners (5 females, 9 males) aged 63 to 86 years old were recruited from the community of Manhattan, KS. In an orientation, informed written consent was obtained, a brief explanation of the experimental procedures was given and a demographic questionnaire was conducted. The Kansas State University Committee for Research Involving human subjects (IRB) approved this study.

Observational study

This study was conducted in Manhattan, KS at the participants own garden plot in June and July of 2006, in the morning or evening to avoid the hottest part of the day. The observational data sheet and training of the observers were previously tested in the spring of 2006.

Two observers (a graduate student and an undergraduate student in the Horticulture, Forestry and Recreation Resources Department at Kansas State University) observed the participants gardening in their own garden on two separate occasions. The observational data sheet allowed the observers to easily mark the gardening tasks observed (kinds of gardening

tasks and body postures used during each garden task). Garden tasks done less than 10 seconds at a time are not included in data analysis. Each participant did various gardening tasks which were planned by themselves. There was no limitation by the researchers on how long they gardened, with none of the participants gardening more than 2 hours. The older gardeners could do their garden tasks freely without any limitation or interference from the researchers. They could take a rest if they wanted during gardening.

Survey instrument

A questionnaire was developed by the researchers to investigate bodily pain while gardening of older gardeners. The older gardeners were asked to report on any bodily pain or injuries experienced during their daily gardening.

Results

Demographic information

Subjects were not overweight. Half of the subjects had no current CDs. The most prevalent CDs of those with CD were high blood pressure and arthritis. Arthritis was the only CD that limited activity (Table 6.1).

Observational study

A total of 35 different gardening tasks were observed in June and July. Observation agreement of the two observers was 79.2 percent. Seventeen of these tasks were performed by 90% of the subjects (Table 6.2). Six distinct motions were used in performing these tasks (Table

6.2 and 6.3). Gripping and bending were observed in over 80% of the gardening tasks. Walking and lifting also showed high percentages.

Self-reported bodily pain while gardening

When the question, ‘do you experience pain when gardening?’ was asked, almost 60% of the participants answered they had bodily pain while gardening (always 7.1%, sometimes 50%, never 35.7%, 1 missing data). Of those that reported bodily pain during gardening the majority reported a low (50%) to moderate (37.5%) pain level. Lower back pain (62.5%) was reported by the most subjects (Figure 6.1). All subjects reported no injuries due to gardening.

Discussion

Results of this observational study reported on the physical motions done while gardening and the types of bodily pains older gardeners experience. Lower back pain was the prevalent bodily pain reported. The gardening motion of bending, lifting, and stretching may help or exacerbate the pain.

Bending overburdens the spine and causes the brain to have more blood than normal. Moreover, working in a flexed posture has been reported as a cause of low back pain (Maeda, Okazaki, & Suenaga, 1980; Stubbs, Buckle, & Hudson, 1983).

Flexibility is the most important factor of fitness in older adults due to mobility (Rikli & Edwards, 1991) and a proper range of motion is necessary to be able to perform the daily living activities (Tinetti, Baker, & Garrett, 1993). Strength is also a crucial element to be able to perform activities of daily living and decreased muscle strength can cause low functional ability. Lifting and stretching that were observed while gardening in this study could be good motions

for body strength and flexibility if done properly. Older gardeners should be aware of their physical fitness level to prevent overweighted loads and overburdened stretching. For example, several small loads instead of a large one can be prepared when they need to lift or shift loads such as bags of compost (Arthritis Research Campaign, 2003).

All of the gardening tasks included a gripping motion, which may help in maintaining and improving hand strength. In our previous research, older gardeners had higher hand strength and pinch force than older non-gardeners (not published). On the other hand, older gardeners with arthritis can have pain and swelling of the knuckles from gripping tightly. Adapted tools such as clippers with sponge rubber sleeves on the handle for elderly with arthritis is recommended and two-handed loppers can reduce effort and be held lightly to protect finger joints from strain (Arthritis Research Campaign, 2003).

Walking is the most popular leisure-time physical activity of older adults (Yusuf, Croft, Giles, Anda, Casper, Caspersen et al., 1996). The health benefits of walking in older adults have been reported (Centers for Disease Control and Prevention, 1993; Duncan, Gordon, & Scott, 1991; Rippe, Ward, Porcari, & Freedson, 1988; Shin, 1999). Older gardeners included significant walking motions while gardening so it is expected that older gardeners can experience the same health benefits such as improvement of cardiorespiratory through their daily gardening. Additionally, gardening is a long-term focused activity (Restuccio, 1992) because a garden requires regular and continuous care (Relf, 1981) so that walking can be encouraged while gardening.

In conclusion, gardening motions used during gardening can provide health benefits and risks at the same time. In order to utilize gardening as a physical activity for health in older adults, the risks of gardening needs to be clearly understood. Future research should investigate

specific solutions to address the uncomfortable and dangerous gardening motions to increase the health benefits of older gardeners through gardening. Moreover, developing a well-designed exercise program through gardening for physical functional ability will be a good intervention for the older population.

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Tables and Figures

Table 6.1. Descriptive characteristics of the 14 participants

	Mean	SD ^a
Age (year)	72	8
Race	Caucasian	
Height (cm)	168.9	7.0
Body weight (kg)	80.1	14.0
Body Mass Index (kg · m ²)	28.1	5
Current CD ^b	Percentage (%)	
No CD	42.9	
High blood pressure	21.4	
Low blood pressure	0	
Heart disease	0	
Lung disease	7.1	
Diabetes	7.1	
Cancer	7.1	
Arthritis	35.7 (7.1) ^c	
Kidney disease	0	
Liver disease	0	
Alcohol/drug use	0	
Mental illness	0	
Asthma	21.4	
Anemia or other blood disease	0	
Ulcer/other stomach disease	0	
others	0	

^aSD: Standard Deviation.

^bCD: Chronic disease.

^c: Percentage of the limited activity from the disease.

Table 6.2. Gardening tasks observed of the 14 older gardeners

Tasks observed ^a	Motions observed ^b	Percentage who did this task (%)
Weeding	B, G, S	92.9
Walking	G, L, W	92.9
Cleaning tools, hands, or produce	B, G, L, W	92.9
Resting	Standing	92.9
Carrying tools	G, L, W	78.6
Storing tools or produce	B, G, L, W	78.6
Harvesting	B, G, S, W	71.4
Watering	B, G, S, L, W	50
Gardening preparation	B, G, L, W	50
Observing plants in the garden	B, G, W	50
Cutting flowers or stems	B, G	35.7
Pruning	B, G	28.6
Mowing	B, G, S, W, Push/Pull	21.4
Deadheading	B, G, S, L, W	21.4
Digging	B, G, L	21.4
Mulching	B	14.3
Planting plants	B, G	14.3

^a: Daily gardening of the 14 older gardeners were observed two times by two trained observers. Tasks done by less than 10% of the subjects are not shown.

^b: Motions observed by both observers and done by more than 50% of the subjects.

B: bending, G: gripping, S: stretching, L: lifting, W: walking.

Table 6.3. Primary motions observed during gardening

Physical motion ^a	% of the 17 observed gardening tasks that had this motion
Gripping	88.2
Bending	82.4
Walking	58.8
Lifting	47.1
Stretching	29.4
Standing	5.9

^a: Motions which were done by 50% or more subjects in each task and overlapped by two observers.

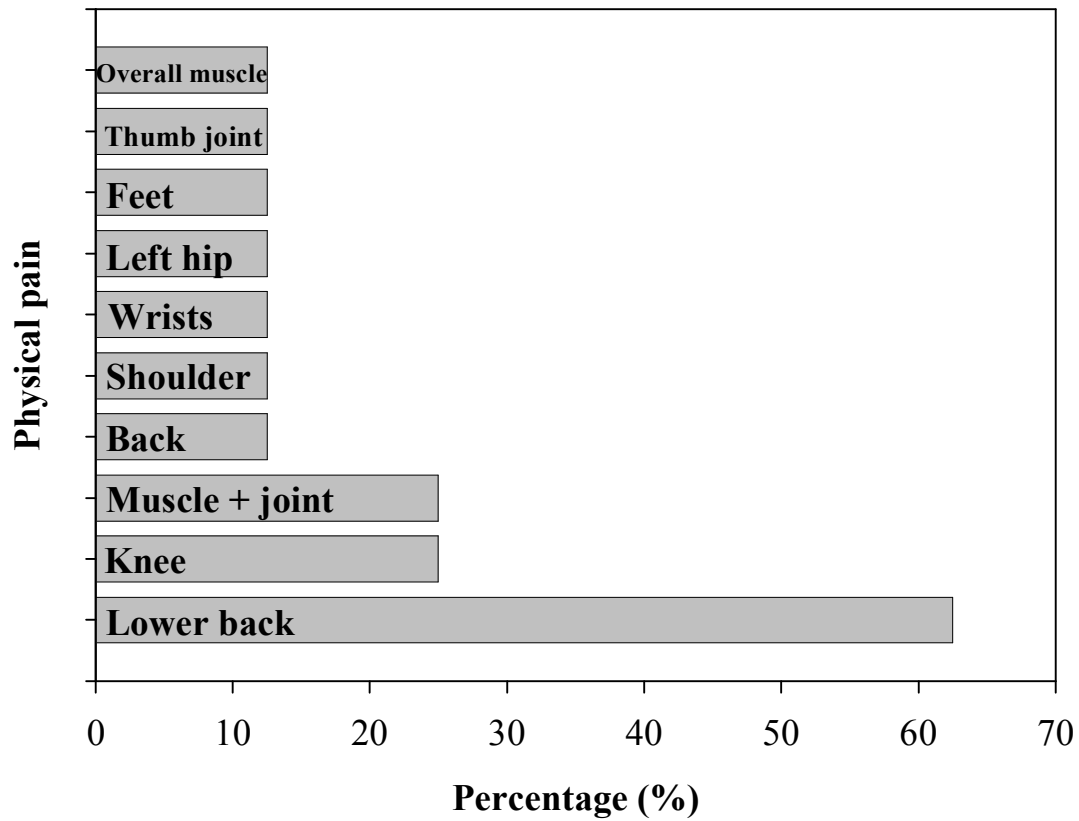


Figure 6.1. Percentages of self-reported bodily pain of 14 older gardeners

**CHAPTER 7 - GARDENING AS A PREDICTOR OF A
PHYSICALLY ACTIVE LIFESTYLE AND LIFE SATISFACTION
IN OLDER ADULTS**

Abstract

Objective: To determine if gardening, as a leisure-time physical activity (PA), is a predictor of a physically active lifestyle and life satisfaction in older adults.

Methods: Fifty-two healthy older adults (age ranged 58-86 years old) were recruited from the community of Manhattan, KS. Overall physical and mental health (the Short-Form 36 Health Survey), current chronic diseases, body composition, body mass index, blood pressure, and pulse of the participants were measured. The Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire was completed by the participants to get information about the caloric expenditure and kinds of leisure-time PAs, and the Life Satisfaction Index Z (LIS-Z) was conducted.

Results: All participants were healthy and there were no significant health differences between gardeners and non-gardeners. Gardeners were more active than non-gardeners based on the CHAMPS questionnaire. Active-gardeners showed significantly better life satisfaction.

Conclusions: Gardening is a predictor for leading a physically active lifestyle in older adults and for providing better life satisfaction.

Keywords: Leisure-time physical activities; The Short Form 36 Health Survey (SF-36); The Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire; The Life Satisfaction Index Z (LIS-Z)

Introduction

Many older people live longer, but they may not necessarily live active, happy, and independent lives because of problems such as biological changes, chronic diseases (CDs), functional disability and psychological problems (National Institute of Aging, 2002; McAuley and Rudolph, 1995; Dustman et al, 1994; Katz, 1983). A sedentary lifestyle and a low-level of physical activity (PA) may a cause or promote these problems in older adults (Stuck et al, 1999; Blair et al, 1989; Saltin, 1992).

For healthy aging, regular PA has been recommended (U.S. Department of Health and Human Services, 1996; Institute of Medicine, Division of Health Promotion and Disease Prevention, 1990). Regular PA of at least 30 minutes of moderate intensity PA on most days of the week has been found to reduce the risk of coronary heart disease and chronic disease such as diabetes, high cholesterol and high blood pressure, and declines in musculo-skeletal function (Chakravarthy et al., 2000; Galloway and Jokl, 2000). Therefore, a physically active lifestyle is a crucial factor for successful aging.

The predictors for a physically active lifestyle in older adults were determined to be high self-efficacy, regular participation of friends and family, finding footpaths safe for walking, and access to local facilities (Booth et al., 2000). Social support such as childhood encouragement in PA, current exercise level, larger family size, and younger age were also predictors for an active later life (Cousins, 1995). Moreover, elderly in a nursing home in Finland reported that good health status, self-rated functioning, depressive symptoms, and contentment with life in the nursing home supported a physically active lifestyle (Ruuskanen and Parkatti, 1994). Trost et al (2002) in a review paper summarized PA determinants as age, gender, socioeconomic status, occupational status, educational attainment, overweight or obesity, and PA self-efficacy.

Life satisfaction is an important factor in aging (Mannell and Dupuis, 1996). The predictors for life satisfaction are younger age, being married, being highly-educated, and having a high income (Fernandez-Ballesteros et al., 2001; Mannell and Dupuis, 1996; Penning and Strain, 1994). Researches has shown that there is a positive relationship between PA and life satisfaction (Elavsky and McAuley, 2005; Elavsky et al., 2005; Mihalko and McAuley, 1996; Grant et al., 2004).

Gardening is a popular and prevalent type of PA among older adults (Armstrong, 2000; DiPietro, 2001; Walsh et al., 2001). In the U.S., 45% of men and 35% of women aged 65 years or older reported participation in gardening as a form of leisure-time PA (Yusuf et al., 1996). Gunn et al. (2005) and Withers et al. (2006) reported that lawn mowing is a moderate intensity PA in females and males aged 55-65 years old. In our previous research, older gardeners met the PA recommendation for health benefits through their daily gardening because they were gardening at a moderate intensity, and spent almost 15 hours per week in June and July and almost 33 hours per week in May gardening. Additionally, the gardeners had better hand function abilities (hand strength and pinch force) than the non gardeners (not published). Gardening has been associated with improved physical and psychosocial health outcomes such as lower total cholesterol, lower blood pressure, lower mortality, psychological well-being, and social integration (Armstrong, 2000; Walsh et al., 2001).

The objectives of this study were to determine if gardening is a predictor for an active lifestyle and can influence life satisfaction in older adults.

Methods

Subjects

Fifty-two healthy older adults (58-86 years old) from Manhattan, KS were randomly recruited. This study was conducted in the fall of 2006. The Kansas State University Committee for Research Involving human subjects (IRB) approved this study. In an orientation, the experimental procedures were explained, written informed consent was obtained and a demographic information questionnaire was completed. The demographic information questionnaire included questions about age, gender, race, education, marital status, living situation, type of housing, current employment status, annual income, current chronic diseases (CDs), presence of a yard at home, care for lawn, and types of lawn tasks performed.

Health assessments

In order to investigate the health conditions of older participants, the Short Form 36 Health Survey (SF-36) and questions about current CDs were completed. Height, weight, body composition, body mass index (BMI), blood pressure, and pulse were measured in a human metabolism lab. The SF-36 assesses eight health concepts: physical functioning, usual role activities (physical), bodily pain, general health, vitality, social functioning, usual role activities (emotional), and mental health (Ware et al., 1993). The SF-36 was scored using SF Health Outcomes Scoring Software (QualityMetric, Lincoln, RI, USA). Height and weight were measured with a wall stadiometer (Seca 216 Stadiometers, USA) and electronic balance (Ohaus, ES200L, USA) without shoes. Body composition (tissue (%Fat), fat (g), and lean (g)) was determined by dual-energy x-ray absorptiometry (DXA) (GE-Lunar Prodigy v6.8, Milwaukee, WI). Body mass index ($BMI = \text{mass}(\text{kg})/\text{height}(\text{m})^2$) was calculated. Blood pressure and pulse

were measured with an automatic blood pressure monitor (Omron HEM-712C, Vernon Hills, IL) after resting on a chair for 5-minutes.

Leisure-time physical activities

The Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire was completed by the older participants to assess frequency and duration of various PAs which are done in typical week during the past month (Stewart et al., 1997; Stewart et al., 2001). Caloric expenditure (CE) for each leisure-time PA in a typical week was estimated, and frequency per week for each PA was summarized. The PAs in this questionnaire were classified as moderate intensity PA (above 3.0 MET) and light intensity PA (below 3.0 MET) based on the values reported by Ainsworth and colleagues (Ainsworth et al., 1993).

Life satisfaction

The Life Satisfaction Index Z (LIS-Z) (Neugarten et al., 1961) was completed. This index has been reported to be valid and reliable (Adams, 1969; Sexton and Munro, 1985; Wood et al., 1969). The LIS-Z consists of 13 questions and rates the questions on a three point scale (Agree, Disagree, and I don't know) (Likert, 1967). The ranges of scores on the LIS-Z are from 6 to 24, and the higher the score the higher the life satisfaction (Hilleras et al., 2001).

Classifying gardeners and non gardeners

To determine if gardening is a predictor of an active lifestyle, gardening duration was used to classify participants as gardeners or non gardeners. Those classified as gardeners met the PA recommendation of at least 150 minutes PA per week (Pate et al., 1995) through gardening

(n=25) and those who did not meet the PA recommendation were classified as non gardeners (n=28).

Classifying active-gardeners and inactive/non gardeners

To determine if gardening is a predictor for life satisfaction, gardening duration and CE per week from gardening were used to classify participants as active gardeners (n= 20) or inactive/non gardeners (n=33). Active gardeners met the PA recommendation through gardening and expended over 3000 calories per week through their leisure-time PA. Inactive/non gardeners, included gardeners (met the PA recommendation) and non gardeners that had less than 3000 CE from their leisure-time PA per week.

Data analysis

Analysis of variance (ANOVA) was performed by the Statistical Analysis System (SAS version 9 for Windows, SAS Institute Inc, Cary, NC, USA). Fisher's Least Significant Difference (LSD) test was used to compare means at $\alpha=0.05$. Backward elimination methods was used for regression of the life satisfaction and dominant leisure-time PAs of older participants at $\alpha=0.1$.

Results

Demographic information

All gardeners had a yard and a number of the gardeners participated in many kinds of lawn tasks compared to non gardeners (Table 7.1). Gardeners averaged 6 hours 38 minutes per week gardening and non gardeners averages 56 minutes per week (data not shown).

Health status

All older participants in both groups were healthy and there were statistically no health differences between gardeners and non-gardeners (Table 7.2 and 7.3). The two groups had higher scores than the standard norm for older adults over 55 years old in all domains of the SF-36 (Ware et al., 2002). Few current CDs were reported in both groups. One of the CDs, arthritis had the highest percentage in both group (44% gardeners and 50% non-gardeners) and the other CDs reported in both groups were high blood pressure, heart disease, diabetes, cancer, and asthma (data not shown). Height, weight, body composition, BMI, blood pressure, and pulse were not significantly difference (Table 7. 3). The blood pressure of the all older participants was normal.

Predictor for a physically active lifestyle in older adults

Gardeners were more active than non gardeners based on total CE from all reported leisure-time PAs. Gardeners reported higher CE and frequency per week of leisure-time PAs compared to non gardeners (Table 7.4). Gardeners CE from gardening, stretching or flexibility exercises, aerobics or aerobic dancing and moderate to heavy strength training was higher than non gardeners (Table 7.5).

Predictor for life satisfaction in older adults

Active gardeners were more active based on the CE of all leisure-time PAs (Table 7.6), and had higher life satisfaction than the inactive/non gardeners (Table 7.7). Active gardeners CE from doing work around the house, doing gardening, doing stretching or flexibility exercises, doing aerobics or aerobic dancing, and doing moderate to heavy strength training was higher than inactive/non gardeners (Table 7.8). Doing house work, gardening, and stretching or flexibility exercises were predictors for life satisfaction in this study. Gardening ($p < 0.005$), housework ($p < 0.005$), and stretching or flexibility exercises ($p < 0.031$) were the leisure-time PA related to life satisfaction. Aerobics or aerobic dancing and moderate to heavy strength training did not show any relationship to life satisfaction. The interaction of gardening and housework ($p < 0.008$), housework and stretching or flexibility exercises ($p < 0.033$), and gardening, housework, and stretching or flexibility exercises ($p < 0.047$) were significant (data not shown).

Discussion

Gardening is a predictor for leading a physically active lifestyle in older adults and for providing better life satisfaction. All older participants were healthy in this study which supports gardening as a predictor for a physically active lifestyle. If there had been differences in the health conditions between the gardeners and non gardeners, the difference in CE and frequency between the two groups would likely have been due to their health. Since both groups were healthy, the difference in leisure-time PA between the groups can be linked to gardening. Moreover, the determinants for PA behavior such as family size, socioeconomic status, occupational status, educational status, and weight (Troost et al, 2002) were similar (Table 7.1).

When older adults do gardening as a PA in their leisure-time, they can experience the health benefits from regular PA and at the same time, they may change their lifestyle to be active or keep physically active. Since gardening was linked to other leisure-time activities, an older adult that starts to garden may increase their overall leisure-time PA and may also have a higher CE due to the required regular and continuous care of a garden (Restuccio, 1992), which is a long-term focused activity.

Changing a sedentary lifestyle is not easy. Many reasons and barriers to PA have been reported such as insufficient time, too tiring, too weak, fear of falling, bad weather, no facilities, and lack of exercise partners (Lian et al., 1999). Accordingly, many approaches have been tried to change the lifestyle of older adults. Märki et al. (2006) reported that an exercise promotion program based on the trans-theoretical model increased exercise behavior of older adults during the one year observation. As another approach, motivational interviewing, which is derived from client-centered counseling, cognitive-behavioral therapy and social-cognitive theory (Brodie and Inoue, 2005) has been recommended by many researchers for changing sedentary lifestyle (Hillsdon et al., 1995; Loughlan and Mutrie, 1995). When older adults with heart failure participated in a traditional exercise program, an exercise program with motivational interviewing, and a both treatment group, motivational interviewing group and the both treatment group showed increased levels and types of activities (Brodie and Inoue, 2005). Telephone based counseling for encouraging PA of older adults also increased physical activity of older adults (Kolt et al., 2006).

Gardening can address many of the reasons and motivational factors for promoting PA. Gardening motivation was investigated with the Leisure Motivation Scale (Beard and Ragheb, 1983) and seven motivational factors for gardening of older adults were reported: intellectual,

stimulus-avoidance, friendship building, social interaction, physical fitness, skill-development, and creativity (Ashton-Shaeffer and Constant, 2005). For example, vegetable and flower gardening of older gardeners provides opportunities to stretch and strengthen large muscle groups, creativity and arrangement in designing beds, and intellectual stimulation and skill-development.

Gardening and two other PAs, housework and stretching or flexibility exercises, were predictors of life satisfaction in older adults (data not shown) which is consistent with previous research. Milligan et al. (2004) reported that older gardeners got a sense of achievement, satisfaction, and aesthetic pleasure while gardening.

In summary, additional advantages of gardening in older adults were determined in this study. Gardening is an effective PA to promote a physically active lifestyle and better life satisfaction in older adults.

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Tables

Table 7.1. Descriptive information of gardeners and non-gardeners.

		Gardeners (N=25)	Non gardeners (N=28)
Age		71.3 (7.5) ^a	71.9 (8.2)
Gender	Female	56.0 ^b	71.4
	Male	44.0	28.6
Race	White	88.0	82.1
	Asian	12.0	17.9
Education	Completed high school	88.0	92.9
Highest education	None, vocational school, or community/junior college	28.0	32.1
	Four year college, graduate school, or professional school	80.0	67.9
Marital status	Single, divorced, or widowed	32.0	35.7
	Married, separated, or not married, but living with partner	68.0	64.3
Living situation	I live alone	36.0	25
	With family	64.0	71.4
	With non-family	0	3.6

What type of housing	Live in a house or duplex	100	92.9
	Live in an apartment, an assisted living, or other	0	7.1
Current employment	Retired	72.0	67.9
	Homemaker	4.0	10.7
	Full time	12.0	21.4
	Part time	8.0	0
	Unemployed	0	0
	On disability	4.0	0
Annual income	Less than \$40,000	24.0	28.6
	\$40,000-59,999	40.0	25
	\$60,000-80,000	12.0	21.4
	More than \$80,000	24.0	10.7
	No answer	0	14.3
Have a yard	Yes	100	57.2
Care for lawn	Yes	80.0	46.4
What type of lawn tasks	Mow the grass with a push mower	28.0	14.3
	Mow the grass with a self-propelled mower	32.0	7.1
	Mow the grass with a riding lawn mower	16.0	28.6
	Pull hoses and set-up sprinklers for watering	68.0	28.6
	Raking	76.0	28.6
	Applying mulch to planting beds	60.0	32.1
	Planting flowers	72.0	21.4

Planting trees and shrubs	48.0	28.6
Pruning trees and shrubs	56.0	35.7
Weeding	64.0	21.4
Fertilizing the lawn with a push spreader	36.0	3.6
Fertilizing the lawn with a hand spreader	20.0	39.3

^a: Mean (Standard Deviation).

^b: Percentage (%).

The sum of the highest education is over 100% because the subjects checked two categories.

Table 7.2. The results of the SF-36 of gardeners and non-gardeners.

Domains	Gardeners (n=25)	Non gardeners (n=28)	Statistics
Physical functioning	50.8	48.8	0.28 ^{NS}
Usual role -physical	48.6	48.5	0.97 ^{NS}
Bodily pain	48.5	49.8	0.63 ^{NS}
General health	51.2	51.3	0.98 ^{NS}
Vitality	53.8	55.1	0.60 ^{NS}
Social function	54.3	53.8	0.81 ^{NS}
Usual role-emotional	49.9	51.6	0.48 ^{NS}
Mental health	53.4	54.3	0.63 ^{NS}
Physical summary	49.0	48.1	0.67 ^{NS}
Mental summary	53.8	55.5	0.39 ^{NS}

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

Table 7.3. The information about height, weight, body composition, body mass index, blood pressure, and pulse of gardeners and non-gardeners.

	Gardeners (n=25)	Non gardeners (n=28)	Statistics
Height (cm)	164.4	160.7	0.09 ^{NS}
Weight (kg)	74.8	72.8	0.61 ^{NS}
Body composition			
Tissue (%Fat)	38.5	39.6	0.66 ^{NS}
Fat (g)	27671	28018	0.89 ^{NS}
Lean (g)	42287	41780	0.87 ^{NS}
Body Mass Index	27.1	27.6	0.75 ^{NS}
Blood pressure			
Systolic mmHg	134.6	131.7	0.51 ^{NS}
Diastolic mmHg	76.8	76.7	0.97 ^{NS}
Pulse	74.0	74.4	0.90 ^{NS}

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

Table 7.4. Physical activity measures from CHAMPS questionnaire of gardeners and non-gardeners.

Measure	Gardeners (n=25)	Non gardeners (n=28)	Statistics ^b
Moderate and greater intensity measures			
Caloric expenditure per week in at least moderate intensity physical activities (MET ≥ 3.0)	4106.0 (478.5) ^a A	1730.4 (452.1) B	0.0007***
Frequency per week in at least moderate intensity physical activities (MET ≥ 3.0)	12.9 (1.6) A	7.5 (1.4) B	0.014*
All activities measures			
Caloric expenditure per week in all listed physical activities	6262.3 (615.7) A	3217.1 (581.8) B	0.0007***
Frequency per week in all listed physical activities	28.0 (2.6) A	20.4 (2.4) B	0.039*

^a: Mean (Standard Error).

^b: A and B means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) at $p=0.05$.

* means $p \leq 0.05$ and *** means $p \leq 0.001$.

Table 7.5. Kinds and energy expenditure of leisure-time physical activities in CHAMPS questionnaire performed by gardeners and non-gardeners.

Physical activities	Gardeners (n=25)	Non gardeners (n=28)	Statistics ^b
Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)	151.1 ^a	0	0.19 ^{NS}
Play golf, carrying or pulling your equipment (count walking time only)	33.5	32.9	0.99 ^{NS}
Play golf, riding a cart (count walking time only)	40.1	82.3	0.60 ^{NS}
Play tennis (single+double)	89.2	155.8	0.64 ^{NS}
Do work around the house (light+heavy)	1184.4	686.8	0.06 ^{NS}
Do gardening (light+heavy)	1494.4 A	197.2 B	0.0001***
Work on your car, truck, lawn mower, or other machinery	87.4	122.3	0.69 ^{NS}
Jog or run	460.3	138.6	0.17 ^{NS}
Walk (uphill, hike uphill, fast, briskly for exercise)	753.0	518.9	0.34 ^{NS}
Walk (errands, leisurely) (count walking time only)	605.1	585.5	0.91 ^{NS}
Ride a bicycle or stationary cycle	166.2	161.8	0.97 ^{NS}
Do other aerobic machines such as rowing, or step machines (do not count treadmill or stationary cycle)	155.4	47.4	0.21 ^{NS}
Do water exercises (do not count other swimming)	44.6	131.1	0.27 ^{NS}
Swim (moderately, fast, gently)	24.5	54.3	0.51 ^{NS}

Do stretching or flexibility exercises (do not count yoga or Tai-chi)	208.4 A	77.21 B	0.03*
Do yoga or Tai-chi	67.8	52.7	0.79 ^{NS}
Do aerobics or aerobic dancing	215.8 A	35.1 B	0.04*
Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push ups)	288.2 A	23.5 B	0.01**
Do light strength training (such as hand-held weights of 5 lbs. or less or elastic bands)	152.3	66.5	0.12 ^{NS}
Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)	75.6	47.2	0.48 ^{NS}

^a: Mean.

^b: A and B means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) test at $\alpha=0.05$.

* means $p \leq 0.05$, ** means $p \leq 0.01$, and *** means $p < 0.001$.

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

Table 7.6. Physical activity measures from CHAMPS questionnaire of active gardeners and inactive/non gardeners.

Measure	Active gardeners (n=20)	Inactive/non gardeners (n=33)	Statistics ^b
Moderate and greater intensity measures			
Caloric expenditure per week in at least moderate intensity physical activities (MET ≥ 3.0)	4957.0 (468.6) ^a A	1574.6 (364.8) B	0.0001***
Frequency per week in at least moderate intensity physical activities (MET ≥ 3.0)	15.8 (1.6) A	6.7 (1.2) B	0.0001***
All activities measures			
Caloric expenditure per week in all listed physical activities	7276.4 (614.3) A	3064 (478.2) B	0.0001***
Frequency per week in all listed physical activities	31.9 (2.7) A	19.2 (2.1) B	0.0005***

^a: Mean (Standard Error).

^b: A and B means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) at $p=0.05$.

*** means $p < 0.001$.

Table 7.7. The results of the LIS-Z of active-gardeners and inactive/non gardeners.

Group	Mean	Statistics ^a
Active gardeners (n=20)	21.6 A	0.02*
Inactive/non gardeners (n=33)	18.8 B	

^a: A and B means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) at $p=0.05$.

* means $p \leq 0.05$.

Table 7.8. Kinds and energy expenditure of leisure-time physical activities in CHAMPS questionnaire performed by active gardeners and inactive/non gardeners.

Physical activities	Active gardener (n=20)	Inactive/ non gardeners (n=33)	Statistics ^b
Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)	188.9 ^a	0	0.11 ^{NS}
Play golf, carrying or pulling your equipment (count walking time only)	41.9	27.9	0.68 ^{NS}
Play golf, riding a cart (count walking time only)	50.1	69.9	0.81 ^{NS}
Play tennis (single+double)	0	199.8	0.17 ^{NS}
Do work around the house (light+heavy)	1309.2 A	686.6 B	0.02*
Do gardening (light+heavy)	1479.4 A	402.8 B	0.0001***
Work on your car, truck, lawn mower, or other machinery	109.2	103.8	0.95 ^{NS}
Jog or run	522.8	149.5	0.12 ^{NS}
Walk (uphill, hike uphill, fast, briskly for exercise)	852.1	494.3	0.15 ^{NS}
Walk (errands, leisurely) (count walking time only)	670.9	548.7	0.50 ^{NS}
Ride a bicycle or stationary cycle	207.8	137.2	0.60 ^{NS}
Do other aerobic machines such as rowing, or step machines (do not count treadmill or stationary cycle)	185.2	45.7	0.11 ^{NS}
Do water exercises (do not count other swimming)	55.7	111.2	0.50 ^{NS}
Swim (moderately, fast, gently)	30.6	46.1	0.74 ^{NS}

Do stretching or flexibility exercises (do not count yoga or Tai-chi)	235.9 A	80.4 B	0.01*
Do yoga or Tai-chi	84.8	44.7	0.50 ^{NS}
Do aerobics or aerobic dancing	269.8 A	29.8 B	0.01**
Do moderate to heavy strength training (such as hand-held weights of more than 5 lbs., weight machines, or push ups)	360.2 A	20.0 B	0.001***
Do light strength training (such as hand-held weights of 5 lbs. or less or elastic bands)	167.7	70.2	0.08 ^{NS}
Do general conditioning exercises, such as light calisthenics or chair exercises (do not count strength training)	83.8	46.6	0.37 ^{NS}

^a: Mean.

^b: A and B means sharing at least one common letter are not significantly different by Least Significant Difference (LSD) test at $\alpha=0.05$.

* means $p \leq 0.05$, ** means $p \leq 0.01$, and *** means $p < 0.001$.

^{NS}: No significant difference by Least Significant Difference (LSD) test at $p=0.05$.

CONCLUSIONS

Nine common gardening tasks were determined to provide low to moderate intensity PA (1.6-3.6 METs) for healthy older adults. Garden tasks that used both the upper and lower body such as digging, turning compost, raking, transplanting plants, and mulching were shown to be moderate intensity PA (METs > 3.0). The tasks that used primarily the upper body such as hand weeding, mixing soil, filling containers with soil, and transplanting seedlings were low intensity PA (METs < 3.0). Knowing the exercise intensity of various gardening tasks could be valuable information when gardening activities are applied to older adults for therapeutic purposes according to their health conditions or various levels of physical ability.

Older gardeners showed that they met the PA recommendation of at least 30 minutes of moderate intensity (MET > 3.0) PA on most days of the week through their daily gardening in spring and summer. They gardened an average of 33 hours in a typical week in May and 15 hours in a typical week in June and July. Self-reported health conditions for physical and mental health were good.

Older gardeners showed physical health benefits (physical function, bodily pain, and physical summary) and hand function ability by meeting the PA recommendation through their daily gardening. Therefore, gardening is a proper intervention for preventing or improving health conditions in older adults because it can offer moderate intensity PA and activities requiring a time commitment consistent with the recommendation of at least 30 minutes most days of the week.

A total of 35 different gardening tasks were observed. Tasks performed by more than 50% of the gardeners were weeding; walking; cleaning tools, hands or produce; resting; carrying

tools; storing tools or produce; harvesting; watering; gardening preparation (getting tools, buckets, hoses, etc.); and observing plants in the garden. Six different postures were observed during gardening and included uncomfortable and dangerous postures. When bodily pain was investigated, lower back pain (62.5%) was the highest of the ten kinds of bodily pain reported.

Gardening is a predictor for leading a physically active lifestyle in older adults because it promotes various leisure-time PAs and gardening by itself improves caloric expenditure. The gardeners reported higher caloric expenditure than non-gardeners in leisure-time PAs such as gardening, stretching or flexibility exercises, aerobics or aerobic dancing, and moderate to heavy strength training. Gardening with housework and stretching or flexibility exercises was a predictor for life satisfaction.

Therefore, gardening is a proper form of PA for health in older adults. The health benefits for older adults from a well-designed and evidence-based gardening intervention should be determined and postures and motions of gardening for less physical burden and maximizing physical benefits should be developed.

APPENDICES

**Appendix A - HOW TO MEASURE EXERCISE INTENSITY OF
GARDENING TASKS USING METABOLIC EQUIVALENTS**

Abstract

Regular physical activity (PA) can provide many health benefits for older adults. Gardening is often recommended as a form of PA although there is lack of research data to support this recommendation. By determining the exercise intensity of various gardening tasks, physical activity programs using gardening can be developed for improvement and maintenance of physical health. Therefore, the purpose of this paper is to show a useful method for measuring exercise intensity of gardening tasks in older adults.

KEY WORDS: ENERGY EXPENDITURE, HEART RATE, OXYGEN UPTAKE, INDIRECT CALORIMETRY, PHYSICAL ACTIVITY, OLDER ADULTS, ELDERLY

Introduction

Regular physical activity (PA) contributes to healthy aging (ACSM, 1998; Pate et al., 1995). Health benefits of PA include reduction in the risk of coronary heart disease, hypertension, type 2 diabetes, osteoporosis, ischemic stroke, selected cancers, anxiety and depression (ACSM, 1993; ACSM, 2004; Helmrich et al., 1991; King et al., 1989; Lee et al., 1991; Leon et al., 1987; Powell et al., 1987; Taylor et al., 1985; Wendel-Vos et al., 2004). Physical activity also provides improvement in fitness level, muscle strength, aerobic capacity, balance and bone mineral density (ACSM, 1998; DiPietro, 2001; USDHHS, 1996). Thus, the American College of Sports Medicine (ACSM) and the Centers for Disease Control (CDC) recommend PA for health, which is at least 30 minutes of moderate intensity PA on most days of the week (Pate et al., 1995).

Gardening is a prevalent type of PA among older adults (Armstrong, 2000; DiPietro, 2001; Walsh et al., 2001). In the U.S., 45% of men and 35% of women aged 65 years or older reported participation in gardening as a form of leisure-time PA (Yusuf et al., 1996). Gunn et al. (2005) and Withers et al. (2006) reported that lawn mowing is a moderate intensity PA in females and males aged 55-65 years old. However, we do not know about the exercise intensity of a number of various gardening tasks in older adults. For a well-designed exercise program through horticulture for older adults, the exercise intensities for each gardening task must be known. Therefore, the purpose of this paper is to explain a useful method for measuring exercise intensity of gardening tasks in older adults.

Materials and Methods

The Concept of METs

Metabolic equivalent is a term commonly used to measure metabolic rate. MET is a unit of metabolic equivalent and is the ratio of a person's metabolic rate at rest to that while performing a task. One MET is the amount of O₂ consumed when a body is at rest (about 250 mL·min⁻¹ for an average man and 200 mL·min⁻¹ for an average woman). Two METs equals two times the O₂ consumed at rest. For more accurate classification, variations such as body size should be considered. METs are expressed in terms of oxygen consumption per unit body mass: 1 MET = 3.5 mL·kg⁻¹·min⁻¹. Moderate PA is activity performed at an intensity of 3-6 METs (Pate et al., 1995). An example of a moderate intensity PA is brisk walking at 3-4 mph for most healthy adults. PA measured below 3 METs is considered low intensity and above 6 METs is considered high intensity.

Measuring METs

To determine the METs values of a physical activity, the amount of oxygen used by the body during the activity is measured (VO₂). In order to measure oxygen consumption of a person during PA, two different methods, direct calorimetry and indirect calorimetry can be used. Indirect calorimetry is commonly used because it is simpler and less expensive than direct calorimetry (McArdle et al., 2007). Research comparing the two methods gives certain evidence for the validity of the indirect method (McArdle et al., 2007). The indirect calorimetry method described in this paper is a submaximal graded exercise test (GXT).

Although it is possible to measure O₂ consumption while gardening, the equipment to do so is costly and may be cumbersome to the gardeners. Thus, a multi-stepped approach was used.

Step 1: Heart Rate (HR) Measurement of Gardening Tasks

To measure HR while gardening, subjects wear a HR monitor under their breast on the skin and a wireless HR storage device on their wrist. The subject's HR is continuously measured and recorded via radiotelemetry (Polar S 610i, Finland) during gardening. The subjects perform each gardening task for 10 minutes followed by a 5-minute resting time while sitting on a chair. In preliminary work, this 10-minute gardening and 5-minute resting schedule was determined to be sufficient to reach a stable maximum HR during the gardening task. For data analysis, the initial minute of HR measurement during each gardening task and during the rest period were not used in order to reduce interference between the end and beginning of a task. After finishing the HR measurement, the subject's HR data can be downloaded by a software program (Polar precision performance SW version 4.01.029, Polar Electro Oy, 2004).

Step 2: Submaximal Graded Exercise Test (GXT)

Using the gardening HR measurements, oxygen uptake (VO₂) can be measured by using a GXT in a lab. Weight, height, and age of each subject are input to the computer system connected to the GXT. The subjects wear a mask over their mouth with their nose plugged to insure they breathe through their mouth and a HR monitor (Polar S 610i, Finland) is worn under their breast while they walk on the treadmill (Precor, 964i, USA, 1997). The speed and elevation of the treadmill increases until the subjects reach their maximum HR measured during the gardening tasks (total time was about 15 minutes). The initial workload is 1.7 mph at 3% grade.

Every 5 minutes the speed and grade of the treadmill is increased depending on the HR values monitored. Expired gases collected in the mask are directed to a ParvoMedics metabolic cart (Provo, UT) through a Hans-Rudolph (Kansas City, MO) non-rebreathing mouthpiece. The flow meter and gas analyzers are calibrated prior to testing. From the GXT, a metabolic report of VO₂, HR, and energy expenditure values is obtained.

Step 3: Calculation of METs

The VO₂ and MET values for each gardening task can then be derived from the laboratory GXT results. VO₂ values are continually being recorded as the subjects HR is increasing so the first step in calculating METs is to find the VO₂ value at the average HR for each garden task. If there is not an exact HR/VO₂ match it can be calculated by using a ratio of the closest values.

The METs value is calculated using 1 MET = 3.5 ml/kg/min.

For example, suppose a male aged 67 years old had a maximum average HR of 74 bpm for digging. From the results of the GXT, VO₂ at a HR of 74 bpm was 11.5 ml/kg/min.

$$\frac{1 \text{ MET}}{3.5 \text{ ml/kg/min}} = \frac{x \text{ METs}}{11.5 \text{ ml/kg/min}} \quad x = 3.3 \text{ METs}$$

Thus, digging as a form of physical activity for this subject was of moderate intensity (MET > 3.0).

Additionally, the energy expenditure (EE) of each gardening task (kj/kg/hour = kal/m·(4.186·60)/kg of body weight) and Percent HRmax (% HRmax = (Gardening HR-Resting HR)/(HRmax-Resting HR)·100) can be calculated. Percent HRmax can be used in determining exercise intensities.

Results and Discussion

In order to use gardening or horticultural tasks as a way to experience the many health benefits associated with moderate PA, it is important to know the exercise intensity of each gardening task. The method presented in this paper can be used to determine the exercise intensity of a number of gardening tasks. Knowing the exercise intensity of a multitude of gardening tasks can then be used to develop PA interventions with gardening for improvement or maintenance of physical health.

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Appendix B - Support material for Chapter 3

Registration Form

Thank you for your interest in participating in our study on determining energy expenditure of garden tasks in older adults. Your answers to the following questions will help us determine if you are eligible to participate in our study. Please read each question carefully and complete it to the best of your ability. You are free to not answer any question. Your responses will be kept strictly confidential. Thank you for your participation.

If you have any questions or concern about this research project, you may contact the principal investigators, Dr. Candice Shoemaker or Sin-Ae Park, MS, Department of Horticulture, Forestry, and Recreation Resources, Throckmorton Hall, Kansas State University, Manhattan, KS 66506, or call (785)532-1431 or 532-3287. For information regarding the rights of human subjects, contact Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 1 Fairchild Hall, Manhattan, KS, 66506, (785)532-3224.

1) Your name: _____
 First Last

2) Gender (circle one): Female Male

3) How old are you: _____ years

4) Your telephone number so we can contact you: _____

5a) Do you currently have any of the following medical problem(s)?
 (circle all that apply)

High blood pressure Low blood pressure Heart disease

Lung disease Diabetes Cancer

Arthritis Kidney disease Liver disease

Alcohol/drug use Mental illness Asthma

Anemia or other blood disease Ulcer/other stomach disease

Other (please list): _____

5b) Are you limited in any way in any activities because of any of these medical conditions (circle one)?

Yes (How? _____)

No

Don't know

5c) Are you in treatment for this medical problem(s)? (circle one)

Yes No

6) Do you currently take a medication(s)? (circle one)

Yes (Which? _____)

No

7a) Has a doctor ever told you that you have arthritis (circle one)?

Yes No

7b) If you circled YES, do you know what type of arthritis you have (circle one)?

Rheumatoid Osteoarthritis Fibromyalgia Lupus

Do not know Other (write the type): _____

8a) Have you experienced pain, aching, stiffness, or swelling in or around a joint in the last 12 months (circle one)?

Yes No

8b) If you circled YES, were these symptoms present on most days for at least one month? Yes No

9) Do you smoke cigarettes now (circle one)? Yes No

10) Do you currently exercise at least 2 or 3 times a week?

Yes No

11) Do you currently garden or do lawn care more than 30 minutes on most days in a week?

Yes No

<p>Thank you for your time. We will call you in the next week to let you know the orientation time. Look forward to seeing you soon.</p>
--

Informed Consent

We are asking you to participate in a study that examines the intensity of common garden tasks to determine if they can be considered moderate-to-high intensity physical activity. As a result of this study, we will be better able to assist older adults in developing and maintaining their health through gardening. Your participation in this study is completely voluntary and will consist of completing a written questionnaire and performing three different garden tasks.

The survey will ask questions about your health. Please read each question carefully and complete it to the best of your ability. There are no right or wrong answers so please give your immediate reaction. You are free to not answer any question. Heart rate will be measured while completing the garden tasks using a heart rate monitor.

You are free to not participate or withdraw from participation in this study at anytime without consequence. **By completing the 40 minute survey you are freely consenting to participation in the study and the inclusion of your responses into the subsequent data set.**

You must obtain your physician's approval to participate in this study. If you agree to participate, your responses will be kept strictly confidential. At no time will your name be associated with your answers or with the results of this study. No individual cases will be singled out for examination; only group data will be presented so your name will not ever be identified.

If you have any questions or concern about this research project, you may contact the principal investigators, Dr. Candice Shoemaker or Sin-Ae Park, MS, Department of Horticulture, Forestry, and Recreation Resources, Throckmorton Hall, Kansas State University, Manhattan, KS 66506, or call (785)532-1431. For information regarding the rights of human subjects, please contact Dr. Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 1 Fairchild Hall, Manhattan, KS, 66506, (785)532-3224.

Thank you for taking time to read this consent. If you are willing to participate, please rip off the bottom part of this paper, sign the consent agreement, and return it. Keep this page for your records. Thank you for your assistance and careful responses.

I have read the informed consent and agree to participate in the program, determining the intensity of common garden tasks for older adults. My participation is voluntary. I understand that I may withdraw from the study at any time without penalty. I understand that my responses are strictly confidential and will be destroyed at the completion of this study.

SIGNATURE: _____

Date: _____

Month/Day/Year

Gardener's Survey



Name _____
(Last Name) (First Name)

This cover sheet will be torn off by the researchers so that your name will not be on the questionnaire.

Instructions:

Please read all of the instructions and questions carefully.

Do not put your name on any part of the survey on the following pages.

Fill in the circle next to each question that indicates your best answer.

Some questions have a blank space for you to write your answer.



Department of Horticulture, Forestry, and Recreation Resources
Kansas State University

Information About You

1. Gender (circle one): Female Male

2. How old are you: _____ years

3. Race (circle all that apply):

White	Black/African American
American Indian/Alaska Native	Native Hawaiian/Pacific Islander
Asian	Other: _____ (please specify)
Don't know	

4. Highest year of school completed (circle one):

1	2	3	4	5	6	7	8	9	10	11	12
(primary)						(middle/high school)					
13	14	15	16	17	18	19	20	21	22	above 22	
(undergraduate)						(graduate school)					

5. Are you currently (circle one):

Married	Separated	Widowed
Single	Divorced	
Not married, but living with a partner		

6a. Living Status (circle one): I live alone

I live with at least one other person

6b. Where do you live (circle one):

In a house	In an apartment	In an assisted living facility
Some place else (please tell us where): _____		

7. CURRENT employment status (circle one):

Retired	Homemaker	Employed FULL-time
Unemployed	On Disability	Employed PART-time

8. Your TOTAL annual household INCOME from ALL SOURCES (circle one):

\$0-9,999	\$20,000-29,999	\$40,000-49,999
\$60,000-69,999	\$10,000-19,999	\$30,000-39,999
\$50,000-59,999	\$70,000-79,999	\$80,000 or more

Moderate Physical Activity

Moderate Physical Activity Definition – Please read.

Moderate physical activity or exercise includes activities such as gardening, yardwork, brisk walking, swimming, cycling, and dancing. Moderate activities cause small increases in breathing or heart rate. You should be able to carry on a conversation when doing moderate activities.

1a) Now, thinking about the moderate physical activities you do in a usual week, do you do moderate activities for at least 15 minutes at a time that cause small increases in breathing or heart rate (circle one)?

Yes: Which moderate activities do you do? _____

: How many days per week: _____

No

1b) On days when you do moderate activities for at least 15 minutes at a time, how much **total time** do you spend doing these activities?

Total minutes per day: _____

Confidence to Garden

1) Write the number that indicates how SURE you are IN YOUR ABILITIES to do the following. Use this SCALE:

0	1	2	3	4	5	6	7	8	9	10
Not at all sure					Somewhat sure					Completely sure

I am sure that in the next 4 weeks:

Sureness



- a) I can garden for 30 minutes or more on *1 day in a week*..... _____
- b) I can garden for 30 minutes or more on *2 days in a week*..... _____
- c) I can garden for 30 minutes or more on *3 days in a week*..... _____
- d) I can garden for 30 minutes or more on *4 days in a week*..... _____
- e) I can garden for 30 minutes or more on *5 or more days in a week* _____

The Short-Form-36 Health Survey (SF-36)
--

This part of the survey asks you for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

For each of the following questions, please circle the word that best describes your answer.

General Health

In general, would you say your health is: (select one)

- Excellent Very Good Good Fair Poor

Compared to one year ago, how would you rate your health in general now? (Select one)

- Much better now than one year ago
- Somewhat better now than one year ago
- About the same
- Somewhat worse now than one year ago
- Much worse now than one year ago

Limitations of Activities

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? (Select one on each line)

a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

c. Lifting or carrying groceries

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

d. Climbing several flights of stairs

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

e. Climbing one flight of stairs

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

f. Bending, kneeling, or stooping

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

g. Walking more than a mile

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

h. Walking several blocks

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

i. Walking one block

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

j. Bathing or dressing yourself

Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
--------------------	-----------------------	------------------------

Physical health problems

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? (Select Yes or No)

- a. Cut down the amount of time you spent on work or other activities

Yes	No
-----	----

- b. A accomplished less than you would like

Yes	No
-----	----

- c. Were limited in the kind of work or other activities

Yes	No
-----	----

- d. Had difficulty performing the work or other activities (for example, it took extra effort)

Yes	No
-----	----

Emotional health problems

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? (Select Yes or No)

- a. Cut down the amount of time you spent on work or other activities

Yes	No
-----	----

- b. Accomplished less than you would like

Yes	No
-----	----

- c. Didn't do work or other activities as carefully as usual

Yes	No
-----	----

Social activities

During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?(Select one)

- Not at all Slightly Moderately Quite a bit Extremely

Pain

How much bodily pain have you had during the past 4 weeks? (Select one)

- None Very Mild Mild Moderate Severe Very Severe

During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)? (Select one)

- Not at all A little bit Moderately Quite a bit Extremely

Energy and Emotions

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. (Select one on each line)

How much of the time

During the past 4 weeks.....

a. Did you feel full of pep?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

b. Have you been a very nervous person?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

c. Have you felt so down in the dumps that nothing could cheer you up?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

d. Have you felt calm and peaceful?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

e. Did you have a lot of energy?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

f. Have you felt downhearted and blue?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

g. Did you feel worn out?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

h. Have you been a happy person?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

i. Did you feel tired?

All of the Time	Most of the Time	A Good Bit of the Time	Some of the Time	A Little of the Time	None of the Time
-----------------	------------------	------------------------	------------------	----------------------	------------------

Social activities

During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

- All of the time
- Most of the time
- Some of the time
- A little of the time
- None of the time

General Health

How true or false is each of the following statements for you? (Select one on each line)

I Seem to get sick a little easier than other people

Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
-----------------	-------------	------------	--------------	------------------

I am as healthy as anybody I know

Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
-----------------	-------------	------------	--------------	------------------

I expect my health to get worse

Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
-----------------	-------------	------------	--------------	------------------

My health is excellent

Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
-----------------	-------------	------------	--------------	------------------

Thank you for completing the survey!

Appendix C - Support material for Chapter 4 and 6

Informed Consent

We are asking you to participate in a study that observes gardening behavior of seniors. As a result of this study, we will be better able to assist older adults in developing and maintaining their health through gardening. Your participation in this study is completely voluntary and will consist of completing a survey, daily logs, and a 10-minute treadmill test, and observation while you're gardening.

The surveys will ask questions about your gardening and health. Please read each question carefully and complete it to the best of your ability. There is no right or wrong answers so please give your immediate reaction. You are free to not answer any question.

You are free to not participate or withdraw from participation in this study at anytime without consequence. By completing the survey you are freely consenting to participation in the study and the inclusion of your responses into the subsequent data set.

If you agree to participate in this study, your responses will be kept strictly confidential. At no time will your name be associated with your answers or with the results of this study. No individual cases will be singled out for examination; only group data will be presented so your name will not ever be identified.

If you have any questions or concern about this research project, you may contact the principal investigators, Dr. Candice Shoemaker or Sin-Ae Park, MS, Department of Horticulture, Forestry, and Recreation Resources, Throckmorton Hall, Kansas State University, Manhattan, KS 66506, or call (785) 532-1431 and Dr. Mark Haub, Department of Human Nutrition, Justin Hall, Kansas State University, Manhattan, KS 66506, or call (785) 532-0170. For information regarding the rights of human subjects, please contact Dr. Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 1 Fairchild Hall, Manhattan, KS, 66506, (785) 532-3224.

Thank you for taking time to read this consent. If you are willing to participate, please sign below and return it. The second copy of this informed consent is for you to keep for your records. Thank you for your assistance and careful responses.

I have read the informed consent and agree to participate in this study. My participation is voluntary. I understand that I may withdraw from the study at any time without penalty. I understand that my responses are strictly confidential and will be destroyed at the completion of this study.

SIGNATURE: _____

Date: _____
Month/Day/Year

Physician Release Form

Dear Doctor:

_____ has applied for enrollment in a research program at K-State.

This research program includes a 10-minute treadmill test. This test will be administered by qualified personnel trained in conducting exercise tests.

By completing the following form, you are not assuming any responsibility for our administration of the treadmill test. If you know of any medical or other reasons why the applicant's participation in the treadmill test would be unwise, please indicate so on this form.

Report of physician

---- I know of no reason that the applicant may not participate.

---- I believe the applicant can participate, but I urge caution because:

---- The applicant should not engage in the following activities:

---- I recommend that the applicant NOT participate.

Physician signature _____ Date _____

Address _____ Telephone _____

City and State _____ Zip _____

Gardener's Survey



Name _____
(Last Name) (First Name)

This cover sheet will be torn off by the researchers so that your name will not be on the questionnaire.

Instructions:

Please read all of the instructions and questions carefully.

Do not put your name on any part of the survey on the following pages.

Fill in the circle next to each question that indicates your best answer.

Some questions have a blank space for you to write your answer.



Department of Horticulture, Forestry, and Recreation Resources
Kansas State University

A. Information about you

1. What is your age? _____ Years
2. What is your gender? (mark one)
 Female Male
3. How do you describe yourself? Select one or more.
 American Indian or Alaska Native
 Asian
 Black or African American
 Hispanic or Latino
 Native Hawaiian or Other Pacific Islander
 White
 Don't know/not sure
 Prefer not to answer

B. Information about your lawn care activities

4. Does your home have a yard? Mark one.
 Yes No, **go to question 7**
5. Do you care for your lawn? Mark one.
 Yes No, **go to question 7**
6. What types of lawn care do you perform? Mark all that apply.
 Mow the grass with a push mower
 Mow the grass with a self-propelled mower
 Mow the grass with a riding lawn mower
 Pull hoses and set-up sprinklers for watering
 Raking
 Applying mulch to planting beds
 Planting flowers

C. Information about your gardening activities

For the following questions on your gardening activities, think about your activities **this gardening season.**

7. What kind of garden do you have? Select one or more.

- Vegetable
- Flower
- Herb
- Fruit
- Butterfly
- Naturalistic
- Container(s)
- Window boxes
- Community Garden plot
- Other

8. What time of the day do you typically garden? Mark one.

- In the morning
- In the afternoon
- In the evening

- | | Always | Sometimes | Never |
|---|-----------------------|-----------------------|-----------------------|
| 9. Do you stretch before starting your gardening activities? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 10. Do you typically wear gloves when you garden? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 11. Do you use a kneeling pad? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 12. Do you use strap-on knee pads? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 13. Do you use a chair or stool to sit on? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 14. Do you use a wheelbarrow? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 15. Do you use a large-wheeled garden cart? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 16. Do you sleep better at night after gardening? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 17. Overall, do you feel better <i>physically</i> after gardening? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 18. Overall, do you feel better <i>emotionally</i> after gardening? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

19. Do you experience pain when gardening?

- Always
- Sometimes
- Never, **go to question 20**

19a. How would you rate the pain you experience when gardening?

- Low
- Moderate
- High

19b. Where do you feel the pain when you are gardening? Please specify, such as lower back, neck, wrists, overall muscle ache, overall joint ache, etc)

20. For the following questions think about your gardening activities **over the past month.**

For each gardening activity, please indicate **how many times a week**, on average, you did the gardening activity over the past month and for **how long**.

In the example, the person weeds the garden about twice a week and 35 minutes each time.

Gardening activity	How many times a week								How long Minutes each time
	0	1	2	3	4	5	6	More (times s)	
Example: weeding			✓						35
Walking, gathering gardening tools									
Implied walking/standing – picking up yard, light work, picking flowers or vegetables									
Picking fruit off trees, picking fruits/vegetables, moderate effort									
Gardening general									
Weeding, cultivation									
Watering lawn or garden, standing or walking									
Trimming shrubs or trees, power cutter, using leaf blower, edger									
Trimming shrubs or trees, manual cutter									
Sacking grass, leaves									
Raking roof with snow rake									
Raking lawn									
Mulching									

Planting trees										
Planting seedlings, shrubs										
Planting seedlings in pots										
Mixing soil by hand										
Putting soil in pots										
Managing compost										
Mowing lawn, walk, self-propelled mower										
Mowing lawn, walk, push mower										
Mowing lawn, riding mower										
Laying sod										
Laying crushed rock										
Gardening with heavy power tools, tilling a garden, chain saw										
Digging, spading, filling garden, compositing										
Digging sandbox										
Clearing land, hauling branches, wheelbarrow chores										
Chopping wood, splitting logs										

D. Information about your general health

21. Do you currently have any chronic diseases? If so, do they limit your activity?
Mark all that apply.

Chronic Disease			Do you have limited activity from this problem?	
	Yes	No	Yes	No
High blood pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Low blood pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heart disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lung disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diabetes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cancer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Arthritis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kidney disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Liver disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alcohol/drug use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental illness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asthma	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anemia or other blood disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ulcer/other stomach disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

General Health

22. In general, would you say your health is: (mark one)

Excellent Very Good Good Fair Poor

23. Compared to one year ago, how would you rate your health in general now?
Mark one.

- Much better now than one year ago
- Somewhat better now than one year ago
- About the same
- Somewhat worse now than one year ago
- Much worse now than one year ago

Limitations of Activities

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? Mark one on each line.

24. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports

- Yes, limited a lot Yes, limited a little No, not limited at all

25. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

- Yes, limited a lot Yes, limited a little No, not limited at all

26. Lifting or carrying groceries

- Yes, limited a lot Yes, limited a little No, not limited at all

27. Climbing several flights of stairs

- Yes, limited a lot Yes, limited a little No, not limited at all

28. Climbing one flight of stairs

- Yes, limited a lot Yes, limited a little No, not limited at all

29. Bending, kneeling, or stooping

- Yes, limited a lot Yes, limited a little No, not limited at all

30. Walking more than a mile

- Yes, limited a lot Yes, limited a little No, not limited at all

31. Walking several blocks
 Yes, limited a lot Yes, limited a little No, not limited at all

32. Walking one block
 Yes, limited a lot Yes, limited a little No, not limited at all

33. Bathing or dressing yourself
 Yes, limited a lot Yes, limited a little No, not limited at all

Physical health problems

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? Mark one for each questions.

34. Cut down the amount of time you spent on work or other activities
 Yes No

35. Accomplished less than you would like Yes No

36. Were limited in the kind of work or other activities Yes No

37. Had difficulty performing the work or other activities Yes No
(For example, it took extra effort)

Emotional health problems

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Mark one for each question.

38. Cut down the amount of time you spent on work or other activities
 Yes No

39. Accomplished less than you would like Yes No

40. Didn't do work or other activities as carefully as usual Yes No

Social activities

41. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? Mark one.

Not at all Slightly Moderately Quite a bit Extremely

Pain

42. How much bodily pain have you had during the past 4 weeks? Mark one.

None Very Mild Mild Moderate Severe Very Severe

43. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)? Mark one.

Not at all A little bit Moderately Quite a bit Extremely

Energy and Emotions

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. Mark one for each question.

How much of the time during the past 4 weeks.....

44. Did you feel full of pep?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

45. Have you been a very nervous person?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

46. Have you felt so down in the dumps that nothing could cheer you up?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

47. Have you felt calm and peaceful?

All of the time

Most of the time

A good bit of the time

Some of the time

A little of the time

None of the time

48. Did you have a lot of energy?

All of the time

Most of the time

A good bit of the time

Some of the time

A little of the time

None of the time

49. Have you felt downhearted and blue?

All of the time

Most of the time

A good bit of the time

Some of the time

A little of the time

None of the time

50. Did you feel worn out?

All of the time

Most of the time

A good bit of the time

Some of the time

A little of the time

None of the time

51. Have you been a happy person?

All of the time

Most of the time

A good bit of the time

Some of the time

A little of the time

None of the time

52. Did you feel tired?

All of the time

Most of the time

A good bit of the time

Some of the time

A little of the time

None of the time

Social activities

53. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? Mark one.

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

General Health

How true or false is each of the following statements for you? Mark one for each question

54. I seem to get sick a little easier than other people

- Definitely true Mostly true Don't know Mostly false
 Definitely false

55. I am as healthy as anybody I know

- Definitely true Mostly true Don't know Mostly false
 Definitely false

56. I expect my health to get worse

- Definitely true Mostly true Don't know Mostly false
 Definitely false

57. My health is excellent

- Definitely true Mostly true Don't know Mostly false
 Definitely false

General gardening question

58. There are many reasons why people garden. Why do you garden?

Thank you for completing the survey!

Observer's Form



Name: _____

(Last Name)

(First Name)

Date: _____

Observation Time: (such as 9 am – 10 am) _____

Instructions:

Please read all of the instructions and questions carefully.

Compete one of these forms each time you observe a gardener.

You will need a watch with minute markings to measure time spent on each activity.



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Kansas State University

Using the following table, write down each activity the gardener is performing and for how long throughout the entire observation time. Please explain how as well as what they are doing.

In the example, the person weeded for 30 minutes, rested for 5 minutes, and deadheaded for 10 minutes.

Gardening and lawn care activity	Motions observed	How long
EXAMPLE:		Minutes each time
Weeding	K, G, B	30
Resting	Sitting	5
Deadheading	B, S	10

B: bending; S: stretching; G: gripping; K: kneeling; Q: squatting; W: walking

What tools, materials, and equipment did you observe being used today? Such as pruners, hoses, mower, etc.

Were any of the tools used today adapted for ease of use, such as having foam or grip tape on handles for easier grasping?

Gardener's Weekly Log



Name _____

(Last Name)

(First Name)

Date for the week of this log: _____

This cover sheet will be torn off by the researchers so that your name will not be on the log.

Instructions:

Please read all of the instructions and questions carefully.

Do not put your name on any part of the log on the following pages.



Department of Horticulture, Forestry, and Recreation Resources
Kansas State University

From the following list of gardening activities, mark how many times **this week** you did each activity and for **how long**. If a gardening activity you did this week is not on the list please add it in the spaces at the end of the list on the next page.

In the example, the person weeded the garden twice this week and 35 minutes each time.

Gardening activity	How many times this week								How long
	0	1	2	3	4	5	6	More (times)	Minutes each time
Example: weeding			✓						35
Walking, gathering gardening tools									
Implied walking/standing – picking up yard, light work, picking flowers or vegetables									
Picking fruit off trees, picking fruits/vegetables, moderate effort									
Gardening general									
Weeding, cultivation									
Watering lawn or garden, standing or walking									
Trimming shrubs or trees, power cutter, using leaf blower, edger									
Trimming shrubs or trees, manual cutter									
Sacking grass, leaves									
Raking roof with snow rake									
Raking lawn									
Mulching									
Planting trees									
Planting seedlings, shrubs									
Planting seedlings in pots									
Mixing soil by hand									
Putting soil in pots									
Managing compost									
Mowing lawn, walk, self-propelled mower									
Mowing lawn, walk, push mower									
Mowing lawn, riding mower									

Laying sod									
Laying crushed rock									
Gardening with heavy power tools, tilling a garden, chain saw									
Digging, spading, filling garden, composting									
Digging sandbox									
Clearing land, hauling branches, wheelbarrow chores									
Chopping wood, splitting logs									

Please add any gardening activities not on the list that you did this week in the spaces above.

1. I gardened more this week than I usually do. Mark one.
 Yes No

2. I was injured while gardening this week. Mark one.
 Yes No

3. Overall, I would rate my physical health this week as: (mark one)
 Excellent Very Good Good Fair Poor

4. Overall, I would rate my emotional health this week as: (mark one)
 Excellent Very Good Good Fair Poor

5. Overall, I would rate my sleep this week as: (mark one)
 Better than usual Normal Worse than usual

6. Overall, I would rate my pain level this week as: (mark one)
 More than usual Usual Less than usual

Thank you for completing this weekly gardening log!

Appendix D - Support material for Chapter 5 and 7

Informed Consent

You are being invited to participate in a study to evaluate physical fitness and leisure-time activities of seniors. As a result of this study, we will be better able to assist older adults in developing and maintaining their health through their leisure-time activities. Your participation in this study is completely voluntary and will consist of completing a survey and performing tests to assess your physical fitness.

To assess your physical fitness you will be asked to perform a series of assessments designed to evaluate your upper- and lower-body strength, aerobic endurance, flexibility, agility, and balance. These assessments involve activities such as walking, standing, lifting, stepping, and stretching. The risk of engaging in these activities is similar to the risk of engaging in all moderate exercise and may possibly result in muscular fatigue and soreness, sprains and soft tissue injury, skeletal injury, dizziness, and fainting.

If any of the following apply, you should not participate in testing without written permission of your physician:

1. Your doctor has advised you not to exercise because of your medical condition(s).
2. You have experienced congestive heart failure.
3. You are currently experiencing joint pain, chest pain, dizziness, or have exertional angina (chest tightness, pressure, pain, heaviness) during exercise.
4. You have uncontrolled high blood pressure (160/100 or above).

During the assessment you will be asked to perform within your physical “comfort zone” and never to push to a point of overexertion or beyond what you feel is safe. You will be instructed to notify the person monitoring your assessment if you feel any discomfort or experience any unusual physical symptoms such as

unusual shortness of breath, dizziness, tightness or pain in the chest, irregular heartbeats, numbness, loss of balance, nausea, or blurred vision. If you are accidentally injured during testing, the test administrators will be unable to provide treatment for you other than basic first aid. You will be required to seek treatment from your own physician, which must be paid for by you or your insurance company.

The survey will ask questions about your physical and psychological health and your leisure-time activities. There is no right or wrong answers and you are free to not answer any question.

If you agree to participate in this study, your responses will be kept strictly confidential. At no time will your name be associated with your answers or with the results of this study. No individual cases will be singled out for examination; only group data will be presented so your name will not ever be identified.

If you have any questions or concern about this research project, you may contact the principal investigators, Dr. Candice Shoemaker or Sin-Ae Park, MS, Department of Horticulture, Forestry, and Recreation Resources, Throckmorton Hall, Kansas State University, Manhattan, KS 66506, or call (785) 532-1431 or Dr. Mark Haub, Department of Human Nutrition, Justin Hall, Kansas State University, KS 66506, or call (785)532-0170. For information regarding the rights of human subjects, please contact Dr. Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 230 Fairchild Hall, Manhattan, KS, 66506, (785) 532-3224.

You are free to not participate or withdraw from participation in this study at anytime without consequence. By signing this form, you acknowledge the following:

1. I have read the full content of this document. I have been informed of the purpose of the testing and of the physical risks that I may encounter.
2. I agree to monitor my own physical condition during testing and agree to

stop my participation and inform the person administering the assessment if I feel uncomfortable or experience any unusual symptoms.

3. I assume full responsibility for all risk of bodily injury as a result of participating in testing. Should I suffer an injury or become ill during testing, I understand that I must seek treatment from my own physician and that I or my insurance company will have to pay for this treatment.

My signature below indicates that I have had an opportunity to ask and have answered any questions I may have, and that I feely consent to participate in this project.

SIGNATURE:

Date:

Month/Day/Year

Print Name:

Medical Clearance Form

Your patient is interested in participating in a research project at Kansas State University that includes the Senior Fitness Test, developed and validated at California State University, Fullerton. This test battery is designed to assess the underlying physical parameters associated with functional mobility (strength, endurance, flexibility, balance, and agility).

All test items will be administered by trained personnel, and procedures for any medical emergency are in place. Participants will be instructed to do the best they can within their “comfort zone” and never to push themselves to the point of overexertion, or beyond what they think is safe for them. Technicians have been instructed to discontinue testing if at any time participants show signs of dizziness, pain, nausea, or undue fatigue. The test items are:

1. Chair Stand Test (number of stands from achier in 30 sec)
2. Arm Curl Test (number of curls in 30 sec; 5-lb weight for women, 8-lb weight for men)
3. 6-Minute Walk Test (number of yds walked in 6 min – person can rest when necessary)
4. Chair-Sit-and-Reach Test (distance one can reach forward toward toes)
5. Back Scratch Test (how far hands can reach behind the back)
6. 8-Foot Up-and-Go Test (time required to get up from a chair, walk 8 ft, and return to chair).

By completing the following form, you are not assuming any responsibility for our administration of the fitness testing. If you know of any medical or other reasons why the applicant’s participation in the fitness testing would be unwise, please indicate so on this form.

Report of Physician

____ I know of no reason that the applicant may not participate.

____ I believe the applicant can participate, but I urge caution because:

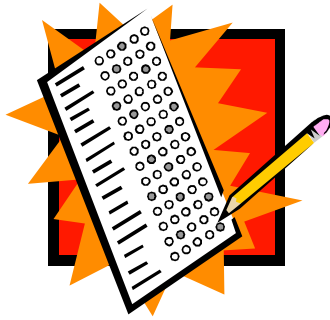
____ The applicant should not engage in the following activities:

____ I recommend that the applicant NOT participate.

Physician's Name	Date	Phone Number
------------------	------	--------------

Physician's Signature	Address
-----------------------	---------

Survey 1



Name _____

(Last Name)

(First Name)

This cover sheet will be torn off by the researchers so that your name will not be on the questionnaire.

Instructions:

Please read all of the instructions and questions carefully.

Do not put your name on any part of the survey on the following pages.

Fill in the circle next to each question that indicates your best answer.

Some questions have a blank space for you to write your answer.



Department of Horticulture, Forestry, and Recreation Resources
Kansas State University

A. Information about you

1. What is your age? _____ Years

2. What is your gender? (mark one)

Female Male

3. How do you describe yourself? Select one or more.

- American Indian or Alaska Native
- Asian
- Black or African American
- Hispanic or Latino
- Native Hawaiian or Other Pacific Islander
- White
- Don't know/not sure
- Prefer not to answer

4. Did you complete high school? (mark one)

Yes No

5. What is the highest education you completed since high school? (mark one)

- None
- Vocational School
- Community/Junior College
- Four Year College
- Graduate School
- Professional School

6. What is your marital status? (mark one)

- Single
- Married
- Divorced
- Separated
- Widowed
- Not married, but living with a partner

7. What is your living situation? (mark one)
- I live alone
 - I live with family members
 - I live with non-family members
8. What type of housing do you live in? (mark one)
- I live in a house
 - I live in a duplex, townhouse, or condominium
 - I live in an apartment
 - I live in an assisted living facility
 - Other (please tell us where):
9. What is your current employment status? (mark all that apply)
- Retired
 - Homemaker
 - Employed Full-time
 - Employed Part-time
 - Unemployed
 - On Disability
10. What is your total annual income from all sources? (mark one)
- less than \$40,000
 - \$40,000-59,999
 - \$60,000-80,000
 - more than \$80,000

B. Information about your lawn care activities

11. Does your home have a yard? Mark one.

- Yes No, **go to question 14**

12. Do you care for your lawn? Mark one.

- Yes No, **go to question 14**

13. What types of lawn care do you perform? Mark all that apply.

- | | |
|---|---|
| <input type="radio"/> Mow the grass with a push mower | <input type="radio"/> Planting flowers |
| <input type="radio"/> Mow the grass with a self-propelled mower | <input type="radio"/> Planting trees and shrubs |
| <input type="radio"/> Mow the grass with a riding lawn mower | <input type="radio"/> Pruning trees and shrubs |
| <input type="radio"/> Pull hoses and set-up sprinklers for watering | <input type="radio"/> Weeding |
| <input type="radio"/> Raking | <input type="radio"/> Fertilizing the lawn with a push spreader |
| <input type="radio"/> Applying mulch to planting beds | <input type="radio"/> Fertilizing the lawn with a hand spreader |

C. Information about your general health

14. Do you currently have any chronic diseases? If so, do they limit your activity?
Mark all that apply.

Chronic Disease	Do you have limited activity from this problem?			
	Yes	No	Yes	No
High blood pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Low blood pressure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Heart disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lung disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diabetes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cancer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Arthritis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kidney disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Liver disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alcohol/drug use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mental illness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asthma	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anemia or other blood disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ulcer/other stomach disease	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15. Are you smoker? Mark one.

Yes (how long?) **go to question 17** No

16. Have you been smoking before? Mark one.

Yes (how long?) No

General Health

17. In general, would you say your health is: (mark one)

Excellent Very Good Good Fair Poor

18. Compared to one year ago, how would you rate your health in general now?

Mark one.

- Much better now than one year ago
- Somewhat better now than one year ago
- About the same
- Somewhat worse now than one year ago
- Much worse now than one year ago

Limitations of Activities

The following items are about activities you might do during a **typical day**. Does your health now limit you in these activities? If so, how much? Mark one on each line.

19. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports

Yes, limited a lot Yes, limited a little No, not limited at all

20. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

Yes, limited a lot Yes, limited a little No, not limited at all

21. Lifting or carrying groceries

Yes, limited a lot Yes, limited a little No, not limited at all

22. Climbing several flights of stairs

Yes, limited a lot Yes, limited a little No, not limited at all

23. Climbing one flight of stairs

Yes, limited a lot Yes, limited a little No, not limited at all

24. Bending, kneeling, or stooping

Yes, limited a lot Yes, limited a little No, not limited at all

25. Walking more than a mile

Yes, limited a lot Yes, limited a little No, not limited at all

26. Walking several blocks

Yes, limited a lot Yes, limited a little No, not limited at all

27. Walking one block

Yes, limited a lot Yes, limited a little No, not limited at all

28. Bathing or dressing yourself

Yes, limited a lot Yes, limited a little No, not limited at all

Physical health problems

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? Mark one for each question.

29. Cut down the amount of time you spent on work or other activities

Yes No

30. Accomplished less than you would like Yes No

31. Were limited in the kind of work or other activities Yes No

32. Had difficulty performing work or other activities Yes No

(For example, it took extra effort)

Emotional health problems

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Mark one for each question.

33. Cut down the amount of time you spent on work or other activities
 Yes No

34. Accomplished less than you would like Yes No

35. Didn't do work or other activities as carefully as usual
 Yes No

Social activities

36. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? Mark one.

Not at all Slightly Moderately Quite a bit Extremely

Pain

37. How much bodily pain have you had during the **past 4 weeks**? Mark one.

None Very Mild Mild Moderate Severe Very Severe

38. During the **past 4 weeks**, how much did pain interfere with your normal work (including both work outside the home and housework)? Mark one.

Not at all A little bit Moderately Quite a bit Extremely

Energy and Emotions

These questions are about how you feel and how things have been with you during **the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. Mark one for each question.

How much of the time during the past 4 weeks.....

39. Did you feel full of pep?

All of the time Some of the time
 Most of the time A little of the time
 A good bit of the time None of the time

40. Have you been a very nervous person?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

41. Have you felt so down in the dumps that nothing could cheer you up?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

42. Have you felt calm and peaceful?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

43. Did you have a lot of energy?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

44. Have you felt downhearted and blue?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

45. Did you feel worn out?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

46. Have you been a happy person?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

47. Did you feel tired?

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

Social activities

48. During the **past 4 weeks**, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? Mark one.

- | | |
|--|--|
| <input type="radio"/> All of the time | <input type="radio"/> Some of the time |
| <input type="radio"/> Most of the time | <input type="radio"/> A little of the time |
| <input type="radio"/> A good bit of the time | <input type="radio"/> None of the time |

General Health

How true or false is each of the following statements for you? Mark one for each question

49. I seem to get sick a little easier than other people

- | | | |
|---------------------------------------|--|----------------------------------|
| <input type="radio"/> Definitely true | <input type="radio"/> Mostly true | <input type="radio"/> Don't know |
| <input type="radio"/> Mostly false | <input type="radio"/> Definitely false | |

50. I am as healthy as anybody I know

- | | | |
|---------------------------------------|--|----------------------------------|
| <input type="radio"/> Definitely true | <input type="radio"/> Mostly true | <input type="radio"/> Don't know |
| <input type="radio"/> Mostly false | <input type="radio"/> Definitely false | |

51. I expect my health to get worse

- | | | |
|---------------------------------------|--|----------------------------------|
| <input type="radio"/> Definitely true | <input type="radio"/> Mostly true | <input type="radio"/> Don't know |
| <input type="radio"/> Mostly false | <input type="radio"/> Definitely false | |

52. My health is excellent

- | | | |
|---------------------------------------|--|----------------------------------|
| <input type="radio"/> Definitely true | <input type="radio"/> Mostly true | <input type="radio"/> Don't know |
| <input type="radio"/> Mostly false | <input type="radio"/> Definitely false | |

D. Information about your sleep

The following questions relate to your usual sleep habits during the *past month only*. Your answers should indicate the most accurate reply for the *majority of days and nights in the past month*. Please answer all questions.

During the past month,

53. When have you usually gone to bed? _____

54. How long (in minutes) has it taken you to fall asleep each night?

55. When have you usually gotten up in the morning?

56. How many hours of actual sleep did you get that night? (This may be different than the number of hours you spend in bed)

For **each item** in the chart, indicate how often during the past month it was a reason you had trouble sleeping.

	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
57. Cannot get to sleep within 30 minutes				
58. Wake up in the middle of the night or early morning				
59. Have to get up to use the bathroom				
60. Cannot breathe comfortably				
61. Cough or snore loudly				
62. Feel too cold				
63. Feel too hot				
64. Have bad dreams				
65. Have pain				
66. Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):				

67. During the past month, how often have you taken medicine (prescribed or “over the counter”) to help you sleep?

- Not during the past month
- Less than once a week
- Once or twice a week
- Three or more times a week

68. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month

Less than once a week

Once or twice a week

Three or more times a week

69. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?

Not during the past month

Less than once a week

Once or twice a week

Three or more times a week

70. During the past month, how would you rate your sleep quality overall?

Very good

Fairly good

Fairly bad

Very bad

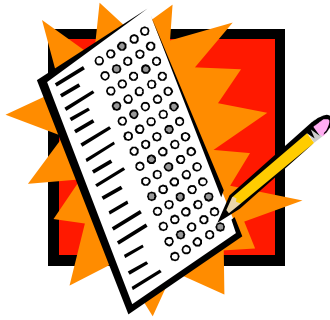
E. Information about your general well-being

For each statement mark if you agree, disagree, or don't know. Mark one for each statement.

Items	Agree	Disagree	Don't know
71.As I grow older, things seem better than I thought they would be	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
72.I have gotten more of the breaks in life than most of the people I know	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
73.This is the dreariest time of my life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
74.I am just as happy as when I was younger	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
75.These are the best years of my life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
76.Most of the things that I do are boring or monotonous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
77.The things I do are as interesting to me now as they ever were	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
78.As I look back on my life, I am fairly well satisfied	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
79.I have made plans for things I'll be doing a month or a year from now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
80.When I think back over my life, I didn't get most of the important things I wanted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
81.Compared to other people, I get down in the dumps too often	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
82.I've gotten pretty much what I expected out of life	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
83.In spite of what people say, the lot of the average man is getting worse, not better	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Thank you very much for completing this survey!

Survey 2



Name _____

(Last Name)

(First Name)

This cover sheet will be torn off by the researchers so that your name will not be on the questionnaire.

Instructions:

Please read all of the instructions and questions carefully.

Do not put your name on any part of the survey on the following pages.

Fill in the circle next to each question that indicates your best answer.



Department of Horticulture, Forestry, and Recreation Resources
Kansas State University

Information about your leisure-time and physical activities

The following questions are about activities that you may have done in the past 4 weeks. The questions on the following pages are similar to the example shown below.

INSTRUCTIONS

If you DID the activity in the past 4 weeks:

Step #1 Check the YES box.

Step #2 Think about how many TIMES a week you usually did it, and write your response in the space provided.

Step #3 Circle how many TOTAL HOURS in a typical week you did the activity.

Here is an example of how Mrs. Jones would answer question #1:

Mrs. Jones usually visits her friends Maria and Olga twice a week. She usually spends one hour on Monday with Maria and two hours on Wednesday with Olga. Therefore, the total hours a week that she visits with friends is 3 hours a week.

In a typical week during the past 4 weeks, did you ...	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours	
1. Visit with friends or family (other than those you live with)? <input checked="" type="checkbox"/> YES How many TIMES a week? <u>2</u> → <input type="checkbox"/> NO	How many TOTAL hours a week did you usually do it? →	○	○	<input checked="" type="checkbox"/>	○	○	○

If you DID NOT do the activity:

- Check the NO box and move to the next question.

In a typical week during the past 4 weeks, did you ...	Less than 1 hour	1-2½ hours	3-4½ hours	5-6½ hours	7-8½ hours	9 or more hours	
1. Visit with friends or family (other than those you live with)? <input type="checkbox"/> YES How many TIMES a week? _____ → <input type="checkbox"/> NO	How many TOTAL hours a week did you usually do it? →	O	O	O	O	O	O
2. Go to the senior center? <input type="checkbox"/> YES How many TIMES a week? _____ → <input type="checkbox"/> NO	How many TOTAL hours a week did you usually do it? →	O	O	O	O	O	O
3. Do volunteer work? <input type="checkbox"/> YES How many TIMES a week? _____ → <input type="checkbox"/> NO	How many TOTAL hours a week did you usually do it? →	O	O	O	O	O	O
4. Attend church or take part in church activities? <input type="checkbox"/> YES How many TIMES a week? _____ → <input type="checkbox"/> NO	How many TOTAL hours a week did you usually do it? →	O	O	O	O	O	O
5. Attend other club or group meetings? <input type="checkbox"/> YES How many TIMES a week? _____ → <input type="checkbox"/> NO	How many TOTAL hours a week did you usually do it? →	O	O	O	O	O	O

<p>6. Use a computer?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>7. Dance (such as square, folk, line, ballroom) (do not count aerobic dance here)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>8. Do woodworking, needlework, drawing, or other arts or crafts?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>9. Play golf, carrying or pulling your equipment (count walking time only)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0

<p>10. Play golf, riding a cart (count <u>walking</u> time only)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>11. Attend a concert, movie, lecture, or sport event?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>12. Play cards, bingo, or board games with other people?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>13. Shoot pool or billiards?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>14. Play singles tennis (do <u>not</u> count doubles)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0

<p>15. Play doubles tennis (do <u>not</u> count singles)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>16. Skate (ice, roller, in-line)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>17. Play a musical instrument?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>18. Read?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0

<p>19. Do heavy work around the house (such as washing windows, cleaning gutters)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>20. Do light work around the house (such as sweeping or vacuuming)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>21. Do heavy gardening (such as spading, raking)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0
<p>22. Do light gardening (such as watering plants)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	0	0	0	0	0	0

<p>23. Work on your car, truck, lawn mower, or other machinery?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>**Please note: For the following questions about running and walking, include use of a treadmill.</p>							
<p>24. Jog or run?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>25. Walk uphill or hike uphill (count only uphill part)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>26. Walk <u>fast</u> or <u>briskly</u> for exercise (do <u>not</u> count walking leisurely or uphill)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O

<p>27. Walk <u>to do errands</u> (such as to/from a store or to take children to school (<u>count walk time only</u>)?)</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O
<p>28. Walk <u>leisurely</u> for exercise or pleasure?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O
<p>29. Ride a bicycle or stationary cycle?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O
<p>30. Do other aerobic machines such as rowing, or step machines (do <u>not</u> count treadmill or stationary cycle)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O

<p>31. Do water exercises (do <u>not</u> count other swimming)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>32. Swim moderately or fast?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>33. Swim gently?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>34. Do stretching or flexibility exercises (do <u>not</u> count yoga or Tai-chi)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O

<p>35. Do yoga or Tai-chi?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>36. Do aerobics or aerobic dancing?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>37. Do moderate to heavy strength training (such as hand-held weights of <u>more than 5 lbs.</u>, weight machines, or push-ups)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>38. Do light strength training (such as hand-held weights of <u>5 lbs. or less</u> or elastic bands)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O

<p>39. Do general conditioning exercises, such as light calisthenics or chair exercises (do <u>not</u> count strength training)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>40. Play basketball, soccer, or racquetball (do <u>not</u> count time on sidelines)?</p> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O
<p>41. Do other types of physical activity not previously mentioned (please specify)?</p> <hr/> <p><input type="checkbox"/> YES How many TIMES a week? _____ →</p> <p><input type="checkbox"/> NO</p>	<p>How many TOTAL hours a week did you usually do it? →</p>	O	O	O	O	O	O

Thank you for completing the survey!

Score Card

Date: _____

Temp.: _____ Hum.: _____

Name: _____ M F Age: _____

Ht: _____ Wt: _____

Blood Pressure

1 st trial			2 nd trial		
Systolic mmHg	Diastolic mmHg	Pulse	Systolic mmHg	Diastolic mmHg	Pulse

Pinch Force (Kg)

Dominant Hand	__ Left	__ Right	__ Unknown
Left Hand	Trial	Right Hand	Trial
	1.		1.
	2.		2.
	3.		3.

Hand Strength (Kg)

Dominant Hand	__ Left	__ Right	__ Unknown
Left Hand	Trial	Right Hand	Trial
	1.		1.
	2.		2.
	3.		3.

Date: _____

Name: _____

Temp.: _____

Hum.: _____

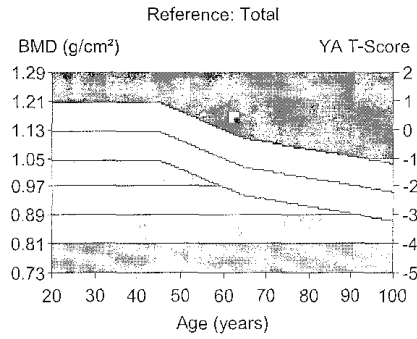
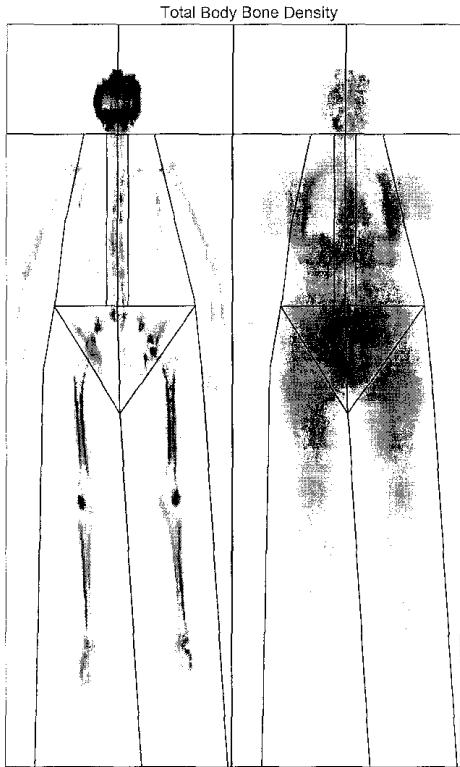
Senior Fitness Test

Test Item	Trial 1	Trial 2	Comments
1. Chair Stand Test (# in 30 sec)		NA	
2. Arm Curl Test (# in 30 sec)		NA	L or R
3. Chair Sit-and-Reach Test (nearest 1/2 in.:+/-)			Extended leg: R or L
4. Back Scratch Test (nearest 1/2 in.:+/-)			Hand over: R or L shoulder
5. 8-Foot Up-and-Go Test (nearest 1/10 sec)			
6. 6-Minute Walk Test (# of yd)		NA	

Bone Mineral Density Result (Sample)

Human Metabolism Laboratory
 Department of Human Nutrition / Kansas State University
 Manhattan, KS 66506

Patient:	Facility ID:
Birth Date:	Physician:
Height / Weight:	Measured:
Sex / Ethnic:	Analyzed:



Region	¹ BMD (g/cm ²)	² Young-Adult T-Score	³ Age-Matched Z-Score
Total	1.159	0.4	1.6

COMMENTS:

Image not for diagnosis

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 Filename: reagas_jpctpy9fi.dfb
 Scan Mode: Standard

1 -Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm² for Total Body Total)
 2 -USA, Total Body Reference Population, Ages 20-40
 3 -Matched for Age, Weight (females 25-100 kg), Ethnic

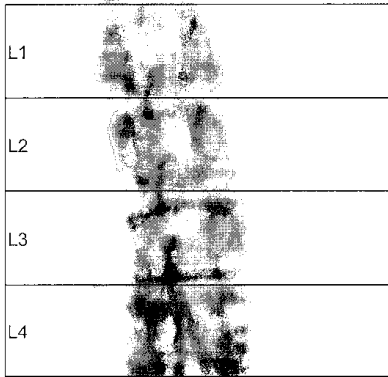
GE Medical Systems
 LUNAR

Prodigy
 DF+12222

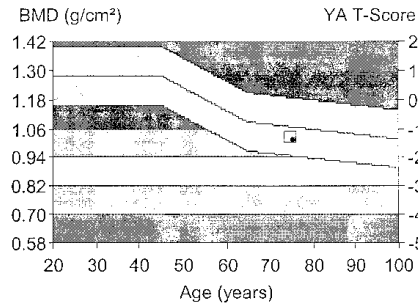
Human Metabolism Laboratory
 Department of Human Nutrition / Kansas State University
 Manhattan, KS 66506

Patient:	Facility ID:
Birth Date:	Physician:
Height / Weight:	Measured:
Sex / Ethnic:	Analyzed:

AP Spine Bone Density



Reference: L1-L4



Region	¹ BMD (g/cm ²)	² Young-Adult T-Score	³ Age-Matched Z-Score
L1-L4	1.025	-1.3	-0.4

COMMENTS:

Image not for diagnosis
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 Scan Mode: Standard

1 -Statistically 68% of repeat scans fall within 1SD (± 0.010 g/cm² for AP Spine L1-L4)
 2 -USA, AP Spine Reference Population, Ages 20-40
 3 -Matched for Age, Weight (females 25-100 kg), Ethnic
 11 -WHO - Definition of Osteoporosis and Osteopenia for White Women: Normal =
 T-Score at or above -1.0 SD; Osteopenia = T-Score between -1.0 and -2.5 SD;
 Osteoporosis = T-Score at or below -2.5 SD

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Human Metabolism Laboratory
 Department of Human Nutrition / Kansas State University
 Manhattan, KS 66506

Patient:	Facility ID:
Birth Date:	Physician:
Height / Weight:	Measured:
Sex / Ethnic:	Analyzed:

DualFemur Bone Density

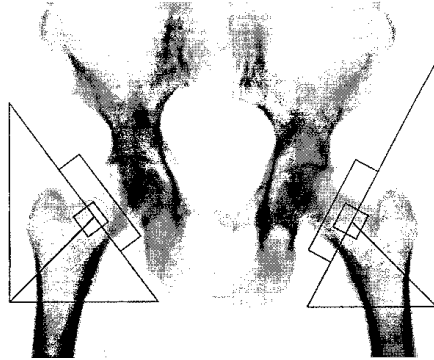
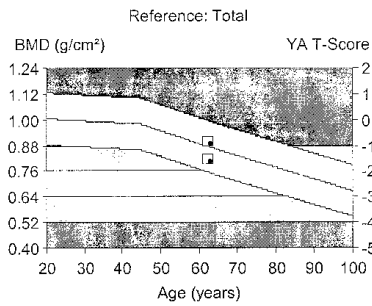


Image not for diagnosis



Region	¹ BMD (g/cm ²)	^{2,7} Young-Adult T-Score	³ Age-Matched Z-Score
Total	0.897	-0.9	0.2
Left	0.816	-1.5	-0.5
Mean	0.857	-1.2	-0.2
Difference	0.081	0.7	0.7

COMMENTS:

- 1 - Statistically 68% of repeat scans fall within 1SD (± 0.012 g/cm² for DualFemur Total Mean)
- 2 - USA, Femur Reference Population, Ages 20-40
- 3 - Matched for Age, Weight (females 25-100 kg), Ethnic
- 7 - DualFemur Total T-Score difference is 0.7. Asymmetry is Mild.
- 11 - WHO - Definition of Osteoporosis and Osteopenia for White Women: Normal = T-Score at or above -1.0 SD; Osteopenia = T-Score between -1.0 and -2.5 SD; Osteoporosis = T-Score at or below -2.5 SD

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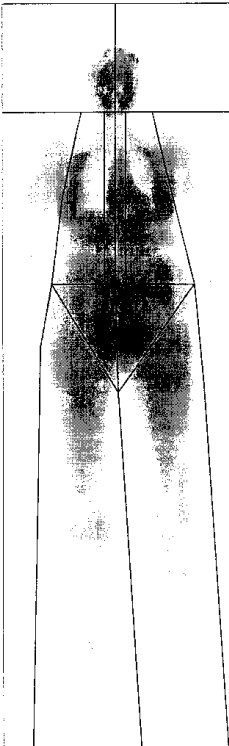
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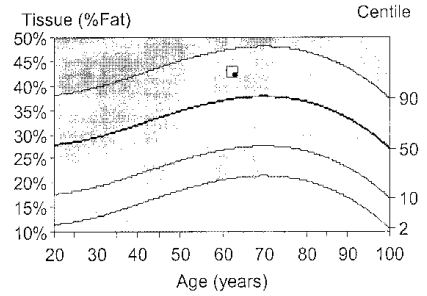
Human Metabolism Laboratory
 Department of Human Nutrition / Kansas State University
 Manhattan, KS 66506

Patient:	Facility ID:
Birth Date:	Physician:
Height / Weight:	Measured:
Sex / Ethnic:	Analyzed:

Total Body Tissue Quantitation



Composition Reference: Total



Region	Tissue (%Fat)	Centile ^{2,3}	T.Mass (kg)	Fat (g)	Lean (g)	BMC (g)
Total	42.8	75	62.5	25,848	34,610	2,054

COMMENTS:

Image not for diagnosis

Printed: 10/03/2007 11:22:25 AM (6.81) 76.0.15:153.85:31.2 0.00:-1.00
 4.80x13.00 11.3:%Fat=42.8%
 0.00:0.00 0.00:0.00
 Filename: reagas_jpcfpy9fi.dfb
 Scan Mode: Standard

2 -USA, Total Body Reference Population

3 -Matched for Age, Weight (females 25-100 kg), Ethnic

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