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Abstract.

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The purpose of this study was to examine the longitudinal relationship of activities of daily living (ADL), cardiovascular risk factors, and cardiovascular diseases, to predict the future cognitive functioning of older Americans who are between the ages of 51 and 61 at the time of initial assessment. Three waves of the Health and Retirement Study (HRS) database between the years of 1992 and 2002 were examined with path analysis.

The longitudinal hypotheses of the study were that (1) ADLs would positively predict future cognitive functioning, (2) ADLs would negatively predict future` cardiovascular risk factors, (3) ADLs would negatively predict future cardiovascular diseases, (4) cardiovascular risk factors would positively predict cardiovascular diseases, (5) cardiovascular risk factors would negatively predict future cognitive functioning, (6) cardiovascular disease would negatively predict future cognitive functioning, (7) cardiovascular risk factors would mediate the relationship between ADLs and cardiovascular disease, and (8) cardiovascular disease would mediate the relationship between cardiovascular risk factors and cognitive functioning.

The results of the analyses indicate that there was no effect of cardiovascular disease on cognitive functioning; however, there were significant effects of cardiovascular risk factors on cognitive functioning that ranged between $\underline{\beta} = -.021$ and $\underline{\beta} = -.145$. Moreover, it was found that cardiovascular risk factors mediate the relationship between ADLs and cognitive functioning, while cardiovascular disease does not.

These results suggest that addressing cardiovascular risk factors may be more important than addressing existing cardiovascular disease to protect future cognitive functioning. This shows the importance of primary / secondary prevention versus tertiary interventions.

ACTIVITIES OF DAILY LIVING AND CARDIOVASCULAR RISK FACTORS' IMPACT ON CARDIOVASCULAR DISEASE (CVD) AND COGNITIVE FUNCTIONING: A THREE STAGE LONGITUDINAL MODEL

Özlem Bozo, M.S.

APPROVED:

Major Professor

Committee Member

Committee Member

Committee Member

University Member

Chair, Department of Health Psychology

Dean, Graduate School of Biomedical Sciences

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DISSERTATION

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Özlem Bozo, M.S.

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CHAPTER I

INTRODUCTION

In 2003, the older population, people who are 65 years old or older, numbered 35.9 million in United States. They represented 12.3% of the U.S. population, about one in every eight Americans. Predictions suggest there will be about 71.5 million older persons in US by 2030, which is more than twice their number in 2000. That is, people who are 65 years old or older represented 12.4% of the population in 2000 in U.S. but they are expected to grow to be 20% of the population by 2030 (Administration on Aging, 2004).

According to U. S. Department of Health and Human Services statistics, most older people have at least one chronic condition and many have multiple conditions (Administration on Aging, 2003). Data from 2000-2001 shows that the most frequent chronic health conditions of the elderly are hypertension (49.2%), arthritic symptoms (36.1%), all types of heart disease (31.1%), any cancer (20.0%), sinusitis (15.1%), and diabetes (15.0%) (Administration on Aging, 2003).

These same statistics indicate that in 1997, 54.5% of the older population had at least one physical or nonphysical disability, and 37.7% of the older people reported at least one severe disability (Administration on Aging, 2003). The profile of older Americans published by U. S. Department of Health and Human Services in 2003 indicated that there is a strong relationship between disability status and reported health status (Administration on Aging, 2003). Among the older people with a severe disability, 68.0% reported their health as fair or poor. Among the older people with no disability, only 10.5% reported their health as fair or poor (Administration on Aging, 2003).

Decline in cognitive functioning is a hallmark of aging. Many studies have demonstrated age differences in cognition, particularly in its processing capabilities (Salthouse, 1999). Psychology of aging literature revealed that learning and memory skills decline gradually with increasing age (Colsher & Wallace, 1991; Poon, 1985).

In spite of the fact that most of the older people have at least one chronic condition and more than half of them have at least one disability (Administration on Aging, 2003), the studies on aging revealed that chronic disease and disability are not inevitable (Administration on Aging, 2004). The present study will focus on one aspect of this relationship and investigate the impact of activities of daily living (ADLs) and health behaviors on three categories of chronic diseases: cardiovascular diseases, cardiovascular risk factors, and cognitive functioning of older Americans between the ages of 51 and 61 initially in a longitudinal model. Moreover, the present study will investigate the mediator effect of cardiovascular diseases and cardiovascular risk factors to the relationship between activities of daily living and cognitive functioning of older Americans.

Activities of Daily Living (ADL)

Activities of daily living (ADL) are defined as the ability to complete most daily tasks such as bathing, dressing, eating, and toileting (Aniansson, Rundgren, & Sperling, 1980; Jette, Branch, & Berlin, 1990). They are categorized into two groups, basic and instrumental ADLs (Aniansson, Rundgren, & Sperling, 1980; Jette & Branch, 1981). Basic ADLs are daily personal care activities that are necessary for people to be able to live independently (Elderweb, 2004a). They include activities like ambulation, bathing, continence, dressing, eating, toileting, and transferring. Instrumental activities of daily living (IADLs) are, on the other hand, core life activities of independent living, including using the telephone, managing money, preparing meals, doing housework, and remembering to take medications (Elderweb, 2004b). It is believed that if a person can fulfill most of the basic and instrumental ADLs, she or he will presumably succeed in living an independent life (Kell, Bell, & Quinney, 2001).

There are two major models of activities of daily living. The first one stated that the decline in musculoskeletal strength and mass due to aging causes decline in function, which in turn causes reduced mobility, muscular strength and coordination that give rise to reduced ability to carry out activities of daily living (Fiatarone & Evans, 1993). The other is a theoretical model of person-environment interaction (Lawton, 1975), and discusses risk factors associated with dependency in the instrumental activities of daily living in a group of non-institutionalized elderly (Loen, 1991).

There are many studies conducted about activities of daily living (ADL), only a few of which are noted here as an overview. Jette and Branch (1981) found that more than 95% of people aged 75-84 are still independent in all ADLs. According to the findings of the Sato, Demura, Kobayashi, and Nagasawa (2002) study, both ADL ability and life satisfaction of independently living elderly tended to decline with aging. Related to their findings they stated that since life satisfaction of the elderly was higher with high

ADL ability level, it was considered that ADL ability level is one of the important factors in providing for life satisfaction of independent elderly. Similarly, Wang, van Belle, Kukull, and Larson (2002) stated that from the perspective of both older individuals and their caregivers, functional independence is an important component of quality of life.

Cardiovascular Risk Factors

There are numerous factors that increase risk of future cardiovascular disease. These include both purely behavioral components (i.e., health behaviors) and diseases that may partially result from such behavioral factors (i.e., diabetes, obesity, hypertension, and hypercholesterolemia). These specific cardiovascular disease risk factors are reviewed here.

Health Behaviors. Much of the research carried out in health psychology is about the concept of health behaviors, or preventive health behaviors (Pitts, 1996). Pitts (1996) defined these two concepts as behaviors carried out by people to enhance or maintain their health. There are many examples of preventive health behaviors. For example, Belloc and Breslow (1972) found seven health behaviors that were carried out regularly by 6928 county residents. They are not smoking, having breakfast each day, having no more than one or two alcoholic drinks each day, regular exercise, sleeping 7 to 8 hours per night, not eating between meals, and being no more than 10% overweight.

There are a number of models of health behaviors. The health belief model is the most popular model that tries to explain health behaviors. It was first developed by Hochbaum (1958) and Rosenstock (1966, 1974) to explain the widespread faiiure of people to participate in disease detection programs. It was then extended to explain people's responses to symptoms (Kirscht, 1974) and their behavior in response to diagnosis of an illness, especially to compliance with medical regimens (Becker, 1974). According to the health belief model individuals would take action if they believed that the illness might lead to serious consequences; that is, if they believed that this action would be beneficial for reducing their susceptibility to or severity of the illness, and finally if they believed that the benefits of taking the action outweighed the barriers to or costs of it (Strecher & Rosenstock, 1997). In short, the health belief model states "when perceived threat is high and perceived health benefits of a behavior outweigh any barriers an individual will engage in the behavior in question" (Christensen, Moran, & Wiebe, 1999; p.169).

Another model of health behaviors, the theory of reasoned action, developed by Ajzen and Fishbein (1980), is a social cognition model. It is assumed that most human behaviors are voluntary behaviors and are guided largely by intention determined by two attitudes: (1) attitude regarding the behavior based on two behavioral beliefs: beliefs about the outcomes of the behavior and evaluations regarding the outcomes of behavior, and (2) subjective norm, "the perception of and commitment to social standards regarding the behavior's acceptability or appropriateness" (Sarafino, 1990; p.193). These attitudes are based on two normative beliefs: beliefs about others' opinions and individual's motivation to comply with these opinions. Attitudes concerning behavior and subjective norms combine and produce an intention that gives rise to the performance of behavior. Thus, people's behaviors are a function of their beliefs. The theory of reasoned action states that external variables such as, age, sex, education, and social class determine these beliefs. It is claimed that these external variables affect behavior indirectly rather than directly (Sarafino, 1990). The theory of planned behavior, developed by Ajzen (1988, 1991), is an extension of the theory of reasoned action (Ajzen & Fishbein, 1980).

According to the protection motivation model (Rogers, 1984), health behaviors are examined from the point of view of motivational factors. Four beliefs constitute the basis of the protection motivation model in protecting oneself from a health threat: (1) the magnitude of the threat (whether it is severe or not), (2) the likelihood of the threat (whether one is vulnerable to threat or not), (3) self-efficacy of the person (whether one can perform the necessary behaviors to protect oneself from the threat), (4) response efficacy (whether the response of the person will be effective or not).

The transtheoretical model was developed by Prochaska and DiClemente (1983) as an integrative, general model of behavior change. Prochaska and DiClemente state that people pass through an ordered series of stages labeled precontemplation, contemplation, preparation, action, and maintenance. This model has been most frequently applied to smoking cessation but other health problems such as cocaine use, condom use, sunscreen use, and weight control have been also studied in the light of the transtheoretical model (Prochaska, 1994).

According to the precaution adoption process model (Weinstein, 1988), there are five stages that individuals go through in order to adopt a healthy behavior. These stages are: (1) hearing the hazard, (2) believing that others are susceptible to the hazard, (3) acknowledging personal susceptibility to the hazard, (4) deciding to take action against the hazard, and (5) taking measures to prevent the hazard (Weinstein 1988). The last model of health behaviors, social learning theory (Rotter, 1954), stated that the occurrence of a behavior in a situation depends on the expectancy that the behavior will bring about a reinforcement in that situation and the value given to the outcome.

Studies revealed that demographic variables, such as race (Green, Polen, & Brody, 2003), age (Resnick, 2002), socioeconomic status (Mulatu & Schooler, 2002), and education (Rhodes, Martin, Taunton, Rhodes, Donnelly, & Elliot, 1999) affects older people's health behaviors. Minority group membership and better health practices seem to be negatively associated with one another (Green, Polen, & Brody, 2003). Elderly between the ages of 86 – 101 are less likely to practice health behaviors compared to old people between the ages of 65- 85 (Resnick, 2002). There is a positive relationship between socioeconomic status and health due to the effects of health related lifestyles/behaviors (Mulatu & Schooler, 2002). Finally, there is positive correlation between education and regular exercise in elderly (Rhodes, Martin, Taunton, Rhodes, Donnelly, & Elliot, 1999).

Burke, Arnold, Bild, Cushman, Fried, Newman, Nunn, and Robbins (2001) looked for the factors associated with remaining healthy in adults who are 65 years old or older in a longitudinal study. They found that numerous behavioral factors, such as physical activity, refraining from cigarette smoking, and wine consumption (women) are associated with continued health. Exercise and not smoking were significant predictors of continued health even after controlling for cardiovascular disease risk factors and subclinical disease in older adults.

If exercise is important to continued health in older ages, it is important to improve our knowledge about older people's motivations and barriers. According to Grossman and Steward's (2003) qualitative study, there were four motivating factors for older adults who are 75 years old or older: (1) Health - preventing disability, increasing health, quality of life, and mental health; (2) Continued independence – maintaining independence, desire to stay in one's own home; (3) Family – maintaining family relationships, watching grandchildren grow up etc.; and (4) Physical appearances – concerns about weight, posture, fitting into clothes, and looking younger were important motivations for older people to stay active. On the other hand, for older people there were also some barriers to physical activity (Grossman & Steward, 2003): (1) Poor health – back, knee, leg, and foot problems, poor balance and fear of falling, failing eyesight and poor hearing; (2) Lack of time – placing priority on other obligations; (3) The aging process – sense of slowing down, lack of energy, feeling tired etc.; and (4) Adverse environments – bad weather, rain, hot / cold weather, poor sidewalks interfere with older adults engaging in physical activity.

Singh (2002) explained in his review how optimal levels of physical activity over the course of the life span as a health behavior could potentially contribute to the prevention of functional disability in elderly. First, direct effects of exercise maximizes physiologic capacity and prevent or delay the onset of disability-related conditions and second, indirect effects of exercise, such as the modulation of psychosocial factors, are very important in the expression of disability. As Singh (2002) indicated, epidemiologic studies revealed that there is negative relationship between functional disability and physical activity level or physical fitness.

Smoking, which is associated with significantly increased risk of heart disease, stroke, lung cancer, and chronic lung diseases, is the leading cause of preventable death and disease in the United States (Centers for Disease Control and Prevention, 1999). Cigarette smoking by adults is strongly associated with the level of education. Among adults, persons with less than a high school education were almost three times as likely to smoke as those with a bachelor's degree or more education (National Center for Health Statistics, 2004). As Ross (2000) found, neighborhood context has an effect on males' smoking behavior: males in poor neighborhoods are more likely to smoke than the males in less disadvantaged places.

Ruchlin (1999) analyzed smoking patterns among older adults and found that 53% of individuals above the age of 54 smoked in the past. She found that beliefs about the adverse health effects of smoking were associated with a greater likelihood of never smoking, and among smokers, a greater likelihood of being a former smoker. Sixty one percent of the smokers tried to quit. Older adults' beliefs about the negative health effects of smoking were associated with a greater likelihood of never smoking, and for smokers, these beliefs were associated with a greater likelihood of being a former smoker.

Most surveys suggest that older people consume less alcohol and they have fewer alcohol-related problems than younger people. On the other hand, other surveys that track individuals over time suggested that drinking patterns of individuals remains relatively stable with age (National Institute on Alcohol Abuse and Alcoholism, 1988). Of 86 percent of elderly patients who end up getting treatment for a history of binge drinking, 76 percent began drinking heavily in mid or late life, according to a Canadian study (Buddy, 2004). Women are even more likely to start heavy drinking later in life (Buddy, 2004). Social isolation, physical health problems, grief or loss, housing, marital, and mental health problems are major reasons for most drinkers who started late (Buddy, 2004).

Bortolussi (2000) found that education and gender are important predictors of lifetime alcohol consumption as a health behavior for elderly social drinkers between the ages of 61 and 90. Green, Polen, and Michael (2001) looked at the health of non-drinkers: Compared to current drinkers, former drinkers and lifelong abstainers had worse health and functioning. Compared to life-long abstainers, former drinkers had worse health. This study supported the hypotheses that former drinkers may stop drinking because of poor health.

Hypertension. Hypertension is defined as a condition in which the pressure of the blood against the blood vessel walls is persistently elevated or stays high for a long period of time (About hypertension, 2004). It is also defined as a systolic blood pressure higher than 140 mm Hg and or diastolic pressure higher than 90 mm Hg (Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, 1997). Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (National Heart, Lung, and Blood Institute, 2004) introduced the term "prehypertension", blood pressure ranging from 120–139 mmHg systolic and/or 80–89 mmHg diastolic. The purpose of this designation is to identify individuals at risk and help them in adopting healthy lifestyles to reduce the blood pressure, decrease the rate of the progression of blood pressure to hypertensive levels with age, or prevent hypertension entirely (National Heart, Lung, and Blood Institute, 2004). According to the statistics, in United States, there are approximately 50 million or more adults with hypertension (National Heart, Lung, and Blood Institute, 2004). It is believed that 24% of the adults in U.S. are hypertensive or taking hypertensive medications (Carretero & Oparil, 2000). However, this proportion varies according to the ethnicity, age, gender, and socioeconomic status. For example, African Americans with hypertension have the highest percentage in the world. Moreover, African Americans develop hypertension at an earlier age (Klag, Whelton, Randall, Neaton, Brancoti, & Stamler, 1997). Compared to non-Hispanic Whites, Hispanics and American Indians have either the same or lower rates of hypertension (Hall, Ferrario, Moore, Hall, Flack, & Cooper, 1997). Until the menopause, more men than women have hypertension, but after the menopause the numbers become equal. High blood pressure is more prevalent in older people because it rises with age. And finally, hypertension s inversely related to the socioeconomic status (Carretero & Oparil, 2000).

The causes of hypertension are not precisely known. Most known factors of hypertension are genetics, obesity, high alcohol intake, aging, sedentary lifestyle, stress, high sodium intake, and low intake of calcium and potassium (INTERSALT Co-operative Research Group, 1988; Severs & Poutler, 1989). However, for 95% of patients who undergo hypertension treatment, the causes of high blood pressure are unknown (About hypertension, 2004).

Hypertension is a very serious risk factor for many people's health. It can cause many complications, such as atherosclerosis, myocardial infarction, strokes, kidney disease, and eye damage (Living with hypertension, 2004). Hypertension is very a dangerous condition because hypertensive people do not usually see or feel any clearly identifiable hypertension symptoms until hypertension causes its damage. Therefore, they suddenly face complications such as changes in the retina of the eyes, heart and kidney problems, or even strokes. Heart problems are very common complication caused by hypertension because the high blood pressure forces the heart to work harder than it should, which means an extra burden to the heart (About hypertension, 2004).

Diabetes. Diabetes is a disease in which the body does not produce or properly use insulin, a hormone that is needed to convert sugar, starches and other food into energy needed for daily life (American Diabetes Association, 2004). Blood always has glucose present, which is needed for cellular metabolism. Excessive glucose in the blood is detrimental to health (WebMDHealth, 2004a). Glucose comes from the food eaten and is also made in the liver and muscles. Blood carries the glucose to all cells in the body. Insulin, a hormone made in the pancreas, is needed for cellular metabolism of glucose. If the body does not produce enough insulin or if the insulin does not work properly, high levels of glucose stays in the blood rather than getting into the cells, which is characteristic of diabetes (WebMDHealth, 2004a).

Although both genetics and environmental factors, such as obesity and lack of exercise can contribute, the cause of diabetes is not known. In the United States 6.3% of the population, 18.2 million people, have diabetes. While an estimated 13 million have been diagnosed with diabetes, 5.2 million additional people may be unaware that they have the disease (American Diabetes Association, 2004).

There are two major types of diabetes: Type 1 diabetes results from the body's total failure to produce insulin, the hormone that makes the cells of the body allow glucose to enter and fuel them (American Diabetes Association, 2004). The beta cells of the pancreas no longer make insulin because the body's immune system has attacked and destroyed them (WebMDHealth, 2004a). It was formerly called juvenile diabetes or insulin-dependent diabetes mellitus because it is usually first diagnosed in children, teenagers, or young adults (WebMDHealth, 2004a). Five to ten percent of Americans who are diagnosed with diabetes have type 1 diabetes (American Diabetes Association, 2004). In order to be treated, type 1 diabetic people must inject insulin subcutaneously or use of insulin pump. Moreover, they need to make wise food choices, exercise regularly, take aspirin daily, and control blood pressure and cholesterol.

Type 2 diabetes results from insulin resistance, a condition in which the body fails to properly use insulin, combined with relative insulin deficiency (American Diabetes Association, 2004). In this type of diabetes, the pancreas does not make enough insulin, and the fat, muscle, or liver cells do not use it properly (WebMDHealth, 2004a). It was formerly called adult-onset diabetes or non-insulin-dependent diabetes mellitus; however, people can develop type 2 diabetes at any age, even during childhood. (WebMDHealth, 2004a). Most Americans who are diagnosed with diabetes have type 2 diabetes (American Diabetes Association, 2004). Being overweight is a risk factor for developing Type 2 diabetes. In order to be treated, type 2 diabetic people use diabetes medicines, make wise food choices, exercise regularly, take aspirin daily, and control blood pressure and cholesterol.

After many years, diabetes can cause serious problems in the eyes, kidneys, nerves, and gums and teeth. However, the most serious problem related to diabetes is heart disease. If a person has diabetes, then he/she is more than twice as likely as people without diabetes to have heart disease or a stroke (WebMDHealth, 2004b). Ryan (2001) notes: "adults with diabetes have rates of hypertension, dyslipidemia, heart disease, and stroke that are at least twice as high as those reported in adults without diabetes, whereas individuals with hypertension, obesity, dyslipidemia have a greatly increased risk of subsequently developing diabetes and / or macrovascular disease".

Overweight/Obesity. It was estimated that 97 million adults in the United States are overweight or obese (Kuczmarski, Carrol, Flegal, & Troiano1997). The most common method to determine whether a person is overweight or obese is to calculate body mass index (BMI). Body mass index equals a person's weight in kilograms divided by height in meters squared (BMI=kg/m2) (Heart Health Diet, 2004). People aged 20 years or over are considered to have healthy weight if their body mass index (BMI) is equal to or greater than 19 and less than 25 (Heart Health Diet, 2004). People with BMI between 25 -29 are considered 'overweight', and people with BMI of 30 and over are considered 'obese'. (Vegetarian Diet Info, 2003).

Overweight and obesity result from a complex interaction between genes and the environment (sedentary life style, excessive caloric consumption, or both) (National Research Council, 1989). The development of being overweight and obesity occurs in a sociocultural environment characterized by mechanization, sedentary lifestyle, and ready access to abundant food (Forster, Jeffery, Schmid, & Kramer, 1988).

The higher the BMI is, the greater the risk of developing additional health problems is (Vegetarian Diet Info, 2003). Being overweight or obese increases the risk of hypertension (Dyer & Elliott, 1989), type 2 diabetes (Larsson, Bjorntorp, & Tibblin, 1981), stroke (Walker, Rimm, Ascherio, Kawachil, Stampfer, & Willett, 1996), gallbladder disease (Khare, Everhart, Maurer, & Hill, 1995), osteoarthritis (Hochberg, Lethbridge-Cejku, Scott, Reichle, Plato, & Tobin, 1995), and sleep apnea (Millman, Carlisle, McGarvey, Eveloff, Levinson, 1995).

Cardiovascular Disease (CVD)

Cardiovascular disease (CVD) includes diseases of heart, blood vessels, and circulation (Katzel & Waldstein, 2001) and it leads to significant morbidity and mortality in the older population (Messinger-Rapport & Sprecher, 2002). The most common CVDs are coronary artery disease (CAD), cerebrovascular disease, and peripheral vascular disease (aneurysms and peripheral arterial disease [PAD]), congenital heart disease, rheumatic heart disease, congestive heart failure, and cardiac arrhythmias (Katzel & Waldstein, 2001).

According to the statistics, in United States, there are approximately 12 million adults with coronary heart disease (CHD) (American Heart Association, 1999), 3.9

million adults with stroke (National Heart, Lung, and Blood Institute, 1996), and 3.5 million adults with peripheral arterial disease (PAD) (Kannel, 1996).

Atherosclerosis. Atherosclerosis is the build-up process of deposits of fatty substances, cholesterol, cellular waste products, calcium and other substances in the inner lining of an artery. This buildup, which is called plaque, can grow large enough to significantly reduce blood flow through an artery. However, most of the damage occurs when plaques become fragile and rupture. Plaques that rupture cause blood clots to form that can block blood flow or break off and travel to another part of the body. If either of these events happens and as a consequence blocks a blood vessel that feeds the heart, it can cause a heart attack. If it blocks a blood vessel that feeds the brain, it causes a stroke. Such blood supply reduction to the arms or legs, can cause difficulty walking and eventually gangrene (American Heart Association, 2004a).

Males and people with a family history of premature cardiovascular disease, risk factors that cannot be controlled, are under greater risk of atherosclerosis. However, there are also controllable risk factors for atherosclerosis, high blood cholesterol (especially LDL or "bad" cholesterol over 100 mg/dL), cigarette smoking and exposure to tobacco smoke, high blood pressure, diabetes mellitus (type 2), obesity, and physical inactivity (American Heart Association, 2004a).

Coronary Heart Disease (CHD). In United States, there are approximately 12 million adults with CHD (American Heart Association, 1999). CHD includes angina pectoris, myocardial infarction, and sudden cardiac death. The prevalence of CHD is estimated to be 61.8 per 1,000 for middle-aged adults and 138.5 per 1,000 for people older than 65 years old (Thom, Kannel, Silbershatz, & D'Agostino, 1998).

Angina pectoris, a sign for increased risk of heart attack, cardiac arrest and sudden cardiac death, is the medical term for chest pain or discomfort due to coronary heart disease. It occurs when the heart muscle does not get sufficient blood flow to supply the oxygen it needs due to the narrowing or blockage in one or more of the coronary arteries. This insufficiency of oxygen supply in the arteries is called ischemia (American Heart Association, 2004b). Angina refers to the chest pain or pressure caused by myocardial ischemia (Katzel & Waldstein, 2001).

Myocardial infarction is the medical term for "heart attack." It is also sometimes called a coronary thrombosis or coronary occlusion (Heart Point, 2004). A myocardial infarction is the death of the cardiac tissue due to a relative or absolute insufficiency of oxygen (Katzel & Waldstein, 2001), caused by occlusion of the coronary artery that supplies that particular region of the heart. This occurs 98% of the time due to the process of arteriosclerosis, hardening of the arteries, in coronary vessels (Heart Point, 2004). If the coronary occlusion lasts for more than a few minutes, cardiac muscle cells suffer permanent injury and die. Depending on the severity of the damage in the heart muscle, it can result in a myocardial infarction (American Heart Association, 2004c). If a coronary artery temporarily constricts or goes into spasm, then the artery narrows and blood flow to that region of the heart muscle decreases or stops. If the spasm is strong enough, it can cause a heart attack (American Heart Association, 2004c). Heart disease is the leading cause of the death in United States. There are approximately 1.5 million patients having a myocardial infarction each year.

Cardiac arrhythmias are composed of number of acute and chronic disorders of rate and rhythm (Katzel & Waldstein, 2001). In 1993 there were approximately 3.6 million visits to physicians for cardiac arrhythmias (Myerburg, Kessler, & Castellano, 1998). Disturbance of cardiac rhythm or arrhythmia refers to a deviation from the normal pattern, which is sinus rhythm. Rhythms producing cardiac slowing are called bradycardias (fewer than 60 beats / min), and rhythms causing fast heart rates than normal pattern are called tachycardia (more than 100 beats / min) (American Heart Association, 2004d).

Peripheral Vascular Diseases. Aneurysm and arterial occlusions are the most common peripheral vascular diseases. Aneurysm is the permanent dilation of an artery due to a weakness in the arterial wall (Katzel & Waldstein, 2001). The main reasons of an aneurysm are hypertension and atherosclerosis. An aneurysm usually occurs in large arteries, e.g. aorta; however, it may also occur in smaller arteries (Katzel & Waldstein, 2001).

Peripheral artery disease (PAD) refers to stenoses and occlusions of the arteries of the lower extremities. Due to the reduction in the blood flow distal to the occlusions, the blood pressure in the dorsalis pedis and posterior tibial arteries at the level of the ankle decreases. PAD affects approximately 6% of the U.S. population above the age of 55 (Katzel & Waldstein, 2001).

Stroke. There are approximately 3.9 million stroke patients in the United States. Stroke is the third leading cause of death in United States, and the main reason of disability in adults (National Heart, Lung, and Blood Institute, 1996). Stroke is a disease that affects the blood vessels that supply blood to the brain (American Heart Association, 2004e). The reduction in blood flow of the cerebrovascular circulation can result in infarcts (tissue death) and areas of dead brain tissue (lesions), because the blood nourishes the brain with oxygen and nutrients and removes heat and by-products of metabolic activity (Green, 2000). The most common reason of cerebrovascular diseases is stroke, which is divided into two major categories: (1) ischemia, reduction in the blood supply, and (2) hemorrhage, abnormal bleeding into surrounding tissue (Green, 2000).

Ischemic strokes account for about 80% of all strokes. A reduction in blood flow results in oxygen deprivation to proximal tissue. This may be due to a build-up plaque in the large or medium sized vessels, thrombosis or to a fragment of thrombotic material that has broken away from a vessel upstream from the area of blockage, embolus (wandering cloth) (Green, 2000). Transient ischemic attack (TIA) is a brief, temporary vascular blockage that changes brain function without any significant tissue death. However, TIA is a warning sign for a major ishemic stroke (Green, 2000).

Hemorrhagic (bleeding) strokes occur when blood vessels rupture (Green, 2000). There are two main categories of hemorrhagic strokes: (1) subarachnoid hemorrhage, which occurs when a blood vessel on the brain's surface ruptures and bleeds into the space between the brain and the skull (Green, 2000); and (2) cerebral hemorrhage, occurs when a defective artery in the brain ruptures bleeds into the surrounding tissue (American Heart Association, 2004e).

Congestive Heart Failure. Congestive heart failure (CHF), is a condition in which the heart cannot pump enough blood to the body's other organs due to coronary artery disease, past myocardial infarction, hypertension, heart valve disease due to past rheumatic fever or other causes, cardiomyopathy, congenital heart defects, or infection of the heart valves and/or heart muscle itself (endocarditis and/or myocarditis) (American Heart Association, 2004f).

Due to the slowness of blood flow out of the heart, blood returning to the heart through the veins backs up, which causes congestion in the tissues and this results in swelling, or edema. Swelling occurs most often in the legs and ankles, but it can also occur in other parts of the body. Sometimes fluid collects in the lungs (i.e., pulmonary edema) and interferes with breathing, causing shortness of breath. Heart failure impacts also on the kidneys' ability to dispose of sodium and water, and this retained water increases the formation of edema (American Heart Association, 2004f).

Cognitive Functioning in Older Adults

Gerontology literature suggests that there are age related changes in cognition. There is considerable evidence for declines in explicit memory (Bäckman, Small, & Wahlin, 2001), language (Kemper & Mitzner, 2001), and executive functions (Rogers & Fisk) in older adults. These age-related cognitive changes, however, are not only due to increased prevalence of diseases in later years (Albert, Duffy, & Naeser, 1987). It had been hypothesized that age-related cognitive change is also, at least in part, the result of alterations in brain structure and function. Albert and Killiany (2001) stated that the increased amount of cognitive decline over time is not due to the widespread neuronal loss. Instead, the possible mechanisms for this cognitive decline over time are a variety of neurobiological changes in the brain, such as functional changes at the molecular level, alterations in dendritic branching, and neuronal loss in selective subcortical regions.

There are many correlates of cognitive functioning in older adults, including age (Yoder, Weitzen, Pickle, Grant, Herrmann, & Schnitzer, 2001; Ponds, Van Boxtel, & Jolles, 2000), gender (Yoder et al., 2001; Johnson, 2001), race (Lopez, Jagust, Dulberg, Becker, DeKosky, Fitzpatrick, Breitner, Lyketsos, Jones, Kawas, Carlson, & Kuller, 2003; Yoder et. al., 2001), education (Lopez et al., 2003), subjective health and depression (Ponds, Van Boxtel, & Jolles, 2000) and proximity to death (Hassing, Johansson, Berg, Nilsson, Pedersen, Hofer, & McClearn, 2002).

Yoder et al. (2001) found that increased age is associated with more cognitive difficulties. However, as Ponds, Van Boxtel, and Jolles (2000) found that cognitive decline does not start until the age of 50 years and after that age it steadily progresses. Although Yoder et al. (2001) found that compared to women men have less cognitive deficits with increasing age, Johnson (2001) found that after the age of 85, women function better than men in terms of cognition. Findings about the relationship between cognitive functioning and race are controversial. While Lopez et al. (2001) found that mild cognitive impairment is associated with being African American, Yoder et al. (2001) found that African Americans tend to have fewer cognitive deficits than White Americans. Education also appears to be related to cognitive functioning. Lopez et al.

(2001) found that mild cognitive impairment is related to low education level. Bortolussi (2000) found education has an important role in temporal cognitive functioning. Level of cognitive performance in late life is associated with proximity to death, that this relationship is longstanding, and that it is partially influenced by compromised cardio- and cerebrovascular functioning. Finally, it was found that (Hassing, Johansson, Berg, Nilsson, Pedersen, Hofer, & McClearn, 2002) the level of cognitive performance in late life is associated with proximity to death; a longstanding relationship that is partially influenced by compromised cardio- and cerebrovascular functioning.

Activities of Daily Living (ADL) and Cardiovascular Disease

Studies in the gerontology literature are examining at either the relationship between current ADLs and current cardiovascular diseases, or they are determining how cardiovascular diseases impact on ADLs. For example, Otiniano, Ottenbacher, Markides, Ray, and Du (2003) found that in Mexican Americans self-reported myocardial infarction is related to ADL limitations. Similarly, Wang, van Belle, Kukull, and Larson (2002) stated that hypertension, coronary heart disease, and cerebrovascular disease, are associated with more difficulty in ADLs. The only published study examined the effect of ADLs on health found that poor health is a cause of decreased ADLs (George, 1980).

Cardiovascular Risk Factors and Cardiovascular Disease (CVD)

Studies depicted the importance of both primary and secondary prevention from CVD. Primary prevention was found to be effective in reducing the risk factors especially when the life style interventions are multifactorial. Secondary prevention interventions, both single and multifactorial interventions, were also found to be effective in reducing mortality and morbidity from CVD (Ketola, Sipilä, & Mäkelä, 2000).

Health Behaviors and Cardiovascular Disease. A low level of physical fitness is an independent risk factor for CVD (Phillips, 1990). Parallel to this statement, Heart Disease Weekly (2004) demonstrated that the importance of cardiovascular fitness in young ages in predicting CVD in middle ages. Greenlund, Giles, Keenan, Croft, and Mensah (2002) found that people who had stroke and reported exercising experienced fewer limited activity days, fewer unhealthy days, and more healthy days than the people who had stroke and reported no exercising.

Twenty percent of CVD related deaths are attributable to smoking (Greenlund, Giles, Keenan, Croft, Casper, & Matson-Koffman, 1988). Even light smokers (women) who smoke 1 to 4 cigarettes per day have high risk of CVD, which means that there is no safe level of smoking. For example, the possibility of having a heart attack is three times higher for light smokers compared to non-smokers (Mosca, Manson, Sutherland, Langer, Manolio, & Barrett-Connor, 1997). Moreover, Toobert, Strycker, and Glasgow (1998) found that the risk of myocardial infarction in women increases six-fold if they are smoking 20 or more cigarettes a day.

The literature showed that alcohol has both benefits and dangers, depending on the dose, to our cardiovascular health. As Kiechl, Willeit, Runggner, Egger, Oberhollenzer, and Bonora (1998) stated there is J- or U-shaped relationship between alcohol consumption and cardiovascular disease: Compared to heavy drinkers and abstainers, light drinkers have a lower risk of CVD. It was found that alcohol has positive effects on the level of high-density lipoprotein cholesterol and inhibition of platelet aggregation (de Lorimier, 2000). Wine, especially red wine, has high levels of phenolic compounds that positively impact on multiple biochemical systems (de Lorimier, 2000). Criqui and Ringel (1994) discussed so called "French Paradox," which suggests that the French population has a low incidence of CVD mortality, although they consume high levels of saturated fat. Fuhrman, Lavy, and Aviram (1995) stated that this paradox is related to high prevalence of red wine consumption.

Grønbæk, Deis, Sørensen, Becker, Schnohr, and Jensen (1995) found that light and moderate wine drinking is related to a dose-dependent decrease in all-cause mortality due to a decrease in cardiovascular related diseases. Similarly, Camargo, Stampfer, Glynn, Grodstein, Gaziano, Manson, Buring, and Hennekens (1997) found that men who consumed two drinks per day had a 47% lower risk for myocardial infarction. And, finally, it was also found that moderate intake of wine decreases the risk of stroke (Truelsen, Gronbaek, Schnohr, & Boysen, 1998).

Hypertension and Cardiovascular Disease. As it was mentioned before, hypertension can cause many complications, such as atherosclerosis, heart attacks, strokes, and kidney disease (Living with hypertension, 2004). Heart problems are very common complication caused by hypertension because the high blood pressure forces the heart to work harder than it should, which means an extra burden to the heart (About hypertension, 2004). Giardina (1998) and Holdright (1998) stated women with hypertension are have a higher risk of having stroke, heart failure, ischemic heart disease, and coronary artery disease. Moreover, uncontrolled hypertension can promote left ventricular hypertrophy (Holdright, 1998). Hypertension interacts with other cardiovascular risk factors, too. It was found that hypertension interacts with hypercholesterolemia and tobacco smoking, and increases the likelihood of CVD mortality in men older than 55 years old (Thomas, Rudnichi, Bacri, Bean, Guize, & Benetos, 2001).

Diabetes and Cardiovascular Disease. As it was stated before, the possibility of having hypertension, dyslipidemia, heart disease, and stroke is at least twice as high as in adults with diabetes as compared to adults without diabetes (Ryan, 2001). It was well established that for women diabetes puts an important risk for coronary artery disease, stroke, peripheral vascular disease, cardiomyopathy, congestive heart failure, and CVD-related death (Holdright, 1998; Hahn, Heath, & Chang, 1994; Krauss, Eckel, Howard, Appel, Daniles, Deckelbaum, Erdman, Kris-Etherton, Goldberg, Kotchen, Lichtenstein, Mitch, Mullis, Robinson, Wylie-Roset, St Joer, Suttie, Tribble, & Bazarre, 2000; Grundy, Benjamin, Burke, Chait, Eckel, Howard, Mitch, Smith, & Sowers, 1999). As Mickelson, Blum and Geraci (1995), and Wingard, and Barret-Connor, (1995) stated, the risk of myocardial infarction increases with age regardless of diabetes, however, diabetes appears to accelerate the process of it (Wingard, & Barret-Connor, 1995).

Overweight, Obesity, and Cardiovascular Disease. Being overweight is an important risk factor for coronary heart disease, especially for young people (Pi-Sunyer, 1993). Body Mass Index (BMI) of 27 or more in middle age is related to increased risk of CHD in late life (Harris, Launer, Madans, & Feldman, 1997). Similarly, Krauss, Winston, Fletcher, and Grundy (1998) stated that more than 75% of hypertension cases could be directly attributed to obesity. It was proved that blood pressure increases with weight gain and decreases with weight loss. As Krauss, Winston, Fletcher, and Grundy (1998) stated, obesity impacts on lipoprotein metabolism. Thus, increased weight is associated with higher levels of triglycerides, elevated LDL-C, and low HDL-C. On the contrary, weight loss is associated with decrease in triglycerides, increase in HDL-C, and decrease in LDL-C.

Activities of Daily Living and Cognitive Functioning

Decline in functional abilities is a major component of dementia. Winer (2000) stated that to make a dementia diagnosis, there should be intellectual and practical decline in work, social, and interpersonal function, such as activities of daily living. The Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) (American Psychiatric Association, 2000) criteria for dementia diagnosis requires impairment of social or occupational function, too.

Aging is an important factor associated with a decrease in both cognitive function and daily life activity. Old people's daily life activity is closely related to their cognitive function (Sauvaget, Yamada, Fujiwara, Sasaki, & Mimori, 2002). The studies about these two constructs investigated either their correlation, or the effect of cognitive functioning on activities of daily living. It was found that dementia and cognitive impairment make the strongest contribution to both the development of long-term functional dependence and decline in function (Agüero, Fratiglioni, Guo, Viitanen, von Strauss, & Winblad, 1998; Lu, Zhen, Yang, Liang, Hu, Li, Han, Jiangbin, Yang, Chen, & Peng, 2003).

Studies revealed that activities of daily living are predicted by simple motor functioning (Zanetti, Geroldi, Frisoni, Bianchetti, & Trabucchi, 1999), tests of executive attention (Carlson, Fried, Xue, Bandeen-Roche, Zeger, & Brandt, 1999), executive functioning (Grigsby, Kaye, Baxter, Shetterly, & Hamman, 1998; Tomaszewski, 2003), memory performance, and visuospatial abilities (Tomaszewski, 2003).

Cardiovascular Risk Factors and Cognitive Functioning

Exercise and Cognitive Functioning. Exercising and cognitive functioning were found to be closely related. Elderly men who are sedentary or walk less than a quarter of a mile per day were found to be nearly twice as likely to develop dementia and Alzheimer's disease compared to men who walk more than two miles per day (Abbott, White, Ross, Masaki, Curb, & Petrovitch, 2004). Similarly, Weuve, Kang, Manson, Breteler, Ware, and Grodstein (2004) found that long-term regular physical activity that includes walking is significantly related to better cognitive functioning and less cognitive decline in older women. By comparing sedentary adults between the ages of 60 and 75, who were randomly assigned to either aerobic (walking) or anaerobic (stretching and toning) exercise programs for 6 months, Kramer, Hahn, Cohen, Banich, Mcauley, Harrison, Chason, Vakil, Bardell, Boileau, and Colcombe, (1999) found that older adults who got aerobic training show substantial improvements in performance of executive control (such as planning, scheduling, inhibition and working memory) compared to older adults who got an aerobic training. All of these studies suggest that walking is associated with a better cognitive performance in older adults.

Smoking and Cognitive Functioning. It was found that in smokers, the risk of Alzheimer's Disease increases with pack-years of smoking at medium and heavy smoking levels (Tyas, White, Petrovitch, Ross, Foley, Heimovitz, & Launer, 2003). They also found that in autopsied smokers, the number of neuritic plaques increases with amounts smoked and this means that the amount smoked is associated with an increasing risk of AD and Alzheimer-type neuropathology up to heavy smoking levels. Similarly, Galanis, Petrovitch, Launer, Harris, Foley, and White (1997) found that smokers or recent quitters perform marginally lower than non-smokers on a mental status screening instrument.

Alcohol and Cognitive Functioning. Although the negative effects of alcohol on cognitive functioning are well known, the recent literature show that there is a U – or – J - shaped relationship between alcohol use and cognitive functioning (Hendrie, Gao, Hall, Hui, & Unverzagt, 1996). Older African Americans who drink but limit themselves to less than four drinks in a week performed better than abstainers in multiple cognitive domains and in memory. Elias, Elias, Robbins, Wolf, and D'Agostino (2001) suggested that lower cognitive performance of abstainers as compared to moderate drinkers may be associated with the fact that abstainers had quit drinking because they were either unwell or were formerly heavy drinkers.

Important gender differences have been found in the association between drinking and cognitive functioning. Although there was no significant association between drinking and cognitive functioning found for men, , moderate drinking in women was related to better performance on the Mini-Mental State Examination, Word Fluency, Digit Symbol Substitution, Paced Auditory Serial Addition, Trail Making B, Auditory Verbal Learning Test, and Raven Progressive Matrices (Dufouil, Ducimetiére, & Alpérovitch, 1997). Similarly, Elias, Elias, D'Agostion, Silbershatz, and Wolf (1999) compared women and men in relation to the association between drinking and cognitive functioning and found that women who drink moderately had superior performance, compared to abstainers, in Logical Memory-Delayed Recall, Word Fluency, Similarities, the Learning and Memory Factor Score, the Attention and Concentration Factor Score, and the Total Composite Score.

Hypertension and Cognitive Functioning. Elias, Elias, Robbins, Wolf, and D'Agostino (2001) stated that hypertension negatively affects cognitive functioning at all ages. It was found that there is a dose-response relationship between the level of blood pressure (mm Hg) and cognitive functioning. As blood pressure, both systolic and diastolic, increases, cognitive function falls (Elias, Robbins, Shultz, & Pierce, 1990; Robbins, Elias, Croog, & Colton, 1994). Waldstein and Katzel (2001) stated that hypertension is related to poorer cognitive performance on tests of attention, learning and memory, executive functions, visuospatial abilities, visuoconstructional abilities, psychomotor abilities, and perceptual abilities. Moreover, they stated that chronic hypertension predicts cognitive decline longitudinally. The Framingham Heart Study data revealed that chronic hypertensive patients have an increased risk for their scores on several learning and memory (Elias, D'Agostino, Elias, & Wolf, 1995). As Elias, Robbins, and Elias (1996) found that deficits in neuropsychological performance persist or get worse among hypertensive people.

Diabetes and Cognitive Functioning. It was found that type 2 diabetes is an independent risk factor for cognitive decline, with type 2 diabetics having twice the risk of developing dementia (Ott, Stolk, van Harskamp, Pols, Hofman, & Breteler, 1999). Ryan (2001) stated that the magnitude of the association between diabetes and cognitive impairment is modest and restricted to only certain subgroups of diabetics. Elias, Elias, D'Agostino, Cupples, Wilson, Silbershatz, and Wolf (1997) looked at the relationship between diabetes and cognitive functioning in the presence of increasing levels of blood pressure, and found a significant interaction between diabetes and blood pressure level. For each 10 mm Hg increase in diastolic blood pressure, there was a two fold increased risk of poor performance in an overall composite of eight test scores which measured verbal, and visuo-spatial memory, learning, and abstract reasoning for Type 2 diabetics.

Overweight/Obesity and Cognitive Functioning. Although it is well known that there is a positive association between atherogenesis and obesity (Kannel & Sytkowski, 1987), obesity has not been studied as a risk factor for cognitive functioning.

Cardiovascular Disease and Cognitive Functioning

The literature suggests that there is an positive association between cognitive decline and atherosclerosis (Everson, Helkala, Kaplan, & Salonen, 2001; Breteler, Claus, Grobbee, & Hofman, 1994), asymptomatic high-grade stenosis of the left internal carotid artery (Johnston, O'Meara, Manolio, Lefkowitz, O'Leary, Goldstein, Carlson, Fried, & Longstreth, 2004), cardiovascular signs (i.e., cardiac murmur, dyspnea, edema in lower limbs) (Fahlender, Wahlin, Fastbom, Grut, Forsell, Hill, Winblad, & Bäckamn, 2000), cardiac and peripheral vascular disease (Elwood, Pickering , Bayer, & Gallacher , 2002), and heart failure (Staniforth, Kinnear, & Cowley, 2001), congestive heart failure (Verhaegen, Borchelt, & Smith, 2003; Cacciatore, Abete, Ferrara, Calabrese, Napoli, Maggi, Varricchio, & Rengo, 1998), stroke (Verhaegen, Borchelt, & Smith, 2003), and coronary heart disease (Verhaegen, Borchelt, & Smith, 2003). Furthermore, Nilsson, Fastbom, & Wahlin, (2002) found that Mini Mental State Examination performance of older adults with CVD is significantly worse than in those without CVD.

The Present Study: Purpose and Hypotheses

This study examined the relationship between activities of daily living (ADLs), cardiovascular risk factors, cardiovascular diseases, and cognitive functioning of older Americans initially between the ages of 51 and 61 in a ten-year longitudinal model. Many studies have demonstrated a relationship between two of the variables among the variables of the present study. However, the exact nature of the relationship between all of these variables is unclear. The purpose of the present study is to investigate the relationship of these closely related constructs in a broader picture.

There are eight main hypotheses of the present study:

(1) ADLs will predict future cognitive functioning (positive relationship),

(2) ADLs will predict future cardiovascular risk factors (negative relationship),

(3) ADLs will predict future cardiovascular diseases (negative relationship),

(4) Cardiovascular risk factors will predict cardiovascular diseases (positive relationship),

(5) Cardiovascular risk factors will predict future cognitive functioning (negative relationship),

(6) Cardiovascular disease will predict future cognitive functioning (negative relationship)

(7) Cardiovascular risk factors will mediate the relationship between ADLs and cardiovascular disease.

(8) Cardiovascular disease will mediate the relationship between cardiovascular risk factors and cognitive functioning.

CHAPTER II

METHOD AND PROCEDURE

Participants

The participants of this study were obtained from Health and Retirement Study (HRS) Dataset. The HRS is a longitudinal study examining that examines the interactions between health, economic status, behavior, and work status in older adults. It is sponsored by the National Institute on Aging and conducted by the University of Michigan Institute for Social Research. The purpose of the HRS is to provide data for researchers who are interested in the changes that take place that affect retirement (Health and Retirement Study, 2001).

Researchers from the University of Michigan initially sampled 69,336 households in the contiguous 48 states in the U.S.A. looking for an older adult sample. These household addresses were obtained from the 1990 U.S. Census data and were chosen to make up a representative sample of U.S. households (Health and Retirement Study, 2001).

Every adult over the age of 49 in the 48 contiguous states of the United States of America had an equal chance of being selected to the HRS, however, Hispanic, African American, and Florida residents were 100% oversampled. There was no informed consent obtained by the present researchers for this secondary analysis because a deidentified blinded publicly available archival dataset was used (Health and Retirement Study, 2001). There are currently six waves in the HRS dataset. This study focused on data collected from wave 1 (1992), wave 4 (1998), and wave 6 (2002); and used participants who were interviewed in all these three waves.

After merging 1992 (wave 1), 1998 (wave 4), and 2002 (wave 6) data, 26,728 participants and spouses were obtained in total. After reducing this number and taking just the study participants who were born between 1931 and 1941 (738 – 609 months-old) to yielded those who were between 51 and 61 years of age at the time of first interview in 1992, and who are Caucasian, African American, or Hispanic, for a total of 7,618 participants were left. After deleting people who did not have data in wave 1 (1992), and selecting completers, who are the participants who were interviewed in waves 1 (1992), wave 4 (1998), and wave 6 (2002), 6,558 participants were left. Of the 6,558 participants, 3,578 (54.6%) were women (mean age = 55.74, S.D. = 3.10); and 2,980 were men (mean age = 55.75, S.D. = 3.11).

Table 1

Demographic Characteristics of Categorical Variables

	Male		Female		Total	
Race/Ethnicity	Frequency	%	Frequency	%	Frequency	%
Caucasian	2332	78.3	2617	73.1	4949	75.5
African American	391	13.1	645	18.0	1036	15.8
Hispanic	257	8.6	316	8.8	573	8.7
Total	2980	45.4	3578	54.6	6558	100

Approximately half of the sample was women (*N* = 3578, 54.6 %), while the rest were men (*N* = 2980, 45.4 %). Table 1 shows the counts and percentages of gender by race / ethnicity. Approximately 75.5 percent of the participants were Caucasian, and the remaining participants were distributed across African Americans (15.8 %) and Hispanics (8.7 %).

Measures

Activities of Daily Living Scale. A 17-item, five-point Likert-type questionnaire was used by the Health and Retirement Study (HRS) to measure physical functioning, which is a multidimensional concept encompassing individual's strength, lower and upper body mobility, fine motor skills, and ability to perform activities of daily living (ADLs) and instrumental activities of daily living (IADLs), which are respondents' abilities to do various tasks for maintaining a household. They were interested in how much difficulty people have with various activities because of a health or physical problem. Of the 17 items, 12 items were mobility, strength, and fine-motor skills ADL items, and 5 were activities of daily living items (ADLs) (See Appendix A). Scoring was reversed so that the higher the total score the participant has on this scale the better their functioning.

In order to create an ADL scale that is more closely related to cardiovascular functioning, performance related items were selected based on factor analysis conducted with oblique rotation. The pattern matrix indicated that performance related ADL items are about climbing several flights of stairs without resting; stooping, kneeling, or crouching; walking several blocks; climbing one flight of stairs without resting; pulling or pushing large objects like a living room chair; lift or carry weights over 10 pounds, like a heavy bag of groceries; running or jogging about a mile; and walking one block. The other ADL items, non-performance related ADL items, are about dressing without help; bathing or showering without help; eating without help; walking across the room; getting in and out of bed without help; picking up a dime from a table; reaching or extending arms above shoulder level; sitting for about two hours; and getting up from a chair after sitting for long periods.

Two studies to date have looked at internal consistency and/or measurement properties of the physical functioning measures in the context of the HRS and Study of Assets and Health Dynamics among the Oldest Old (AHEAD). Wallace and Herzog (1995) performed an exploratory factor analysis of the physical functioning items in HRS Wave 1 and identified three domains: 1) mobility, including all ambulation items except jogging and climbing stairs (i.e., mobility difficulty index); 2) lower and upper body strength (i.e., large muscle difficulty index); and 3) ADLs (ADL difficulty index). Using AHEAD Wave 1, Clark, Stump, and Wolinsky (1997) attempted to confirm the multi-dimensional structure identified by Wolinsky and Johnson (1992). They found that the physical functioning measures formed factors around lower body disability and basic, household, and advanced ADLs. The lower body items included walking several blocks, climbing one flight of stairs, pulling and pushing large objects, and carrying 10 pounds. The basic ADL items were dressing, bathing, getting in and out of bed, and using the toilet. The household ADLs were preparing hot meals and shopping for groceries and the advanced ADLs were managing money, making telephone calls, and taking medication.

Table 2

Reliability Analysis for the Physical Functioning Measures in the HRS Wave 1

	All Physical Functioning Measures[a]	Strength, Mobility, & Fine Motor Skills	ADLs	IADLs[a]
HRS Wave1	.87/.86	.85	.77	.60[b]

[a] The first alpha in each cell is from analyses omitting atypical measures. The second includes them.

[b] HRS Wave 1 only included measures of people's difficulties using maps, microwaves, calculators, and computers.

It appears from this Table 2 (cited from Fonda, 2002; p. 23) that the physical functioning scales were fairly reliable; i.e., the Cronbach's coefficient alphas generally exceeded the minimum value of .70. One exception is the IADL summated scale in HRS Wave 1, which contained atypical IADL items including using a map, calculator, computer, and microwave; this particular scale had a Cronbach's coefficient alpha of .60.

There are only three studies that have explicitly addressed construct validity in the physical functioning measures of the Health and Retirement Study (HRS) and its companion, the Study of Assets and Health Dynamics among the Oldest Old (AHEAD). The first is a study by Wallace and Herzog (1995) that assessed the construct validity of physical functioning measures of the HRS and AHEAD by juxtaposing respondents' level of difficulty in each against measures of disease included in HRS Wave 1. As expected, they found that individuals with health conditions such as diabetes, cancer, heart problems and stroke, had more problems with mobility and ADLs. The second study, by

Rodgers and Miller (1997), examined the extent to which three different summary scores representing AHEAD Wave 1 respondents' ADL functioning were correlated with several criterion variables such as age, health rating, number of health conditions, and number of doctor visits. All correlations were in the expected direction and statistically significant, providing evidence of moderate to high construct validity. The third study, by Stump and colleagues (1997), related basic ADL functioning, household ADL functioning, advanced ADL functioning, and lower body functioning among AHEAD Wave 1 respondents to other aspects of health and social-demographics, including perceived health, affective functioning, health conditions, gender, race, and age. As the researchers expected, most of the health conditions were associated with worse functioning, as outlined by Stump and associates. Several of the physical functioning domains were related to poorer affective functioning and perceived health, such as basic ADL functioning and lower body functioning.

Cardiovascular Risk Factors Index. Cardiovascular risk factors were conceptualized as a continuum. Eighteen questions about smoking, alcohol, exercising, diabetes, weight and height (body mass index), and hypertension provide a total cardiovascular risk factor index score (See Appendix B). A higher score, with items all in the direction of risk, indicates having more cardiovascular risk factors and potentially poorer health.

Cardiovascular Disease Index. Cardiovascular disease was conceptualized as a disease continuum with the number of heart related diagnoses and treatments being counted once. Twenty-two questions about myocardial infarction, congestive heart failure, and stroke provide a total cardiovascular disease score (See Appendix C). A higher score indicates a higher level of cardiovascular disease and poorer health.

Cognitive Functioning Index. Cognitive functioning was assessed by 23 items about self-rated cognitive ability, immediate and delayed recall, cognitive activities in daily living, time orientation, general information, vocabulary, and arithmetic (See Appendix D). To test cognitive function, HRS used modified items from Wechsler Adult Intelligence Scale-revised (WAIS-R) and Wechsler Memory Scale (WMS). A higher score indicates better cognitive functioning.

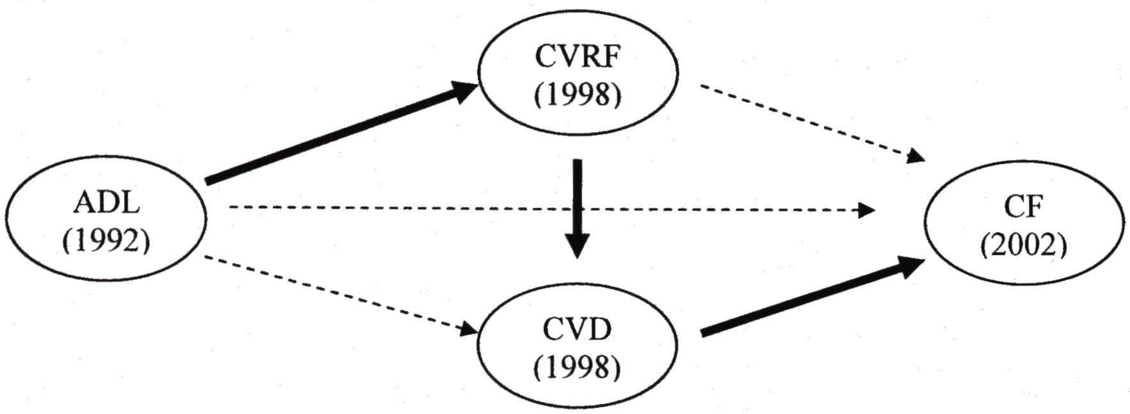
Procedure

Participant Recruitment. The Health and Retirement Study represents older Americans between the ages of 51-61 and their spouses. HRS paid $10 for individual participation and $30 for participation as couples. If participants refused to participate, they were offered $20 for individual participation and $60 for participation as couples. If participants refuse the second request, they were offered $100 for individual participation, and $299 for participation with their partner via mail (Juster & Suzman, 1995). Once they accept to participate to the study, they were interviewed, which lasts approximately 130 minutes.

Testing Hypotheses. To test the longitudinal hypotheses of the study, path analysis was performed (See Figure 1). Path analysis can be seen as an extension of multiple regression. The "X causes Y" in regression analysis, becomes "X causes Y and Y causes Z" in path analysis. In other words, by doing path analysis, one can test a theory of causal order among a set of variables (Klem, 1997). Specifically, in order to find out the mediating effect of cardiovascular risk factors (1998) and cardiovascular disease (1998) in the relationship between activities of daily living (1992) and cognitive functioning, path analysis was conducted. In the first step, the association between activities of daily living (1992) and cardiovascular risk factors (1998) was tested. While cardiovascular risk factors (1998) was entered into the equation as the dependent variable, activities of daily living (1992) was an independent variable. In the second step, cardiovascular disease (1998) was the dependent variable whereas all variables in the first step (activities of daily living (1992) and cardiovascular risk factors (1998)) became independent variables. Therefore, analyses reveal the mediating effect of cardiovascular risk factors (1998) on the relationship between activities of daily living (1992) and cardiovascular disease (1998). In the third step, cognitive functioning (2002) was the dependent variable whereas all the variables in the second step (activities of daily living (1992), cardiovascular risk factors (1998), and cardiovascular disease (1998)) become independent variables. In short, by performing a path analysis, all of the hypotheses of the present study were tested. The hypotheses were: (1) ADLs would predict future cognitive functioning (positive relationship), (2) ADLs would predict future cardiovascular risk factors (negative relationship), (3) ADLs would predict future cardiovascular diseases (negative relationship), (4) cardiovascular risk factors would predict cardiovascular diseases (positive relationship), (5) cardiovascular risk factors would predict future cognitive functioning (negative relationship), (6) cardiovascular disease would predict future cognitive functioning (negative relationship), (7) cardiovascular risk factors would mediate the relationship between ADLs and cardiovascular disease, and (8) cardiovascular disease would mediate the relationship between cardiovascular risk factors and cognitive functioning.

Figure 1

Path Model



Note. Solid arrows represent the main model (Hypothesis 7 and Hypothesis 8)

CHAPTER III

RESULTS

Descriptive Statistics

Table 3

Scales' Descriptive Statistics and Gender Differences

	Total		Men		Women		t
	M	SD	M	SD	M	SD	
Age (1992)	55.75	3.10	55.75	3.11	55.74	3.10	.143
ADL Scale (1992)	3.60	0.43	3.68	0.89	3.53	0.45	14.502***
CVRF (1998)	0.91	0.58	0.94	0.58	0.89	0.58	3.562***
CVD (1998)	0.20	0.57	0.24	0.60	0.18	0.53	4.326***
Cognitive Functioning (2002)	27.48	8.37	27.06	8.42	27.79	8.32	-3.333**

**Significant in $p < .001$, ***Significant in $p < .0001$, N = 6558

Table 3 shows the means and standard deviations and t-test differences of continuous variables in total and by gender. As the t values reveal, men and women were significantly different from each other on continuous variables except from on the age. Table 3 indicates that men functioned better than females in Activities of Daily Living in 1992, $t\,(6558) = 14.502$, $p < .0001$; had more cardiovascular risk factors than women in 1998, $t\,(6558) = 3.562$, $p < .0001$; had more cardiovascular disease than women in 1998, $t\,(6558) = 4.326$, $p < .0001$; and functioned worse than women cognitively in 2002 $t\,(6006) = -3.333$, $p < .001$.

Table 4

Descriptive Statistics, Analysis of Variance, and Tukey HSD Range Tests for Group Differences for the Scales and Race/Ethnicity

	Caucasian		African American		Hispanic		Oneway ANOVA		
	M	SD	M	SD	M	SD	df	F	p
Age (1992)	55.79	3.12	55.70	3.05	55.48	3.06	2	2.75	.064
ADL Scale (1992)	3.63_{ab}	0.39	3.51_{a}	0.52	3.53_{b}	0.50	2	41.61	.000
CVRF Index (1998)	0.87_{ab}	0.58	1.09_{a}	0.56	1.00_{b}	0.57	2	23.71	.000
CVD Index (1998)	0.20	0.56	0.23	0.62	0.17	0.54	2	1.92	.146
Cognitive Functioning Index (2002)	28.52_{ab}	8.34	24.35_{a}	7.55	23.92_{b}	7.64	2	153.42	.000

Note. Groups with the same subscript are significantly different from one another at least $p < .05$ using a Tukey HSD Range Test

Table 4 shows the means and standard deviations of continuous variables, age and scale / indices scores, by race / ethnicity; and the Oneway ANOVA results to look at whether the differences between race / ethnicity groups were significant in terms of the continuous variables or not. The ANOVA results were significant for ADL Scale (1992), CVRF Index (1998), and Cognitive Functioning Index (2002). Follow-up tests were conducted to evaluate pairwise differences among the means. As Table 4 reveals, Caucasians functioned in terms of daily activities better than African Americans and Hispanics $F(2, 6557) = 41.61$, p< 001; had less cardiovascular risk factors than African Americans and Hispanics $F(2, 6557) = 23.71$, p< 001; and functioned better than African Americans and Hispanics cognitively $F(2, 6557) = 153.42$, p< 001.

Inferential Statistics

Table 5

Reliabilities of the ADL Scale (1992)

	Cronbach's α	Mean	SD	α If Item Deleted	Item-Total r
ADL Scale (1992)	.886				
Item 1		2.02	1.12	.8916	.3775
Item 2		3.59	0.86	.8729	.6848
Item 3		3.84	0.56	.8768	.6437
Item 4		3.95	0.31	.8830	.5301
Item 5		3.50	0.89	.8855	.4095
Item 6		3.49	0.80	.8745	.6512
Item 7		3.90	0.41	.8806	.5748
Item 8		3.14	1.07	.8740	.6765
Item 9		3.72	0.72	.8721	.7249
Item 10		3.58	0.88	.8732	.6769
Item 11		3.28	0.99	.8728	.6886
Item 12		3.91	0.40	.8843	.3973
Item 13		3.95	0.33	.8827	.5287
Item 14		3.83	0.55	.8796	.5483
Item 15		3.56	0.87	.8720	.7043
Item 16		3.99	0.12	.8884	.2167
Item 17		3.97	0.23	.8853	.4510

Table 5 shows the results of the reliability analyses of the ADL (1992) Scales. The Cronbach α of ADL Scale was .89 indicating that the scale had a good reliability. Item-total correlation values showed that only the deletion of first and sixteenth items would increase the Cronbach α, but not to a significant extend.

Table 6

Correlations of Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Cardiovascular Disease Index 1998 (CVD1998), and Cognitive Functioning Index 2002 (CF2002)

	ADL1992	CVRF1998	CVD1998	CF2002
ADL1992	1.000			
CVRF1998	-.267**	1.000		
CVD1998	-.229**	.131**	1.000	
CF2002	.113**	-.160**	-.047**	1.000

Note. **Correlation is significant at the 0.01 level, N = 6558

Table 6 shows the correlation coefficients among the four scales / indices that were used in this study. The results of the correlational analyses show that all of the correlations were statistically significant. In general, the results suggest that as the current daily functioning of the participants gets better, which is measured by ADL Scale (1992), both cardiovascular risk factors (CVRF1998) ($r = -.267, p < .01$) and cardiovascular disease (CVD1998) ($r = -.229, p < .01$) of the participants decrease which means that they stay healthier four years later. Moreover, as the participants functioned better in daily living (ADL1992), they also functioned cognitively better ten years later (CF2002) ($r =$

.113, p = .01). Furthermore, Table 6 shows that concurrent cardiovascular risk factor (CVRF1998) and cardiovascular disease (CVD1998) status correlated positively, which suggests that the participants who had more cardiovascular risk factors (CVRF1998), had more cardiovascular disease (CVD1998) (r = .131, p = .01). Finally, Table 6 shows that participants who had higher cardiovascular risk factors (CVRF1998) (r = -.160, p = .01). and more cardiovascular disease (CVD1998) (r = -.047, p = .01)., functioned worse 10 years later cognitively (CF2002).

Attrition Analyses

T-test analyses were performed to compare participants who provided time 1 data (1992) and time 2 data (1998) but did not provide time 3 data (2002) (dropouts), and participants who provided data in all three times, in 1992, 1998, and 2002 (completers).

Table 7

Demographic Characteristics of Dropouts and Completers

	Dropouts		Completers		Total		χ^2
	Frequency	%	Frequency	%	Frequency	%	Chi-sq
Gender							7.953*
Male	531	15.1	2980	84.9	3511	46.1	
Female	529	12.9	3578	87.1	4107	53.9	
Race/Ethnicity							18.062***
Caucasian	737	13.0	4949	87.0	5686	74.6	
African American	217	17.3	1036	82.7	1253	16.4	
Hispanic	106	13.9	573	86.1	679	8.9	
Total	1060	13.9	6558	86.1	7618	100.0	

*Significant in $p < .01$, ***Significant in $p < .0001$

Attrition analyses suggested that 7,618 participants provided data in time 1 (1992) and in time 2 (1998) data, but 1,060 of them dropped out and did not provide data in 2002, leaving 6,558 participants, completers (See Table 7). Table 7 shows that 15.1 % of males and 12.9 % of females in the study dropped out in time 3 (2002). The chi-square analysis shows that men were more likely to dropout. Moreover, 13.0 percent of Caucasians, 17.3 percent of African Americans, and 13.9 percent of Hispanics dropped out in time 3 (2002). These data indicate that African Americans were more likely to drop out.

Table 8

Dropouts' and Completers' Differences in terms of Continuous Variables

	Dropouts		Completers		t
	M	SD	M	SD	
Age (1992)	56.08	3.16	55.75	3.10	3.255**
ADL Scale (1992)	3.51	0.52	3.60	0.43	-6.512***
Performance ADLs (1992)	3.20	0.75	3.34	0.65	-6.711***
Non-Performance ADLs (1992)	3.78	0.39	3.83	0.29	-4.764***
Blood Pressure (1998)	0.17	0.19	0.15	0.18	4.261***
Diabetes Mellitus (1998)	0.08	0.17	0.05	0.13	6.398***
Smoking (1998)	0.23	0.38	0.16	0.35	6.173***
Alcohol (1998)	0.06	0.16	0.06	0.14	0.206^{ns}
Not Exercising (1998)	0.30	0.24	0.26	0.25	5.833***
Overweight / Obesity (1998)	0.21	0.20	0.24	0.21	-4.927***
CVRF (1998)	1.05	0.63	0.91	0.58	7.220***
Presence of Heart Condition (1998)	0.14	0.28	0.09	0.23	6.200***
Myocardial Infarction (1998)	0.04	0.19	0.02	0.16	5.095***
Angina (1998)	0.08	0.24	0.04	0.18	5.287***
Congestive Heart Failure (1998)	0.04	0.19	0.01	0.09	8.136***
Other Coronary Heart Factors Requiring Invasive Treatment (1998)	0.04	0.17	0.03	0.13	3.230**
Stroke (1998)	0.05	0.16	0.02	0.09	9.174***
CVD (1998)	0.39	0.84	0.20	0.57	8.951***

**Significant in p < .001, ***Significant in p < .0001

Table 8 shows the differences between dropouts and completers in terms of continuous variables of the study. It reveals that dropouts and completers were significantly different from each other in all continuous variables except for alcohol. Compared to dropouts, completers were younger, t (7618) = 3.255, $p < .001$; performed better in daily life in general, t (7618) = -6.512, $p < .0001$; performance related daily activities, t (7618) = -6.711, $p < .0001$, and non-performance related daily activities, t (7618) = -4.764, $p < .0001$; had lower blood pressure, t (7618) = 4.261, $p < .0001$; had lower diabetes mellitus related risks, t (7618) = 6.398, $p < .0001$; had less smoking related risks, t (7618) = -6.173, $p < .0001$; exercised more, t (7618) = 5.833, $p < .0001$; had higher body mass index (BMI), t (7618) = -4.927, $p < .0001$; had generally less cardiovascular risk factors, t (7618) = 7.220, $p < .0001$; had fewer heart related conditions, t (7618) = 6.200, $p < .0001$; had fewer myocardial infarction related problems, t (7618) = 5.095, $p < .0001$; had fewer angina related problems, t (7618) = 5.287, $p < .0001$; had fewer congestive heart failure related problems, t (7618) = 8.136, $p < .0001$; received fewer coronary heart factors requiring invasive treatments, t (7618) = 3.230, $p < .001$; had fewer stroke related problems, t (7618) = 9.174, $p < .0001$; and had fewer cardiovascular diseases in general, t (7618) = -8.951, $p < .0001$.

In order to reduce falsely significant results in t-tests, the alpha level was adjusted downward to account for the number of comparisons being performed. In other words, Bonferroni correction was made. After Bonferroni correction, the new p value became .05 / 18 = .00277 and all of the significant t-tests remained significant at the new p level.

Path Analyses

Table 9

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

	Variable	B	SE B	β
Step 1				
	ADL1992 (IV)	-.361	.016	-.267***
	CVRF1998 (DV)			
Step 2				
	ADL 1992 (IV)	-.275	.016	-.209***
	CVRF1998 (IV)	.074	.012	.076***
	CVD1998 (DV)			
Step 3				
	ADL 1992 (IV)	1.459	.268	.073***
	CVRF1998 (IV)	-2.027	.192	-.139***
	CVD98 (IV)	-.179	.199	$-.012^{ns}$
	CF2002 (DV)			

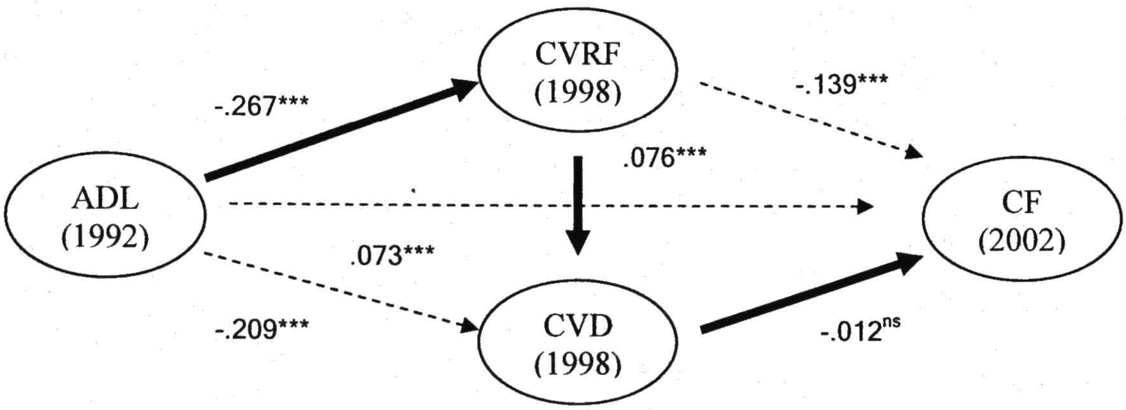
***Significant in p < .0001

Results of path analysis revealed that (See Table 9) the path predicting Cardiovascular Risk Factors (1998) from Activities of Daily Living (1992) is significant ($\beta = -.267, p < .0001$), which means that better daily functioning of older adults predicted less cardiovascular risk factors 6 years later. Similarly, the path predicting

Cardiovascular Disease (1998) from Activities of Daily Living (1992) was significant (β = -.209, $p < .0001$), which means that better daily functioning of older adults predicted less cardiovascular disease 6 years later. The path predicting Cardiovascular Disease (1998) from Cardiovascular Risk Factors (1998) suggested that higher cardiovascular risk factors predicted worse concurrent cardiovascular health ($\beta = .076$, $p < .0001$). Finally, the paths predicting Cognitive Functioning (2002) from Activities of Daily Living (1992) and Cardiovascular Risk Factors (1998) were significant, suggesting that better daily functioning ($\beta = .073$, $p < .0001$) and less cardiovascular risk factors (β = -.139, $p < .0001$) of older adults predicted better cognitive functioning longitudinally. The only predictor of the study that was not significant in predicting cognitive functioning of older adults was cardiovascular disease ($\beta = .012$, $p = .367$), suggesting that cardiovascular disease did not mediate the relationship between activities of daily living and cognitive functioning, and the relationship between cardiovascular risk factors and cognitive functioning. However, the path analysis indicated that cardiovascular risk factors were mediating the relationship between activities of daily living and cognitive functioning of older adults longitudinally (See Figure 2).

Figure 2

Path Model with Composite Scales/Indices



Note. Solid arrows represent the main model (Hypothesis 7 and Hypothesis 8)

After conducting the main path analysis, several other path analyses were conducted in order to examine the model with the parcels of the indices. In other words, the same model was tested with decomposing the scales/indices into their parcels. A parcel is an aggregate-level indicator made up of the sum or average of two or more items, responses, or behaviors (Little, Cunningham, Shahar, & Widaman, 2002). First, the model was tested by performance related ADLs and non-performance related ADLs, that were acquired by decomposing Activities of Daily Living Scale (1992) into its parcels.

Table 10

Path Analysis using Performance Related Activities of Daily Living Items 1992 (PADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
PADL1992 (IV)	-.258	.011	-.290***
CVRF1998 (DV)			
Step 2			
PADL1992 (IV)	-.180	.011	-.207***
CVRF1998 (IV)	.070	.012	.071***
CVD1998 (DV)			
Step 3			
PADL1992 (IV)	.783	.177	.060***
CVRF1998 (IV)	-2.056	.193	-.141***
CVD98 (IV)	-.244	.199	-.015^{ns}
CF2002 (DV)			

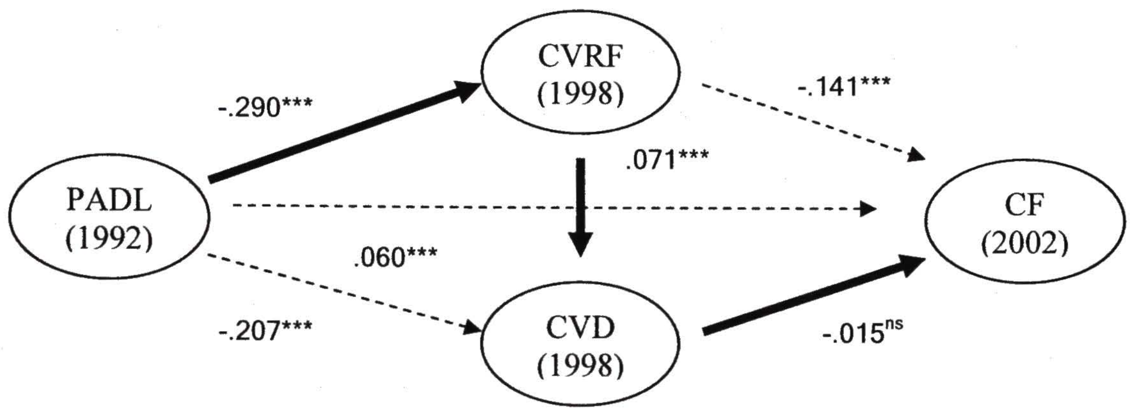
***Significant in p < .0001

Results of path analysis revealed that (See Table 10) the path predicting Cardiovascular Risk Factors (1998) from Performance Related Activities of Daily Living (1992) was significant (β = -.290, p < .0001), which means that better performance related daily functioning of older adults predicted less cardiovascular risk factors 6 years later. Similarly, the path predicting Cardiovascular Disease (1998) from Performance

Related Activities of Daily Living (1992) was significant (β = -.207, p < .0001), which means that better daily functioning of older adults predicted less cardiovascular disease 6 years later. The path predicting Cardiovascular Disease (1998) from Cardiovascular Risk Factors (1998) suggested that higher cardiovascular risk factors predicted worse concurrent cardiovascular health (β = .071, p < .0001). Finally, the paths predicting Cognitive Functioning (2002) from Performance Related Activities of Daily Living (1992) and Cardiovascular Risk Factors (1998) were significant, suggesting that better daily functioning (β = .060, p < .0001) and less cardiovascular risk factors (β = -.141, p < .0001) of older adults predicted better cognitive functioning longitudinally. As in the previous path model, the only predictor of the study that was not significant in predicting cognitive functioning of older adults was cardiovascular disease (β = .012, p = .367), and cardiovascular risk factors mediated the relationship between activities of daily living and cognitive functioning of older adults longitudinally (See Figure 3).

Figure 3

Path Model with Performance Related ADLs 1992



Note. Solid arrows represent the main model (Hypothesis 7 and Hypothesis 8)

Results of path analysis revealed that (See Table 11) the path predicting Cardiovascular Risk Factors (1998) from Non-Performance Related Activities of Daily Living (1992) was significant (β = -.166, p < .0001), which means that better performance related daily functioning of older adults predicted less cardiovascular risk factors 6 years later. Similarly, the path predicting Cardiovascular Disease (1998) from Activities of Daily Living (1992) was significant (β = -.166, p < .0001), which means that better daily functioning of older adults predicted less cardiovascular disease 6 years later. The path predicting Cardiovascular Disease (1998) from Cardiovascular Risk Factors (1998) suggested that higher cardiovascular risk factors predicted worse concurrent cardiovascular health (β = .104, p < .0001). Finally, the paths predicting Cognitive Functioning (2002) from Activities of Daily Living (1992) and Cardiovascular Risk Factors (1998) were significant, suggesting that better daily functioning (β = .081, p < .0001) and less cardiovascular risk factors (β = -.145, p < .0001) of older adults predicted better cognitive functioning longitudinally. As in the previous path model, the only predictor of the study that was not significant in predicting cognitive functioning of older adults is cardiovascular disease ($\beta = .012, p = .013$), and cardiovascular risk factors mediate the relationship between activities of daily living and cognitive functioning of older adults longitudinally (See Figure 4).

Table 11

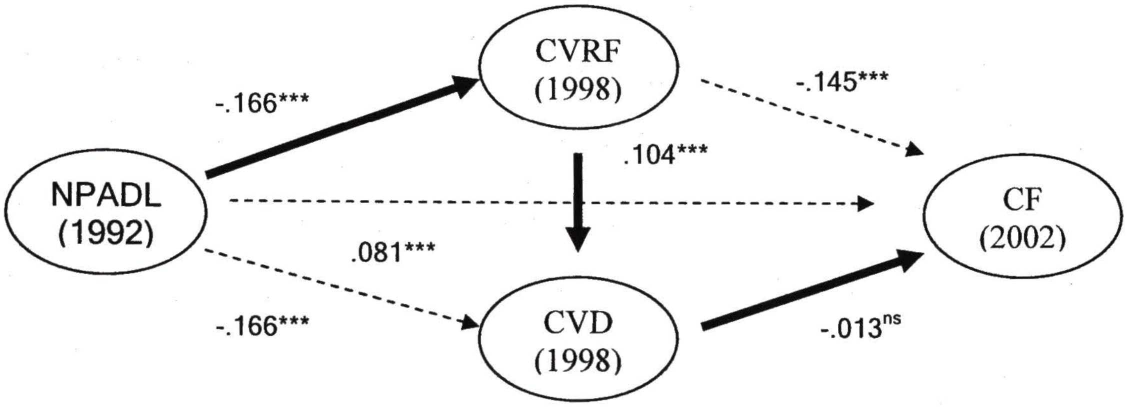
Path Analysis using Non-Performance Related Activities of Daily Living Items 1992 (NPADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
NPADL1992 (IV)	-.327	.204	-.166***
CVRF1998 (DV)			
Step 2			
NPADL1992 (IV)	-.320	.024	-.166***
CVRF1998 (IV)	.101	.012	.104***
CVD1998 (DV)			
Step 3			
NPADL1992 (IV)	2.365	.383	.081***
CVRF1998 (IV)	-2.110	.188	-.145***
CVD98 (IV)	-.197	.197	-.013^{ns}
CF2002 (DV)			

***Significant in p < .0001

Figure 4

Path Model with Non-Performance Related ADLs 1992



Note. Solid arrows represent the main model (Hypothesis 7 and Hypothesis 8)

The pattern that the variables predicted the other variables was same in all three models tested with using composite Activities of Daily Living (ADL) Scale, Performance Related ADLs, and Non-Performance Related ADLs. Although Performance Related ADLs predicted cardiovascular risk factors more strongly, Non-Performance Related ADLs predicted cardiovascular risk factors less strongly than composite ADL scores. Both Performance Related ADLs and Non-Performance Related ADLs predict cardiovascular disease less strongly than composite ADL Scale. And finally, the best longitudinal ADL predictor of cognitive functioning was non-performance related ADLs, and the least strong ADL predictor of cognitive functioning was performance related ADLs. In summary, ADLs were important in terms of cardiovascular risk factors, cardiovascular disease, and cognitive functioning longitudinally. However, it seemed that performance related ADLs and non-performance related ADLs worked differently. They varied in the strength of their effects through different paths. While performance related

ADLs were more important than non-performance related ADLs for cardiovascular risk factors, non-performance related ADLs were more important than performance related ADLs for cognitive functioning longitudinally. Although non-performance related ADLs' ($\beta = .104, p < .0001$) direct effect on cognitive functioning was larger than performance related ADLs' direct effect on cognitive functioning longitudinally ($\beta = .071, p < .0001$), the indirect effect of performance related ADLs on cognitive functioning through cardiovascular risk factors was larger than the indirect effect of non-performance related ADLs on cognitive functioning through cardiovascular risk factors.

Next, the path model was tested by using cardiovascular risk factor parcels, blood pressure, diabetes mellitus, smoking, alcohol, not exercising, and obesity / overweight measured by body mass index (BMI).

Table 12

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Blood Pressure 1998, Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.070	.005	-.165***
Blood Pressure (DV)			
Step 2			
ADL1992 (IV)	-.279	.016	-.221***
Blood Pressure (IV)	.336	.038	.108***
CVD1998 (DV)			
Step 3			
ADL1992 (IV)	1.997	.265	.100***
Blood Pressure (IV)	-2.460	.605	-.053***
CVD98 (IV)	-.255	.201	$-.017^{ns}$
CF2002 (DV)			

***Significant in p < .0001

Table 12 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Cardiovascular Disease 1998, were statistically significant. Compared to the composite Cardiovascular Risk Factors Index (1998), Blood Pressure (1998) was a weaker predictor of Cardiovascular Disease (1998) ($\beta = .108, p < .0001$) and Cognitive Functioning (2002) ($\beta = -.053, p < .0001$) of older adults.

Table 13

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Diabetes Mellitus 1998, Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

	Variable	B	SE B	β
Step 1				
	ADL1992 (IV)	-.054	.004	-.174***
	Diabetes Mellitus (DV)			
Step 2				
	ADL1992 (IV)	-.271	.016	-.205***
	Diabetes Mellitus	.583	.052	.137***
	CVD1998 (DV)			
Step 3				
	ADL1992 (IV)	2.026	.264	.102***
	Diabetes Mellitus	-3.031	.838	-.047***
	CVD98 (IV)	-.233	.202	$-.015^{ns}$
	CF2002 (DV)			

***Significant in p < .0001

Table 13 shows that all of the beta coefficients, except from the one that predicts Cognitive Functioning (2002) from Cardiovascular Disease (CVD) 1998, were statistically significant. While Diabetes Mellitus (1998) predicted Cardiovascular Disease (1998) more strongly than the composite Cardiovascular Risk Factors Index (1998) (β = .137, $p < .0001$), its strength to predict the Cognitive Functioning (2002) of older adults is less than the composite Cardiovascular Risk Factors Index (β = -.047, $p < .0001$) (1998).

Table 14

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Smoking 1998, Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.047	.010	-.061***
Smoking (DV)			
Step 2			
ADL1992 (IV)	-.304	.016	-.231***
Smoking (IV)	-.045	.020	-027***
CVD1998 (DV)			
Step 3			
ADL1992 (IV)	2.016	.262	.101***
Smoking (IV)	-2.508	.321	-.100***
CVD98 (IV)	-.387	.199	-.026^{ns}
CF2002 (DV)			

***Significant in p < .0001

Table 14 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Cardiovascular Disease (CVD) 1998, were statistically significant. Compared to the composite Cardiovascular Risk Factors Index (1998), Smoking (1998) predicted of Cardiovascular Disease (1998) ($\beta = -.027, p < .0001$) and Cognitive Functioning (2002) ($\beta = -.100, p < .0001$) of older adults less strongly. While the beta coefficient of the path between composite Cardiovascular Risk

Factors Index (1998) and Cardiovascular Disease (1998) ($\beta = .076, p < .0001$) was positive, the beta coefficient of the path between composite Smoking (1998) and Cardiovascular Disease (1998) ($\beta = -.027, p < .0001$) was negative.

Table 15

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Alcohol 1998, Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.029	.004	.093***
Alcohol (DV)			
Step 2			
ADL1992 (IV)	-.298	.016	-.226***
Alcohol (IV)	-.123	.050	-.029***
CVD1998 (DV)			
Step 3			
ADL1992 (IV)	2.186	.264	.110***
Alcohol (IV)	-1.338	.816	-.021***
CVD98 (IV)	-.350	.200	$-.023^{ns}$
CF2002 (DV)			

***Significant in p < .0001

Table 15 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Cardiovascular Disease (CVD) 1998, were statistically significant. Similar to Smoking (1998) as a predictor of Cardiovascular Risk Factors Index (1998) and Cognitive Functioning (2002); compared to the composite Cardiovascular Risk Factors Index (1998), Alcohol (1998) predicted of Cardiovascular Disease (1998) (β = -.029, p < .0001) and Cognitive Functioning (2002) (β = -.021, p < .0001) of older adults less strongly. While the beta coefficient of the path between composite Cardiovascular Risk Factors Index (1998) and Cardiovascular Disease (1998) (β = .076, p < .0001) was positive, the beta coefficient of the path between composite Smoking (1998) and Cardiovascular Disease (1998) (β = -029, p < .0001) was negative.

Table 16

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Not Exercising 1998, Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.132	.007	-.226***
Not Exercising (DV)			
Step 2			
ADL1992 (IV)	-.291	.016	-.221***
Not Exercising (IV)	.082	.028	.036***
CVD1998 (DV)			
Step 3			
ADL1992 (IV)	1.965	.268	.099***
Not Exercising (IV)	-1.437	.440	-.043***
CVD98 (IV)	-.317	.200	$-.021^{ns}$
CF2002 (DV)			

***Significant in p < .0001

Table 16 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Cardiovascular Disease (CVD) 1998, were statistically significant. Compared to the composite Cardiovascular Risk Factors Index (1998), Not Exercising (1998) was a weaker predictor of Cardiovascular Disease (1998) ($\beta = .036, p < .0001$) and Cognitive Functioning (2002) ($\beta = -.043, p < .0001$) of older adults.

Table 17

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Overweight / Obesity 1998 (OBESITY1998), Cardiovascular Disease Index 1998 (CVD1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.087	.006	-.181***
OBESITY1998 (DV)			
Step 2			
ADL1992 (IV)	-.292	.016	-.221***
OBESITY1998 (IV)	.116	.033	.042***
CVD1998 (DV)			
Step 3			
ADL1992 (IV)	1.926	.266	.097***
OBESITY1998 (IV)	-2.636	.527	-.065***
CVD98 (IV)	-.290	.200	$-.019^{ns}$
CF2002 (DV)			

***Significant in p < .0001

Table 17 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Cardiovascular Disease (CVD) 1998, were statistically significant. Similar to Blood Pressure (1998) and Not Exercising (1998); compared to the composite Cardiovascular Risk Factors Index (1998), Obesity (1998) was a weaker predictor of Cardiovascular Disease (1998) ($\beta = .042$, $p < .0001$) and Cognitive Functioning (2002) ($\beta = -.065$, $p < .0001$) of older adults.

Table 18

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Presence of a Heart Disease Condition 1998 (HDC1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.361	.016	-.267***
CVRF1998 (DV)			
Step 2			
ADL 1992 (IV)	-.108	.007	-.200***
CVRF1998 (IV)	.026	.005	.064***
HDC1998 (DV)			
Step 3			
ADL 1992 (IV)	1.529	.268	.077***
CVRF1998 (IV)	-2.046	.192	-.141***
HDC1998 (IV)	.195	.473	$-.005^{ns}$
CF2002 (DV)			

***Significant in p < .0001

Table 18 shows that all of the beta coefficients, except from the one that predicts Cognitive Functioning (2002) from Presence of a Heart Disease Condition (1998), were statistically significant. Thus, similar to Cardiovascular Disease (1998) Index, Presence of a Heart Disease Condition (1998) did not predict cognitive functioning of older adults, too (β = -.005, p > .05).

Table 19

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Myocardial Infarction 1998 (MYOCAR1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.361	.016	-.267***
CVRF1998 (DV)			
Step 2			
ADL 1992 (IV)	-.115	.004	-.054***
CVRF1998 (IV)	.006	.003	.029*
MYOCAR1998 (DV)			
Step 3			
ADL 1992 (IV)	1.495	.263	.075***
CVRF1998 (IV)	-2.037	.192	-.140***
MYOCAR1998 (IV)	-.841	.930	$-.012^{ns}$
CF2002 (DV)			

***Significant in p < .05, ***Significant in p < .0001**

Table 19 shows that all of the beta coefficients, except from the one that predicts Cognitive Functioning (2002) from Myocardial Infarction (1998), were statistically significant. Thus, similar to Cardiovascular Disease (1998) Index, Myocardial Infarction (1998) did not predict cognitive functioning of older adults, too ($\beta = -.012, p > .05$).

Table 20

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Angina 1998, Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.361	.016	-.267***
CVRF1998 (DV)			
Step 2			
ADL 1992 (IV)	-.081	.005	-.192***
CVRF1998 (IV)	.016	.004	.051***
Angina 1998 (DV)			
Step 3			
ADL 1992 (IV)	1.396	.267	.070***
CVRF1998 (IV)	-2.018	.192	-.139***
Angina 1998 (IV)	-1.396	.616	-.029*
CF2002 (DV)			

*Significant in p < .05, ***Significant in p < .0001

Table 20 shows that all of the beta coefficients were statistically significant. Thus, unlike to Cardiovascular Disease (1998) Index, Angina (1998) predicted cognitive functioning of older adults significantly ($\beta = -.029, p < .05$).

Table 21

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Congestive Heart Failure 1998 (CONGHF1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.361	.016	-.267***
CVRF1998 (DV)			
Step 2			
ADL 1992 (IV)	-.025	.003	-.112***
CVRF1998 (IV)	.008	.002	.052***
CONGHF1998 (DV)			
Step 3			
ADL 1992 (IV)	1.438	.264	.074***
CVRF1998 (IV)	-2.031	.192	-.140***
CONGHF1998 (IV)	-1.000	1.153	$-.011^{ns}$
CF2002 (DV)			

***Significant in p < .0001

Table 21 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Congestive Heart Failure (1998), were statistically significant. Thus, similar to Cardiovascular Disease (1998) Index, Congestive Heart Failure (1998) did not predict cognitive functioning of older adults, too ($\beta = -.011, p > .05$).

Table 22

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Other Coronary Heart Factors Requiring Invasive Treatment 1998 (CHFTX1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

Variable	B	SE B	β
Step 1			
ADL1992 (IV)	-.361	.016	-.267***
CVRF1998 (DV)			
Step 2			
ADL 1992 (IV)	-.020	.004	-.064***
CVRF1998 (IV)	.009	.003	.037**
CHFTX1998 (DV)			
Step 3			
ADL 1992 (IV)	1.521	.263	.076***
CVRF1998 (IV)	-2.046	.192	-.141***
CHFTX1998	.667	.836	$.010^{ns}$
CF2002 (DV)			

**Significant in p < .01, ***Significant in p < .0001

Table 22 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Other Coronary Heart Factors Requiring Invasive Treatment (1998), were statistically significant. Thus, similar to Cardiovascular Disease (1998) Index, Other Coronary Heart Factors Requiring Invasive Treatment (1998) did not predict cognitive functioning of older adults, too ($\beta = .010, p > .05$).

Table 23

Path Analysis using Activities of Daily Living Scale 1992 (ADL1992), Cardiovascular Risk Factors Index 1998 (CVRF1998), Stroke 1998 (STROKE1998), Cognitive Functioning Index 2002 (CF2002) (N = 6558)

	Variable	B	SE B	β
Step 1				
	ADL1992 (IV)	-.361	.016	-.267***
	CVRF1998 (DV)			
Step 2				
	ADL 1992 (IV)	-.026	.003	-.025***
	CVRF1998 (IV)	.009	.002	.058***
	STROKE1998 (DV)			
Step 3				
	ADL 1992 (IV)	1.472	.264	.074***
	CVRF1998 (IV)	-2.027	.192	-.139***
	STROKE1998	-1.499	1.242	$-.016^{ns}$
	CF2002 (DV)			

***Significant in p < .0001

Table 23 shows that all of the beta coefficients, except from the one that predicted Cognitive Functioning (2002) from Stroke (1998), were statistically significant. Thus, similar to Cardiovascular Disease (1998) Index, Stroke (1998) did not predict cognitive functioning of older adults, too ($\beta = -.016, p > .05$).

CHAPTER IV

DISCUSSION

In the present study the impact of activities of daily living and cardiovascular risk factors on cardiovascular disease and cognitive functioning of Americans progressing from middle-age (51 to 61 in 1992) to old age (61 to 71 in 2002), was investigated in a three-wave longitudinal study by using 6558 participants selected from 1992 (wave 1), 1998 (wave 4), and 2002 (wave 6) of the Health and Retirement Study (HRS) Dataset. Path analysis was used to test the hypotheses of the study. The path analysis tested a theory of temporal order among the variables of the study, which may be suggestive of possible causal relationships.

Overview of Findings.

The first hypothesis of the study was that activities of daily living (ADL) would positively predict future cognitive functioning. This proposes that better activities of daily living functioning predicts better future cognitive functioning of older adults. The hypothesis was confirmed by the path analyses performed for general ADLs, performance related ADLs, and non-performance related ADLs as independent variables. Not surprisingly, the strongest group of ADLs in predicting cognitive functioning was non-performance related ADLs, followed by general ADLs (which is composed of both performance and non-performance ADLs), and lastly performance related ADLs.

The second hypothesis of the study was that activities of daily living (ADL) will negatively predict future cardiovascular risk factors, which proposes that better daily functioning predicts less cardiovascular risk factors in older adults longitudinally. Again, the hypothesis was confirmed by all groups of ADLs. As might be suspected, the strongest group of ADLs in predicting cardiovascular risk factors was performance related ADLs, followed by general ADLs, and non-performance related ADLs.

The third hypothesis was that activities of daily living (ADL) will negatively predict future cardiovascular diseases, which proposes that which means that better daily functioning predicts less cardiovascular disease in older adults longitudinally. The path analyses showed that all three groups of ADLs confirm the hypothesis, with the general ADLs as the strongest predictor, followed by performance related ADLs, and non-performance related ADLs. In summary, while the general ADL construct was the best predictor of future cardiovascular disease, performance related ADLs were the best predictors of future cardiovascular risk factors, and non-performance related ADLs were the best predictors of future cognitive functioning in older adults. These relationships are discussed below.

The fourth hypothesis, cardiovascular risk factors will positively predict cardiovascular diseases, was tested with both the composite cardiovascular risk factor index, and with the parcels of the index. This hypothesis suggests that more cardiovascular risk factors predict more concurrent cardiovascular disease. The hypothesis was confirmed by the composite CVR index and by its all parcels except for smoking and alcohol, which suggested that more smoking and more drinking related to less concurrent cardiovascular disease. The reason of this counter intuitive result may be that the people with more serious CVD may cut down their concurrent drinking and smoking. As predicted, unlike smoking and drinking, the composite cardiovascular risk factor concept, high blood pressure, diabetes mellitus, high body mass index (BMI) (overweight/obesity), and not exercising predicts more cardiovascular disease in older Americans. Among the cardiovascular risk factor parcels that positively predict cardiovascular disease in older adults, Diabetes Mellitus was the strongest one, followed by high blood pressure.

The fifth hypothesis of the study was that cardiovascular risk factors would negatively predict future cognitive functioning, which proposes that more cardiovascular risk factors predict worse cognitive functioning longitudinally. The hypothesis was confirmed by both the composite cardiovascular risk factor index and by its all parcels; blood pressure, diabetes mellitus, smoking, alcohol, high body mass index (BMI) (overweight/obesity), and not exercising. Among all these predictors, the composite cardiovascular risk factor index was the strongest one, followed by smoking.

Based on the findings about the positive association between cognitive decline and congestive heart failure (Verhaegen, Borchelt, & Smith, 2003; Cacciatore, Abete, Ferrara, Calabrese, Napoli, Maggi, Varricchio, & Rengo, 1998), stroke (Verhaegen, Borchelt, & Smith, 2003), and coronary heart disease (Verhaegen, Borchelt, & Smith, 2003), the sixth hypothesis of the study was that cardiovascular disease will negatively predict future cognitive functioning, which proposes that more cardiovascular disease predicts worse cognitive functioning in older adults longitudinally. This hypothesis was not confirmed neither by the composite cardiovascular disease index nor by its parcels except for angina, although the correlation between cardiovascular disease index and cognitive functioning index, r = -.047, was significant at $p < .01$. Surprisingly, stroke, a disease that affects the blood vessels that supply blood to the brain, was not found to be a significant predictor of future cognitive functioning in older adults. Alternately, angina, chest pain or discomfort due to insufficient blood supply to the heart muscle due to the narrowing or blockage in one or more of the coronary arteries, was found to be a significant predictor of poorer future cognitive functioning. This was a counterintuitive finding, because stroke is due to the insufficiency of the blood supply to the brain itself. This difference may be similar to the cardiovascular disease (stroke in this case) versus cardiovascular risk factor (angina in this case) differences found above. Angina was originally conceptualized in this study as a CVD state, but it might also be considered a cardiovascular risk factor for future, more serious, cardiovascular disease, myocardial infarction.

The seventh hypothesis of the study was that cardiovascular risk factors will mediate the relationship between ADLs and cardiovascular disease. This hypothesis was confirmed by the path analyses conducted for the composite cardiovascular risk factor index and for its parcels. However, as mentioned before, the direction of the path from smoking and alcohol to cardiovascular disease is different from the direction of path from the composite cardiovascular risk factor and other parcels of it to cardiovascular disease. As noted, there is a J- or U- shaped relationship between alcohol consumption and cardiovascular disease (Kiechl, Willeit, Runggner, Egger, Oberhollenzer, & Bonora, 1998) and this may, in part, be the explanation of the unexpected result that more alcohol consumption seems to predict less cardiovascular disease in older adults. As it was also discussed above, the reason of the counter intuitive result that more smoking and alcohol consumption is related to less concurrent cardiovascular disease may additionally be that the people with more serious cardiovascular disease may smoke and drink less than they did before.

The last hypothesis of the study was that cardiovascular disease would mediate the relationship between cardiovascular risk factors and cognitive functioning. Since angina was the only cardiovascular disease parcel that significantly predicts future cognitive functioning, this hypothesis was true only for angina; angina mediated the relationship between cardiovascular risk factors and cognitive functioning in older adults.

Integration of the Findings.

The focus of the present study was to extend our knowledge about the predictors of cognitive functioning in older adults, to provide clinically meaningful information to guide health care professionals and help them in preparing better prevention interventions and / or in selecting appropriate interventions to prevent cognitive dysfunctions in older adults.

Many studies have demonstrated a relationship between two of the variables among the variables of the present study; however, the exact nature of the relationship between all of these variables was unclear. Moreover, previous studies have been looked at either the correlation of ADLs and CVD / cognitive functioning, or how CVD / cognitive dysfunctions influence ADLs. There was no study in the literature that has reported the impact of ADL on CVD and cognitive functioning. This study investigated the relationship of these closely related constructs in a broader picture. This study is also important to the area of aging within the field of Health Psychology, because the results of this study were obtained by analyzing United States population-based data. Even though this non-experimental study cannot answer questions about cause, the use of longitudinal data allows discussion of prediction of status in the future, and allows the development of some ideas of potential causal relationships.

As it was mentioned before, there will be about 71.5 million older persons above the age of 65 years in United States by 2030, which will be more than twice their number in 2000 (Administration on Aging, 2004). Studies on aging reveal that chronic diseases and disability are not inevitable (Administration on Aging, 2004). For this reason, it is important to study middle-aged adults. This study includes middle-aged adults between ages 51-61 at wave 1 to look at longitudinal predictors of future cognitive functioning with cardiovascular risk factors and cardiovascular disease as risk factors. The results of this study suggested that cardiovascular risk factors, but not cardiovascular disease, might be the important intermediately risk factors for cognitive dysfunctions. Thus, it is important to further study cardiovascular risk factors as risk factors for future cognitive dysfunctions in older adults, to identify the adults at risk and to take measures to prevent possible future cognitive dysfunctions.

It was indicated that there is a strong relationship between disability status and reported health status (Administration on aging, 2003). Among the older people with a severe disability, 68.0% reported their health as fair or poor. Among the older people with no disability, only 10.5% reported their health as fair or poor (Administration on Aging, 2003). The findings of this study confirmed this, in a strong longitudinal relationship between activities of daily living and health. Better daily functioning seems to predict less cardiovascular risk factors and cardiovascular disease in four years. Moreover, the present study found that activities of daily living, both the composite ADL scale and its parcels, are very important predictors of future cognitive functioning status of older adults. However, as the results suggested, it seems that performance related ADLs (activities such as walking several blocks; climbing one flight of stairs without resting; and lift or carry weights over 10 pounds, like a heavy bag of groceries) and non-performance related ADLs (activities such as dressing without help; walking across the room; getting in and out of bed without help; and getting up from a chair after sitting for long periods) appear to work differently in their predictive influence.

Performance related ADLs and non-performance related ADLs vary in the strength of their effects through different paths, as shown in Figures 3 and 4. While performance related ADLs are more important than non-performance related ADLs for cardiovascular risk factors, non-performance related ADLs are more important than performance related ADLs for cognitive functioning longitudinally. Although non-performance related ADLs' direct effect on cognitive functioning is larger than performance related ADLs direct effect on cognitive functioning longitudinally, the indirect effect of performance related ADLs on cognitive functioning through cardiovascular risk factors is larger than the indirect effect of non-performance related ADLs on cognitive functioning through cardiovascular risk factors.

As the findings of the previous studies and the present study suggested, low level of physical fitness (Phillips, 1990), and not exercising are independent risk factors for cardiovascular disease / cardiovascular risk factors. One of the reasons for the differential effects of performance related ADLs and non-performance related ADLs found in this study may be the highly relatedness of exercising and performance ADLs, including items such as climbing several flights of stairs without resting, walking several blocks, climbing one flight of stairs without resting, pulling or pushing large objects like a living room chair, etc.

These findings may be important to choose target ADLs to facilitate in order to prevent future cardiovascular risk factors, cardiovascular disease, and cognitive dysfunctions for people at risk. Moreover, findings of this study suggest that ADLs can be thought of as indicators of potential cardiovascular and cognitive functioning problems. They can be assessed to identify people who are at risk of cardiovascular risk factors / cardiovascular disease and cognitive dysfunctions.

It was found that earlier dementia and cognitive impairment make the strongest contribution to the development of long-term functional dependence and decline in function (Agüero, Fratiglioni, Guo, Viitanen, von Strauss, & Winblad, 1998; Lu, Zhen, Yang, Liang, Hu, Li, Han, Jiangbin, Yang, Chen, & Peng, 2003). In addition to this predictive relationship with the direction from earlier activities of daily living to later cognitive functioning, the present study found this predictive relationship in the reversed direction; better daily functioning predicts better future cognitive functioning. For this reason, by keeping older adults active in their daily life, we would increase the likelihood of better future cognitive functioning, and better daily functioning in the long run.

The model tested in this study suggested that the action between the activities of daily living and cognitive functioning in older adults is more through cardiovascular risk factors rather than cardiovascular disease. There may be several reasons for this finding that the cardiovascular risk factors, but not cardiovascular disease, mediated the relationship between activities of daily living and cognitive functioning in older adults. First, the time range between cardiovascular risk factors / cardiovascular disease and cognitive functioning is approximately 4 years in the model tested. This time-period may not be long enough for cardiovascular disease to show its effect on cognitive functioning in a general population study such as this. Second, cardiovascular risk factors may predict future cognitive functioning outcome more quickly than does cardiovascular disease. Third, as the attrition analyses suggested, the participants of the present study are relatively healthy compared to dropouts and may not have that serious cardiovascular disease to affect their future cognitive function, so there may be a restriction of range problem. And finally, the dropouts might already have the disease, however, the sample of the study did not contain them for the main analyses.

The participants of the present study are different from the participants of the other studies investigating cardiovascular risk factors, cardiovascular disease, and cognitive dysfunctions. The participants of this study are part of a general population probability study, rather than a special disease sample. For this reason, the effect of these constructs, cardiovascular risk factors and cardiovascular disease, in the general population may act more slowly than in a targeted disease sample.

Strengths and Limitations of Study.

The present study had some strengths and limitations. As the first limitation of the study, an archival dataset was used and it did not include some of the variables of potential interest, such as diet and cholesterol. Second, the participants were between 51 and 61 years of age at the first wave (1992) of the study and were present for the two subsequent waves. This restricted age range is not representative of a broader range of middle-aged and older adults with cardiovascular risk factors, cardiovascular disease, and cognitive dysfunctions. Third, daily functioning of participants was assessed at time 1, in 1992, when they were between ages 51 and 61 years. These ages may be too young to show many hardships in daily functioning, which in turn may cause restriction of range to generally better levels of functioning. Fourth, cardiovascular risk factors, cardiovascular disease, and cognitive functioning constructs were measured with indices constructed for this study, rather than with widely used measures.

In spite of these limitations, there are also many strengths of the present study. First, this study utilized Health and Retirement Study (HRS) dataset, which has a national probability sample. Therefore, the participants of the study represent the U.S. middle-aged and older adult population well. Second, sample size and subject heterogeneity increases the power of the present study greatly to study effects in detail and generalize to the broader population. The large sample size of the study enabled the researchers to better estimate real differences between dropouts and completers. Since the sample of the study represents the U.S. population well, the generalizability of the study is great and the sample of the study represents an ethnically diverse population.

Treatment Implications.

As it was mentioned before, compared to cardiovascular diseases, cardiovascular risk factor was found to be more meaningful construct as a risk factor for cognitive dysfunctions. For this reason, addressing cardiovascular risk factors as a treatment application maybe more important than addressing existing cardiovascular disease to protect future cognitive functioning. This may show the importance of secondary prevention interventions versus tertiary disease treatment interventions for such a population of aging individuals.

Smoking, as a cardiovascular risk factor, was found to be the most important predictor of worse future cognitive functioning. This finding suggests that in order to prevent future cognitive dysfunctions, people should be strongly encouraged to quit smoking to prevent cognitive decline. According to the Health Belief Model, individuals would take action if they believed that the illness might lead to serious consequences; that is, if they believed that this action would be beneficial for reducing their susceptibility to or severity of the illness, and finally if they believed that the benefits of taking the action outweighed the barriers to or costs of it (Strecher & Rosenstock, 1997). Thus, education programs about the consequences of cognitive dysfunctions, smokers' vulnerability to cognitive dysfunctions, and the benefits of quitting smoking should be more widely advertised. Moreover, in order to motivate those smokers, it should be emphasized that the threat of smoking and benefits of quitting smoking outweigh any barriers to quit smoking (Christensen, Moran, & Wiebe, 1999). The results of the present study also suggest that an additional avoiding negative outcome advantage of stopping smoking is protection of future cognitive ability.

The transtheoretical model, developed by Prochaska and DiClemente (1983), is another model that can be utilized because it is the health behavior model applied to smoking cessation most frequently. Prochaska and DiClemente state that people pass through an ordered series of stages labeled precontemplation, contemplation, preparation, action, and maintenance. This model makes it possible to apply interventions tailored to each individual depending on their stage of the problem.

The education programs targeting smokers to prevent future cognitive functioning should address points made by the protection motivation model (Rogers, 1984). The model suggests that there are four important beliefs: (1) the magnitude of the threat (whether cognitive dysfunctions are severe or not), (2) the likelihood of the threat (whether smokers are vulnerable to cognitive dysfunctions or not), (3) self-efficacy of the person (whether one can quit smoking to protect oneself from cognitive dysfunctions), and (4) response efficacy (whether quitting smoking will be effective or not).

Low level of physical fitness was found to be an independent risk factor for cardiovascular disease (Phillips, 1990). Similarly, the present study found that not exercising is a significant risk factor for concurrent cardiovascular disease and future cognitive functioning. However, it may be harder to motivate older adults to change their lifestyles. Grossman and Stewart (2003) suggested four motivating factors that can be utilized to motivate older adults to exercise: health (preventing disability etc.), continued independence (desire to stay in one's own home etc.), family (watching grandchildren grow up etc), and physical appearances (concerns about weight, posture, fitting into clothes, and looking younger etc.). On the other hand, as Grossman and Stewart (2003) stated there are also some barriers to physical activity: poor health, such as back, knee, leg, and foot problems, poor balance and fear of falling, failing eyesight and poor hearing; lack of time, such as placing priority on other obligations; the aging process, such as sense of slowing down, lack of energy, feeling tired etc.; and adverse environments, such as bad weather. All of these points should be taken into consideration by primary prevention program developers. Otherwise, they cannot reach their target population's needs and cannot be successful.

Yoder et al. (2001) found that increased age is associated with more cognitive difficulties. However, as Ponds, Van Boxtel, and Jolles (2000) found this cognitive decline does not start until the age of 50 and after that age this cognitive decline steadily increases. By developing primary and secondary prevention programs in the light of suggestions mentioned above, the speed / rate of this cognitive decline can be decreased. Moreover, as Ketola, Sipilä, and Mäkelä (2000) stated, both primary and secondary preventions are important for preventing adults from CVD. Primary prevention was found to be effective in reducing the risk factors especially when the life style interventions are multifactorial. Secondary prevention interventions, both single and multifactorial interventions, were also found to be effective in reducing mortality and morbidity from CVD. As it was found in the present study, hypertension, diabetes mellitus, obesity / overweight, and not exercising are significant risk factors for cardiovascular disease. Thus, if primary and secondary prevention programs target all of these risk factors at the same time, they would be more successful than the programs targeting only one of these cardiovascular risk factors.

As the middle-aged adults in this study were at the age of between 51 and 61 at the time of the first assessment, they were likely still actively engaged in the workplace. This suggests that workplace based interventions and incentives might be used to encourage reduction of these cardiovascular risk factors that were found to be related to later cognitive decline. This is especially important at this period of high technological change, because older people may drop from employment just because of their low cognitive abilities caused by age and cardiovascular risk factors. By providing employees education about the relationship between cardiovascular risk factors and cognitive functioning; and interventions to detect people who are at risk, and to guide people who have cardiovascular risk factors, cognitive function of an aging U.S. workforce can be protected as it ages, that will in turn may reduce the stress in social security system.

In summary, the findings of this study show the importance of primary / secondary prevention versus tertiary interventions, because cardiovascular risk factors were found to be more important to potentially address than cardiovascular disease itself to have better cognitive function in future. Moreover, it shows the importance of educating individuals about cardiovascular risk factors to identify their symptoms and seek medical help earlier, which will in turn prevent future problems regarding cognitive functioning. Future studies should assess long-term effects of this kind of education programs.

APPENDIX A

ACTIVITIES OF DAILY LIVING ITEMS (1992)

How difficult is it for you to… (not at all difficult, a little difficult, somewhat difficult, very difficult/can't do, don't do)

1. run or jog abut a mile?
2. walk several blocks?
3. walk one block?
4. walk across a room?
5. sit for about 2 hours?
6. get up from a chair after sitting for long periods?
7. get in and out of bed without help?
8. how difficult is it for you to climb several flights of stairs without resting?
9. climb one flight of stairs without resting?
10. lift or carry weights over 10 pounds, like a heavy bag of groceries?
11. how difficult is it for you to stoop, kneel, or crouch?
12. pick up a dime from a table?
13. bathe or shower without help?
14. reach or extend your arms above shoulder level?
15. pull or push large objects like a living room chair?
16. eat without helping?
17. dress without helping?

APPENDIX B

CARDIOVASCULAR RISK FACTORS ITEMS (1998)

Hypertension

1. Has a doctor ever told you that you have high blood pressure or hypertension?

2. In order to lower your blood pressure are you now taking any medication?

3. Is your blood pressure generally under control?

Diabetes

4. Has a doctor ever told you that you have diabetes or high blood sugar?

5. In order to treat or control your diabetes, are you now taking medication that you swallow?

6. Are you now using insulin shots or a pump?

7. In order to treat or control your diabetes, have you lost weight

8. Are you following a special diet?

9. Is your diabetes generally under control?

10. Has your diabetes caused you to have trouble with your kidneys or protein in your urine?

Smoking

11. Have you ever smoked cigarettes?

12. Do you smoke cigarettes now?

13. About how many cigarettes or packs do you usually smoke in a day now?

Alcohol

14. Do you ever drink any alcoholic beverages such as beer, wine, or l liquor?

15. In the last three months, on the days you drink, about how many drinks do you have?

Exercise

16. On average over the last 12 months have you participated in vigorous physical activity or exercise three times a week or more?

Body Mass Index

17. About how much do you weigh?

18. About how tall are you?

APPENDIX C

CARDIVASCULAR DISEASE ITEMS (1998)

Presence of a Heart Disease Condition

1. Has a doctor ever told you that you had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?

2. Are you taking or carrying any medications because of your chest pain?

3. Have you seen a doctor for your heart problem?

4. Has this condition gotten better, worse, or stayed about the same?

Myocardial Infarction

5. Have you had a heart attack or myocardial infarction?

6. Since we talked to you last, have you seen a doctor in connection with your heart attack?

7. Are you now taking or carrying medication because of your heart attack?

Angina

9. Have you had any angina or chest pains due to your heart?

10. Are you now taking or carrying medications because of angina or chest pain?

11. Are you limiting your usual activities because of your angina?

Congestive Heart Failure

12. Has a doctor told you that you have congestive heart failure?

13. Have you been admitted to the hospital overnight because of congestive heart failure?

14. Are you taking or carrying any medication for congestive heart failure?

Other Coronary Heart Factors Requiring Invasive Treatment

15. Have you had a special test or treatment of your heart where tubes were inserted into your veins or arteries (cardiac catheterization, coronary angiogram or angioplasty)?

16. Have you had surgery on your heart?

Stroke

17. Has a doctor told you that you have had) a stroke?

18. Have you seen a doctor because of this or any other stroke?

19. Do you still have any remaining problems because of your stroke(s)?

20. Are you now taking any medications because of your stroke or its complications?

21. Are you receiving physical or occupational therapy because of your stroke or its complications?

22. Has a doctor told you that you had another stroke?

APPENDIC D

COGNITIVE FUNCTIONING ITEMS (2002)

Self-Report

1.How would you rate your memory at the present time? Would you say it is excellent, very good, good, fair or poor?

2. Compared to two years ago, would you say your memory is better now, about the same, or worse now than it was then?

Immediate and Delayed Recall

3. Next, I'll read a set of 10 words and ask you to recall as many as you can. We have purposely made the list long so that it will be difficult for anyone to recall all the words -- most people recall just a few. Please listen carefully as I read the set of words because I cannot repeat them. When I finish, I will ask you to recall aloud as many of the words as you can, in any order Is this clear?

LIST 1	LIST 2	LIST 3	LIST 4
1. HOTEL	1. SKY	1. WOMAN	1. WATER
2. RIVER	2. OCEAN	2. ROCK	2. CHURCH
3. TREE	3. FLAG	3. BLOOD	3. DOCTOR
4. SKIN	4. DOLLAR	4. CORNER	4. PALACE
5. GOLD	5. WIFE	5. SHOES	5. FIRE
6. MARKET	6. MACHINE	6. LETTER	6. GARDEN
7. PAPER	7. HOME	7. GIRL	7. SEA

8. CHILD	8. EARTH	8. HOUSE	8. VILLAGE
9. KING	9. COLLEGE	9. VALLEY	9. BABY
10. BOOK	10. BUTTER	10. ENGINE	10. TABLE

Note: One of these 4 lists is randomly assigned to each respondent at variable X011. Each respondent in a household is assigned a different list. Only assigned words are displayed to the interviewer, one word appearing per screen. The interviewer reads each word to the respondent as it appears. The screen automatically advances every 2 seconds, so the interviewer does not press [enter] to show the next word. The numerical codes for the words are not shown on the screen.

Now please tell me the words you can recall.

4. A little while ago, I read you a list of words and you repeated the ones you could remember. Please tell me any of the words that you remember now.

LIST 1	LIST 2	LIST 3	LIST 4
1. HOTEL	1. SKY	1. WOMAN	1. WATER
2. RIVER	2. OCEAN	2. ROCK	2. CHURCH
3. TREE	3. FLAG	3. BLOOD	3. DOCTOR
4. SKIN	4. DOLLAR	4. CORNER	4. PALACE
5. GOLD	5. WIFE	5. SHOES	5. FIRE
6. MARKET	6. MACHINE	6. LETTER	6. GARDEN
7. PAPER	7. HOME	7. GIRL	7. SEA
8. CHILD	8. EARTH	8. HOUSE	8. VILLAGE

9. KING	9. COLLEGE	9. VALLEY	9. BABY
10. BOOK	10. BUTTER	10. ENGINE	10. TABLE

Self Report of Cognitive Activities in Daily Living

5. Because of a health or memory problem, do you have any difficulty using a map to figure out how to get around in a strange place?

6. Because of a health or memory problem, do you have) any difficulty with making phone calls?

7. Because of a health or memory problem, do you have any difficulty with managing your money such as paying your bills and keeping track of expenses?

Time Orientation

Please tell me today's date.

8. Month

9. Day

10. Year

11. Day of week

General Information

Now I'm going to ask you for the names of some people and things.

12. What do people usually use to cut paper?

13. What do you call the kind of prickly plant that grows in the desert?

14. Who is the President of the United States right now?

15. Who is the Vice President?

16. What is the meaning of the word: [REPAIR/CONCEAL]?

17. What is the meaning of the word: [FABRIC/ENORMOUS]?

18. What is the meaning of the word: [DOMESTIC/PERIMETER]?

19. What is the meaning of the word: [REMORSE/COMPASSION]?

20. What is the meaning of the word: [PLAGIARIZE/AUDACIOUS]?

Arithmetic

Next I would like to ask you some questions which assess how people use numbers in everyday life.

21. If the chance of getting a disease is 10 percent, how many people out of 1,000 would be expected to get the disease?

22. If 5 people all have the winning numbers in the lottery and the prize is two million dollars, how much will each of them get?

23. Let's say you have $200 in a savings account. The account earns ten percent interest per year. How much would you have in the account at the end of two years?

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